STUDIES IN HEALTH TECHNOLOGY AND INFORMATICS 297

Transforming our World through Universal Design for Human Development

Proceedings of the Sixth International Conference on Universal Design (UD2022)

Editors: Ilaria Garofolo
Giulia Bencini
Alberto Arenghi

IOS Press

An environment, or any building product or service in it, should ideally be designed to meet the needs of all those who wish to use it. Universal Design is the design and composition of environments, products, and services so that they can be accessed, understood and used to the greatest extent possible by all people, regardless of their age, size, ability or disability. It creates products, services and environments that meet people's needs. In short, Universal Design is good design.

This book presents the proceedings of UD2022, the 6th International Conference on Universal Design, held from 7 - 9 September 2022 in Brescia, Italy. The conference is targeted at professionals and academics interested in the theme of universal design as related to the built environment and the wellbeing of users, but also covers mobility and urban environments, knowledge, and information transfer, bringing together research knowledge and best practice from all over the world. The book contains 72 papers from 13 countries, grouped into 8 sections and covering topics including the design of inclusive natural environments and urban spaces, communities, neighborhoods and cities; housing; healthcare; mobility and transport systems; and universally-designed learning environments, work places, cultural and recreational spaces. One section is devoted to universal design and cultural heritage, which had a particular focus at this edition of the conference.

The book reflects the professional and disciplinary diversity represented in the UD movement, and will be of interest to all those whose work involves inclusive design.

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TRANSFORMING OUR WORLD THROUGH UNIVERSAL DESIGN FOR HUMAN DEVELOPMENT

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The image on the front cover represents the Winged Victory of Brescia, a bronze statue from the first century CE. The statue is preserved in the Roman Archaeological Park in Brescia.

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Preface

> *"All over the world, people are struggling for a life that is fully human, a life worthy of human dignity. Countries and states are often focused on economic growth alone, but their people, meanwhile, are striving for something different: they want meaningful human lives."* (Martha C. Nussbaum, 2012. Creating Capabilities, p. 1, Cambridge, Massachusetts and London, UK, Harvard University Press)

From its first edition in 2012, the journey of the international conference on Universal Design has been the story of an expanding intellectual and practical movement. The aim of this movement is to put into practice the aspirations and goals of human-centred approaches to sustainable development founded on human rights, human development and equality for all, such as those encoded in the United Nations Sustainable Development Goals and the Convention on the rights of Persons with Disabilities (UNCRPD).

After the first meeting in Norway (Oslo, 2012), which was organised by several enlightened governmental bodies in the Scandinavian region as a forum for the exchange of views and sharing of good practice in Universal Design, the second edition in Lund in 2014 saw the entry of academia, with wide participation from across academic disciplines, setting the stage for UD practitioners, researchers and educators to connect directly and to share ideas, research and practice.

The role of academic institutions in organising the UD conference (York, 2016, Dublin, 2018 and Helsinki, 2021) has persisted across successive editions, strengthening over time, as universities have increasingly recognised and taken on board their responsibility as primary actors in working towards societies that are founded on equity, justice and sustainable development for all human beings through their research, educational and outreach activities.

The 2022 edition, held in the historic town of Brescia, Italy, marks another landmark in the journey of the UD movement, as it crosses the alps to be hosted in southern Europe for the first time. Three Italian Universities – the Universities of Brescia, Trieste, and Ca' Foscari University of Venice – have joined forces to make this edition possible, opening up a space for conversations between researchers, educators and policy-makers in a truly multi-disciplinary vision for UD.

The title: Transforming our World for Human Development is intentionally aimed at realising broad sustainable development goals from a person-centred UD perspective by engaging delegates in a conversation across cultural, geographical, and disciplinary boundaries about what sustainable development really means. This was eloquently put by our dear colleague and friend Elio Borgonovi:

> *"There is much talk about renewable energies, resources and circular economies. Most of the time, however, we forget that human beings, with their characteristics and capabilities, provide the most precious renewable energy of all. Human capabilities develop with age and grow through education and experience. People flourish when they are given the chance to exercise their potential. This potential is exercised in social and natural environments when human beings can contribute*

with their physical, intellectual, rational and emotional participation, by people, with people and for people." (Address delivered at the University of Brescia, December 17th, 2020).

The sessions of the 2022 edition are characterised by their multi-disciplinary and multi-perspective nature, with sessions aimed at the design of inclusive natural environments and urban spaces, communities, neighbourhoods and cities, housing, healthcare, and educational facilities, mobility and transport systems, moving on to universally-designed learning environments, work places, cultural and recreational spaces. Contributions come from 13 different countries and various continents (Africa, Australia, Central America, East Asia, Europe, North America, South Asia) once again demonstrating that this is a growing international movement.

Our special thematic session is dedicated to Universal Design and Cultural Heritage. We believe that cultural heritage is part of what makes our lives human and meaningful. Providing full access for all human beings to cultural heritage combines two fundamental values crucial for human development and flourishing: cultural heritage provides each and every person with the possibility to engage meaningfully with their cultural and historical past, and at the same time it develops the awareness in each human being of the value of conserving the past so that we can better live in and understand the present.

A distinctive characteristic of the UD conference is the coming together of academic, governmental and professional communities under one roof. Our wish and invitation for the conference is for openness to others and to perspectives and experiences that may be different from our own, letting go of professional and disciplinary barriers, engaging with each other with empathy and curiosity. The experience of being so long deprived of face-to-face interaction due to the Covid-19 pandemic has made everyone more aware of the value of coming together during live conferences, in formal and informal ways.

The professional and disciplinary diversity represented in the UD movement is what allows us to transcend current existing separations between communities of knowledge and communities of practice, as well as existing separations between academic disciplines. Only when knowledge, practice and research from different disciplines are allowed to engage meaningfully and to feed into each other in a virtuous circle, can the power of ideas and actions become truly transformational.

Brescia, September 2022

Ilaria Garofolo, University of Trieste
Giulia Bencini, Ca' Foscari University of Venice
Alberto Arenghi, University of Brescia

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Transforming our World through Universal Design for Human Development
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The Emancipatory Design Manifesto: Let's Suppose That Disability Does Not Exist

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Abstract. In this paper we present and propose the concept of *Emancipatory Design* (ED), which is an alternative way of thinking about the human being and the ever intricate relations between people, design, architecture and the built environment. The paper is given the form of a manifesto and has the overall aim to reflect critically on the possibility of design as a practice that potentially carry emancipatory effects in the everyday lives of particular human beings. Defining ED, we draw on notions from philosophy and the history of ideas to challenge the concept of human disability often at play in writings concerned with design and architecture. This approach allows for a provocative, disruptive and experimental attempt to relativize and cancel the notion of disability – and, subsequently, to explore the possibilities inherent to this maneuver in the realm of design thinking. With ED we propose a concept that works as a contribution to the community engaged in Universal Design (UD), as well as a gentle objection and critique of the abstract and intangible element of universality at play within this tradition.

Keywords. Emancipatory Design, Critical and Existential Design, Speculative Design, Universal Design, Manifesto, (dis)Ability

1. Introduction

In this paper we propose the concept of Emancipatory Design (ED) [2] that works as an addendum, or an assistant notion, to the broad conceptual umbrella of Universal Design. ED is formulated on the very basic – and somewhat idealistic – premise that the disciplines of design and architecture must encompass emancipatory and liberating aspects for the humans, and non-human beings, for which the efforts and solutions are intended. Another pivotal element expressed within the frame of ED is that the view of humanity, and of life in general, which is embedded in every designed product, building, and exterior space, must be both reflected upon and challenged in the outset. We argue that design projects in general should aim to be highly critical against 'business as usual'. This critique applies to the often vaguely defined and imprecise notion of "the user", or even "the end user", as these concepts appear in mainstream design and architectural lingo and writings, and, on a more crucial level, to the characteristics, expectations and

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[2] ED is not to be confused with the work of design researcher Lesley-Ann Noel, and her concept of *Emancipatory Design Thinking* (e.g. "Promoting an Emancipatory Research Paradigm in Design Education and Practice", 2016). Despite some very overall similarities and shared ambitions inherent to the two concepts, they are very different in terms of content and scope.

normatively informed ideas about human capability and functionality that implicitly forms the basis on which architecture and design is often executed. Moreover, with ED we argue for a critical stance towards the comprehensive and deeply entangled relationships between design, architecture, and commercial interests.

With ED we lay ground for critical reflection on the wide diversity of people and abilities – hence represent an opposition towards the medical and clinical discourses at play, in e.g. the area of health design as well as in the normatively informed health discourses circulating in societies of the late modernity at large. Reflections and critical discussions can help us ensure that human beings are firstly conceived of as exactly *human beings*, with a range of personal abilities and capabilities, before they are exposed to various practices and forceful processes of marginalization inherent to e.g. the social position of 'the disabled person' – a position that inflict severe performative consequences and produce certain kinds of (dis-)location in the life of individual human beings [1]. In this regard, ED is targeting emancipation from the prejudice, ruling and marginalization that follow in the slipstreams of stigmatizing labelling processes.

Furthermore, ED is defined by a preoccupation with particularity and an insistent focus on conditions characteristic of the particular people and environments that are subjected to design and architectural processes. The focus on particularity represents a gentle objection and critique of the general notion of universality as expressed in the paradigm of universal design, albeit in the most edifying and engaged manner. In this context, the argument is that to change the world by design (and architecture), and thus to develop solutions that are emancipatory and liberating by function, we must produce and possess both nuanced and context specific knowledge about people and environment laying the foundation for changes appropriate in the given contexts. Moving from ambition to action calls for novel methods and thorough procedures by which interdisciplinary teams can tailor, develop and secure the implementation of adequate initiatives in specific environments.

The paper is given the form of a manifesto in which we declare our intentions, motifs, and motivations regarding the work with design and architecture as an act of emancipatory practice. The manifesto will comprise four sections. The first section describes the preliminary and basic prerequisites on which the development of ED is based. This is followed by an outline of the idealistic, political, and societal elements inherent to this way of thinking about design and architecture, along with a description of the academic and theoretical approaches and currents serving as sources of inspiration in the formulation of ED. Next section comprises some preliminary methodological offerings and reflections – paths to be followed in the further development and implementation of ED in practice. Finally, we conclude with a short recap describing the key elements comprising the Emancipatory Design Manifesto.

2. Preliminary and basic prerequisites

In this section we outline the preliminary and basic prerequisites and premises on which the contribution rests. This is done to address the building blocks we depart from in the development of ED.

Prerequisite I:
All human beings are confined and restricted within their own bodies to some extent.

Prerequisite II:

The notion that given persons *have handicap* and *live with disability* are products of social constructions and a deficiency-oriented worldview that facilitate and enable a structural hegemony in which certain expressions of humanity are prioritized over others. Inherent to this is the acknowledgement that conceptions of both physical and mental disability (and other forms of "deviance", in the understanding *divergence from conventionally accepted notions of 'normality'*) have been defined and understood in varying ways during given historical epochs.

With *prerequisite I,* we emphasize a common and universal phenomenon shared by all human beings. That is to say, the experience of being restricted, confined and limited in everyday life is a common experience concerning any living being. This goes for all of us whether we are living with so-called 'ordinary' bodily and mental functions, with minor variations in our abilities (physical and/or mental/psychical) or with major functional variations having a distinct and extensive impact on everyday life. When scrutinized in detail, all members of humankind experience limitations and restrictions in terms of participation, possibilities and the unfolding of individual agency – either on occasion or on a more permanent basis. In a phenomenological perspective, the human being is born into this world in a body that also constitute our primary mode of existence, our *being-in-the-world* [2]. According to this existentially and sensory oriented perspective, we exist in the world *through* and *in* our corporeality; and, adding to this, the myriad corporal experiences that also shapes our consciousness and our intentionality in fundamental ways [3]. Hence, human corpo(reality), i.e. *to have a body* and *to be in a body*, is to be limited *per se*. Following these lines of thought, the body is our first and primary set of conditions, thus corporality is the basis for all other experiences, processes, relations and opportunities in life. In this regard, all human beings are inherently confined, trapped and restricted within their bodies (and their bodily-intentional field of action) to some extend and degree – some more, obviously, others less.

Prerequisite II, goes in another direction by drawing on the historically based analytical argument that notions of handicap and disability are social constructs that undergo serious changes during and in-between given epochs. In the work of French philosopher and historian of ideas, Michel Foucault, it is distinct how social constructions and the phenomena arising in the wake of historically bound rationales and ideas about the human being, come to matter in the form of social exclusion and the construction of 'the deviant' as a social category. In a lecture from 1979, Foucault describes the genealogical method he subscribed to and its critical potentials and implications in connection with his work on biopolitics. Here, Foucault states that he "start from the theoretical and methodological decision that consists in saying: Let's suppose that universals do not exist." [4]. In other words, Foucault attempts to start from a sort of neutral position with which he does not presuppose anything about the human being, not even universals and so-called 'meta-narratives'. Then, he writes, he put the question to history and historians by asking "How can you write history if you do not accept a priory the existence of things like the state, society, the sovereign, and subjects?" [5]. The critique posed here is that all attempts at describing the human being is dependent on categories, categorizations and on certain historical understandings of existing societal institutions and the intricate practices exercised in, and around, these institutions. To gain a critical distance necessary in the analysis of human beings and the socio-material environments (societies) in which we live, Foucault starts with the attempt at peeling off all layers of pre-understanding. The argument is that by doing so, it

becomes possible to ask new and fundamental questions. Foucault employed this method in the case of madness, a subject he worked consistently with:

> *"Let's suppose that madness does not exist. If we suppose that it does not exist, then what can history make of these different events and practices which are apparently organized around something that is supposed to be madness."* [6]

In the process of formulating ED, we are very much inspired by this approach towards understanding the human being as a product of biopolitics working on both implicit and explicit levels of any society. Furthermore, we find that a Foucauldian approach towards disability can supply us with a new footing in challenging the paradigm of disability currently at work. By paraphrasing the sentences above, we wish to pose a question and an argument that possess both provocative and productive implications, namely:

Let's suppose that disability does not exist.

If we suppose that disability does not exist, we are simultaneously forced to apply a new perspective on design, architecture and the built environment as such. Applying this maneuver already in the initiating phase of the development process – before the first sketch of a public school, playground, bus-shield, etc., is made – the preconditions simply change quite a lot, maybe they are even turned upside down? Instead of applying our focus on the individual human being that is not able to use given design solutions and built environments due to personal variations in ability, we encounter designs and built environments that are not sufficiently suited and adapted to the life of human beings and the variations in being human that are normalized and accepted with this discursive maneuver. If human disability does not exist, but we instead embrace a term used more and more in Sweden and Norway, i.e., 'normbrytande funktionsvariation (freely translated to "norm-breaking functional variation"; means having a functional variation that conflicts with society's prevailing norms of body function or performance) [7]) as an immanent part of the human condition, we have a whole new set of norms on the rise. If human disability does not exist, instead we encounter *disabling design, disabling architecture*, *disabling built environments,* etc. or even *dark design* [8]. By the same token, and consequently, we can start talking about ED as a response and a methodical approach with which to counteract these incarcerating and constraining elements experienced and encountered by human beings in their engagement with the physical world.

The two interrelated prerequisites outlined above constitute the primary building blocks on which ED is formulated. Firstly, we depart from the acknowledgement that all human beings are restricted and confined in relation to their bodies to some extent. Secondly, we perform a discursive critique that highlight how the human being is positioned within the boundaries of a conventional and current disability paradigm. Instead of subscribing to this notion of human disability, we resist and counteract it by proposing a new and stronger emphasis on functional variations as an integral part of the human condition. As a product of this maneuver, the stigmatizing and marginalizing consequences posed on the individual human being is relocated to concern the responsibilities of design, architecture, etc.; in fact, everyone involved in planning, building and maintaining the built environment.

Hereby we initiate a discussion that aims at removing the individual human being from issues regarding disability as a person-centered phenomenon – and to stress the stance that to move forward, we need to firstly grasp how design and architecture as

enterprises can entail and produce disabling consequences, and next transform this into a new perspective when dealing with future built environments.

3. On ideals, utopias & design theoretical inspirations

"*We have to imagine something that doesn't exist*
Carve intentionally into the future
And demand space for hope [...]
Let's write music for our destination" [9]

The citation above is from a short and poetic text, "Imagine", written by islandic artist Björk that is featured in an anthology exploring the myriad implications on the world as we know it posed by the Anthropocene. The excerpt is included here because it reflects a key element also central to ED-thinking. Working with ED demands for approaches that are partly visionary partly utopian, but simultaneously very realistic and sensitive towards current states and circumstances. Therefore, the attitude represented in ED is defined by a somewhat naïve idealism that dares to dream on behalf of the populations and people that will live and function in the designs developed and built, now and for decades to come. Knowing that the construction industry is responsible for a considerable amount of the 'black' resource consumption, thus paying a significant contribution to the ongoing and irreversible global climate change, any design action is also deeply embedded in local and global processes implying an immense amount of responsibility and circumspection from people working within all areas of design and architecture. In this regard, when it concerns the common future goods available on any scale, social and environmental sustainability are deeply connected and intertwined. In questions regarding both kinds of sustainability, we must imagine something, and some things, which doesn't yet exist. We must carve intentionally into the future in order to demand, imagine and create space for hope – *space* in terms of physical, social and inclusive space as well as imaginative, experienced and emancipatory space.

A prominent and increasing critique of architecture and planning arising in the wake of resent and present activistic movements with connection to e.g. feminist theory is that these practices, and the physical designs they promote, favor certain kinds of people and conditions/functionalities over others. And, following this, that social and a range of other inequalities therefore are systematically built into our cities, homes, and neighborhoods [10]. What has been laying the basis for development of the built environment (in the eyes and hands of commercial developers) until this point, is therefore a particular set of notions and presuppositions about the human being and the range of 'ordinary' human functionality (cf. prerequisite II, outlined above). In other words, architecture and design can be understood as the operationalization of certain current and historically embedded norms and ideals in(to) firm objects. Monuments, buildings, and spaces are elements and signs in 'a language' that both expands upon and reveal existing ideas about the societal participant (the human being) and the capabilities and ways in which this actor is (supposed to be) working. The reaction to these ways of conceiving of the world, and of the relation between human and non-human beings and the world of artifacts that we inhabit – from the position of ED, is demanding and crucial. It consists in simply saying that *this must change*. By joining Björk in her call from the position of design, we can state: Let's write music for our destination, let's draw up and

design a world that encompass emancipatory qualities in the lives of individuals and collectives alike.

Taking a departure in critical and existential design [11] and speculative critical design [12], we argue for a need to turn these conventional modes of conceiving of and thinking about the human being in its environment upside down. Instead of asking commercial developers and actors what future needs will be from their perspective, and instead of letting commercial interests dictate design and the built environment by measures and considerations that are other-than-human (economy, conventions, standards etc.), speculative and critical design argues that skepticism towards consumer culture is a key element as every design actor is obliged to question the given assumptions surrounding any project [13]. In the words of Anthony Dunne and Fiona Raby, speculative critical design (SCD) is about "… critical thinking, that is, not taking things for granted, being skeptical, and always questioning what is given." [14]. And, as they further argue, the speculative element of this approach is a way of fostering and igniting social dreaming that makes it possible to reflect upon and discuss societal needs and issues, and, furthermore, to respond on these reflections and their implications by means of design. On this subject, SCD offer possibilities to reflect critically on the social and societal foundations on which planners, designers, developers, and architects stand when carrying out design. This approach allows for a productive and socially oriented detachment from procedures and logics inherent to design processes defined by a "profit first, then people" logic. The premise outlined here is that in order to create broadly accommodating and applicable, inclusive designs and environments, the human being – also described as "the user"/"the end-user" in conventional design and architectural lingo – must be placed at the heart of this process from the initial stages throughout the entire span of given projects. Furthermore, such inclusion must be informed and secured by the application of procedures, approaches, and methods able to generate knowledge about concrete human beings, or users of the future design, in a specific environment and context.

4. Preliminary methodological offerings – operationalization of ED

The ideal of ED can be understood in opposition to strands of (design)thinking that operate under terms as e.g. "barrier free design", "design for all" and the general characteristics expressed in the notion of *universal design*. ED poses a gentle critique of the element of universality expressed in the notion of universal design by pointing to the necessity of particularity in any given design approach. Whereas all design 'takes place' and whereas any architectural design process distinguishes itself by the literal creation or change of a particular physical space, a setting, a context, a building or a place, ED is preoccupied with a focus on particularity capable of reflecting this inevitable fact. Architecture is immanently about places and particular environments, not about universal place, which, by the way, is a self-contradictory term [15]. Furthermore, any design project is aimed at a particular group of people inhabiting or using a specific physical environment that is situated in a particular cultural and societal context. Again, the argument underlining ED is that development and creation of design must therefore thoroughly understand and consider the societal and cultural variations and norms at play in the specific environments addressed by design endeavors. These norms are indeed particular and connected to both cultural variation and preferences held by the specific groups and communities in which the design is implemented. In order to succeed; and in

order to promote the desired emancipatory (or other) effects in the lives of the people targeted through design, the work must be based on complex understanding and analyses able to take these aspects into account. In other words, design able to address specific needs as these exist among actual human beings must be particular – not universal. And the ways in which we aim to apprehend and acknowledge the needs and conditions among people living in environments subjected to design and architectural projects must be steered by an interest in the particularities of everyday life in context, not the universals of being human on a general scale.

Within the frame of ED, this acknowledgement is reacted upon by the application and modification of a variety of methods. We argue that ED entails a well-developed methodology that draw on acknowledgements and tools from the realm of the social sciences as well as on methodology, acknowledgements and working modes from the world of design. ED is therefore defined by being research-based in a very direct and literal manner, since any intervention and implementation is based on knowledge acquired in the specific setting. In the operationalization of the ambitions inherent to ED, we draw on methods as ethnographic fieldwork [16], conduction of interdisciplinary workshops and other participatory formats as well as on other techniques of empirical knowledge production adequate in the individual case. The primary criteria in the selection, application and modification of methods are that the approach chosen can redeem the ambition at understanding the conditions, phenomena, the needs as well as the context (and its people) in which ED is carried out.

The slogan we want to contribute with, and stress is: "Let's be particular". In order to meet human beings with design, and in order to secure environments able to carry emancipatory effects, impacts and implications, we need to understand the conditions connected to the everyday lives of actual people of flesh, blood and bones. These conditions are particular. And they are entangled with, (in)formed by, and emergent properties of societal, environmental and cultural variations characteristic of the specific context in which a given community is taking place.

5. Conclusion and Considerations – an Emancipatory Design Manifesto

This paper explores the possibilities that emerge when the notion of human disability is critically challenged and disrupted. Instead of subscribing to the premise that disability is a phenomenon clinging to the human being *per se*, with ED we argue that a central constituent of being human, or of being alive on a more general scale, is the experience of being restricted. If we acknowledge that restrictions and limitations are inherent properties of the human condition as any human being encounter limitations regarding so-called individual freedom and agency in some form, both continually and at points during their life span, there is no strict contradiction or opposition between ability and the experience of being restricted in some contexts and settings and to some extent. Therefore, with ED we incite for the discursive and activistic action that consist in relocating the first syllable in the concept of disability from the sphere of the human being to the sphere of design and the built environment. A consequence of this simple, but nevertheless very decisive, maneuver is that we now encounter the human being as abled (in opposition to *dis-abled*) in a variety of different ways. The notion of *being able* is hereby an open-ended and inclusive one embracing a multitude of expressions, functionalities and human variations. Simultaneously this relocation imposes a whole new level of responsibility and demands on the products of design and architecture

because what emerges in the wake of this conceptual action is potentially *disabling design, disabling architecture*, *disabling built environments*. Proposing the concept of ED is an explicit approach with which we place the responsibility of securing inclusive design and both broadly and specifically accommodating architecture in the hands of designers, architects, stakeholders and developers. Within the ED paradigm it is no longer sufficient or acceptable to use the notion of human disability as a pretext for designs that does not meet a broadly embracing and representational conception of humankind. Instead, and on the contrary, the endeavor is to emancipate human beings by means of design.

The paper attempts to paint a picture of how the world would look like without the concept of human disability that is currently at play. A world where the term 'disability' – all too often promoting stereotypes, prejudice, and discrimination – no-longer exist and people are treated as (abled) equals no matter what their circumstances may be. Successfully applying this declaration of principles, policies, or intentions if you like, i.e., the Emancipatory Design Manifesto, onto the way we plan, design and maintain the future built environment, calls for a new generation of designers and architects, that a) are trained to shift focus from universality to particularity, b) dare to dream up possible futures – hence create debate, initiate critiques and discussions about the current state of things, c) have the skills to work in interdisciplinary teams (consisting of experts like ethicists, political and social scientists, economists, etc.), and d) have the know-how to develop this way of thinking further.

By introducing ED to design and architecture students in hands-on speculative and critical design workshops all over Scandinavia, thus letting them explore and hopefully embrace, what Dunne and Raby refer to as, "the many tools available for crafting not only things but also ideas," namely fictional worlds, cautionary tales, what-if scenarios, thought experiments, counterfactuals, etc. [17], our hope is that the design professionals of tomorrow will apply ED-thinking and thus generate emancipatory and liberating design and architecture for the near future.

The Emancipatory Design Manifesto might be a lofty utopia for many of us that have been in this game for some time. However, it is crucial to consider the next generation of designers and architects who are eager to learn, dear to turn things upside down, put their ideas to the test and to integrate current debates, critiques and societal needs in their work. Our impression from e.g. conducting critical design workshops – for students in the disciplines of design, architecture, heritage studies, urbanism, spatial planning, etc. – for close to 10-years [11, 18, 19, 20, 21] is, that they are most certainly up for the task. Tomorrow's designers already dream and speculate about how things could and should be – no doubt. And they can redeem these visions and imaginaries in their work.

Surely ED has its obvious weaknesses, self-contradictions and flaws: the ideas are new, in progress and thus untested. Therefore, the paper also raises several vital questions and inconsistencies awaiting to be addressed. At the present state the manifesto is a proposal for further thinking, action and reflection. The primary objective at this point is to push and provoke the boundaries inherent to the world of design and architecture, and to challenge some of the assumptions and normative conceptions that immanently occur within any tradition. In this regard, ED is also a contribution to debates in the Universal Design community with which we dare to disturb, disrupt and hopefully spark necessary and critical discussions pointing forward. So, please join us in this manifesto and in the discussions it may initiate. Sign up, take a step outside the comfort zone and help build a new world in which human disability is replaced by human ability. In which

(emancipatory) design is carried out based on thorough insights and research produced in particular settings, among particular people living with particular conditions. And, in which design artifacts and architecture are results of interdisciplinary and engaged collaboration between professionals with disparate and complementary perspectives concerning the human being.

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Understanding Person-Environment Relationships as Criteria to Support the Operationalization of Universal Design*ing*

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Abstract. To reach a broader understanding of person-environment relationships as building blocks for universal design in research and practice, this paper combine and discuss three types of interaction between individuals and environments – instrumental, non-instrumental, and non-physical - and five constituent concepts, i.e. accessibility, usability, aesthetic experience, the experience of meaning and emotional experience. Theoretical frameworks/models for person-environment relationships are synthesized and combined based on a literature review and the author's previous experiences. The author proposes to classify accessibility and usability as instrumental person-environment interaction, aesthetic experience as non-instrumental interaction, and experience of meaning and emotional experience as non-physical interaction. At the same time, acknowledge the potential of the three types of interaction to embed cues and choices to accommodate the widest variety and number of people throughout their lifespans. This paper contributes to understanding person-environment relationships as criteria to support research strategies and the operationalization of universal design*ing*.

Keywords. Accessibility, usability, aesthetics, meaning, emotion

1. Introduction

Universal Design (UD) can be thought of as an approach to the practice of design *"... to accommodate the widest variety and number of people throughout their lifespans"* [1]. In other words, universal design*ing* [2] is a process of embedding cues and choices for as many people as possible into products such as environments, goods, objects, programs, and services (further referred to as environments) to improve human performance, health and wellbeing, independence, and social participation [3]. UD is also known as Inclusive Design and Design for All – terms with some differences regarding historical, professional, and political inception, but, showing large similarities regarding human-centeredness, ideology, praxis, and implementation [4,5].

In general, design has increasingly moved toward answering human needs [4]. Considering P-E relationships in design processes represents a step away from the perspective that quality exists as properties in the environments themselves and closer to an approach in which value is added when individuals interact with and live in

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environments. For this paper, a person-environment (P-E) relationship is defined as the outcome of the interaction between the individual and the environment.

Individuals include those who access, use, and experience the environment, those who operate the environment, and those who support the environment. The individual can be the primary user, (i.e. direct hands-on user), the secondary user (i.e. indirect user interacting through a mediator), and the tertiary user (i.e. individual affected by the environment) [6]. Adding to this, the basic starting point for UD is to consider human diversity. During the life course, not least, the ageing process involves increased diversity in terms of functional capacity, past experiences, resources, and expectations since older adults are far from a homogeneous collective.

To better understand the complexities of UD and to reach cross-boundary consciousness about the interactions between individuals and environments, this paper suggests combining concepts of P-E relationships as criteria to support the operationalization of universal design*ing*.

2. Method

In this paper, theoretical P-E frameworks and models are synthesized and combined to suggest a compilation of P-E relationship concepts for a broader understanding of interactions between individuals and environments. The paper is based on a literature review and the author's previous experiences. Primarily, two frameworks are used – Lawton and Nahemow's [7] competence-press model, a theory describing relationships between individual factors and factors related to the environment, and – Desmet and Hekkert's [8] general framework of product experience that applies to all affective responses in human-environment interaction.

In this paper, environments primarily refer to physical environments. Factors related to the environment include dynamic changes, for example, seasonal changes or differences between daylight and darkness. In design processes, there are additional criteria beyond the micro-level [9] and a human-centered focus on P-E relationships as well as potentially conflicting interests to consider. Such criteria, not included in this paper, concern, for example, criteria from the producer perspective (e.g. marketability, profitability, materials, transportation, manufacturing, skills, work environment for production staff, ecological and economic sustainability) and the organizational perspective (e.g. embodying the visions of an organization, strategic objectives, branding).

2.1. Competence-press model

Lawton and Nahemow's [7] competence-press model concerns the relationship between the individual's internal abilities and the external demands of the environment. In the development of the competence-press model, the ageing processes of individuals and environments as well as continuous and mutual adaptations were central. Changes in the individual's competence need to be balanced with changes in the environmental press to achieve balance. Alternatively, the individual has to adapt to external demands by strengthening internal abilities. If the external demands exceed internal abilities, the outcome of the interaction is dysfunctional.

2.2. Framework of product experience

Desmet and Hekkert's [8] theoretical framework of product experience concerns all affective responses in interactions between individuals and environments. The framework indicates that there are patterns, both in the three different levels of experiences and in their own lawful underlying processes. Affective experiences can be positive, neutral, or negative such as pleasantness or unpleasantness, goodness or badness. The possibility to use the framework to describe the multi-layered and individual nature of product experience is one of its advantages.

3. Findings

The suggested compilation of P-E relationship concepts includes the three interaction types - instrumental, non-instrumental, and non-physical interaction - and five constituent concepts, i.e. accessibility, usability, aesthetic experience, the experience of meaning, and emotional experience (Table 1).

3.1. Instrumental interaction

Instrumental interaction refers to the everyday practical conditions of accessing, using, operating, and managing environments to serve particular purposes and achieve specific goals [8]. Concepts such as safety, evacuation (in the event of an emergency), or allergen exposure could be added next to accessibility in the suggested compilation of P-E relationship concepts with both factors related to the individual and the environment relevant for those concepts.

Accessibility as defined by Iwarsson and Ståhl [10] refers to the relationship between the functional capacity of the individual and the barriers to physical access to the physical environment (Table 1). The individual factors relevant to this definition are mobility, sensory, cognitive, and strength-related limitations. The factors related to the environment, that is the barriers in the material world, are based on official norms and standards. To use and benefit from this definition's possibility to describe the largely objective, observable and measurable nature of accessibility is one of its major advantages. However, the environmental factors are not constant as a phenomenon because there are international differences, and societal objectives changing over time. Accessibility as defined by Iwarsson and Ståhl [10] and also interpreted by the building sector and people in general, relates to individuals with disabilities and minimum compliance with norms and standards, rather than being a human right dimension [11]. This definition indicates that the P-E relationship concept of accessibility is necessary when addressing people experiencing one or more temporary or permanent disabilities during their lifespan. In addition, accessibility can enable or restrict participation in other situations such as when individuals bring a stroller, a suitcase, or being pregnant or with a friend facing accessibility issues. However, human differences exist beyond functional capacity.

Table 1. The suggested compilation of P-E relationship concepts for an understanding of universal design*ing*.

P-E relationship concept	Inter-action type	Involves	Individual factors[1]	Factors related to the environment[2]
			Mutual influence and control	
Accessibility (Iwarsson & Ståhl, 2003)	Instrumental (e.g. accessing, understanding, using, operating, managing)	Access attainment with a focus on functional needs and behavior.	Functional capacity Mobility, as well as sensory, cognitive, and strength-related disabilities.	Barriers to access in the physical environment. Based on official norms and standards.
Usability European Committee for Standardization (CEN) (EN 17161:2019)		The extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Task, use, operating, managing, maintaining, and goal attainments.	In addition Personality, personal history, age, life stage, gender, motives, attitude, skill, cultural identity, preference, hopes, aspirations, dreams, circumstances, role in a situation at any given time, and role in a group.	In addition Environment type, properties, characteristics, geography, architecture, scale, technology, social environment, culture, economy, politics, and use context.
Three levels of experience (Desmet & Hekkert, 2007)	Aesthetic experience — Non-instrumental	Perception with all the senses (e.g. beautiful, pleasant sound, good to touch, soft texture, nice smell, thermal comfort, discomfort, and wellness).	Senses Sensory modalities.	Perceived values The material presence of the environment and context of experience. Such as shape, texture, and colour.
	Experience of meaning — Non-physical	The meaning a person attaches to the environment (e.g. independence, sense of control, sense of belonging, attachment, and empowerment).	Cognition Cognition such as interpretation, memory retrieval, and associations.	Affective values The personal or symbolic significance of the environment.
	Emotional experience — Non-physical	Feeling and emotions (e.g. frustration, self-determination, dignity, pride, stigmatization, freedom, comfort, happiness, and atmosphere).	Cognition Affective phenomena, often automatic and unconscious, position vis-à-vis the environment.	Affective values The personal significance of the push and pull related factors of the environment.

[1]Individuals include those who access, use, and experience the output of the environment, those who operate the environment, and those who support the environment.

[2]Environments include goods, objects, products, systems, services, programs, packaging, user documentation, online and human help, support and training, etc.

Usability, which implicitly requires accessibility as a prerequisite, is defined as the extent an environment can be used *"…by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use"* [12] (Table 1). Thus, usability involves the performance of desirable activities, the specified individual's perception of goal attainment, and is dependent on culture, context, and social norms of use around an environment. Understanding and addressing usability requires more than focusing on functional needs and behavior. The fact that individual factors represent a substantial source of variation such as hopes, aspirations, and dreams [4] means that many individual factors in addition to functional capacity must be incorporated into usability analyses. Factors related to the environment include environment type, properties, characteristics, architecture, scale, technical, social environment, culture, economy, politics, and use context [13]. Usability focuses on functioning, activity, behavior, and cognition. A more holistic and human-centered approach also needs to take experiences into account.

3.2. Non-instrumental interaction

Non-instrumental interaction refers to caressing, playing, or interacting with an environment for delight, stimulation, and inspiration [8]. It is an interaction that has a value in itself, not just as a means to achieve a practical goal or purpose.

Aesthetic experiences concern the environment's capacity to delight one or more of our sensory modalities [8] (Table 1). In other words, the degree to which our sight, hearing, smell, touch, balance, and kinaesthetic are gratified or displeased. For example, green spaces and waterways can delight our senses and hence provide a positive distraction, promote mental and physical health, stimulate social cohesion, and support physical activity [14]. Generally, sensuous shapes (e.g. handrails), harmonic sounds (e.g. indication of the floor level and direction of lift travel), orderly organized elements (e.g. buttons on a lift control panel) soft texture (e.g. seats) are perceived as delighting. While noisy, dilapidated, or ugly disturbing and sudden sounds generally are perceived as distressing. In many contexts, moderate levels of stimulation are recommended because too much stimulation and complexity may cause unintended distraction and overload for cognitive processes and lack of stimulation may cause boredom or sensory deprivation [15]. Light levels and light directions can influence social interaction, particularly in communication with people with cognitive disabilities [16]. The concepts of thermal comfort and discomfort are here classified as aesthetic experiences because they relate to perceived sensory values such as cold, heat, biomechanics, restlessness, and fatigue [17]. Multi-sensory aesthetics should be preferred because diversity in needs demands many potential options and design solutions.

3.3. Non-physical interaction

Non-physical interaction refers to imagining, anticipating, or remembering usage [8].

Experience of meaning refers to the meaning individuals attach to environments (Table 1). At the level of experience of meaning, cognition plays a major role [8]. Interpretation, associations, and memory retrieval are examples of cognitive processes enabling recognition of metaphors, assessment of symbolic significance, and assignment of personality or other characteristics. Individual and cultural differences certainly

influence the cognitive processes involved. Factors related to the individual, environment, and the context influence experience of meaning. The experience of attachment represents profound and sustained meaning with feelings of confidence, independence, security, and control. Using a walking device can evoke other people's stereotypical beliefs, which in turn can generate affective reactions.

Emotional experience refers to the emotions and feelings that environments elicit (Table 1). Desmet and Hekkert [8] refer to affective phenomena such as desire and fear, love and disgust, pride and despair. Emotions are functional, because pleasant emotions will pull individuals towards certain environments interpreted as beneficial, and unpleasant emotions will push individuals away from environments interpreted as harmful. Importantly, it is each individual's interpretation or the significance he/she attributes to the environment, rather than the environment itself that elicits the emotion. The individual's state of mind influences the emotional response. Emotions are often a result of an automatic and unconscious cognitive process. For example, for individuals without hearing disabilities or headphones, a response to a fire alarm will most likely be the basic emotion of fear. However, the principle also applies to subtle emotions experienced in interactions between individuals and environments such as comfort-related emotions of plushness and well-being [17].

3.4. Comparisons and relations between the interaction types and the constituent concepts

The common denominator of the five constitution concepts is that they all describe the dynamic relationships between the individual and the environment – a mutually constructed mediation co-shaping subjectivity and objectivity. All the P-E relationship concepts must be analyzed by integrating both the factors related to the individual and the environment. With such an approach, the focus is on the role environments play in people's everyday life, which raises the need for a holistic view and a life course perspective, instead of a narrow focus on the properties that environments can possess (e.g. barriers; functionality; originality) or properties of the individual (e.g. disability; asthmatic condition). In all the five constitution concepts, the diversity of user needs and many potential options should be taken into account. Such an approach often improves the overall interactions between individuals and environments.

Moreover, the five P-E relationship concepts cover different aspects that all are important and complement each other. It is important to recognize their interdependence and impact on each other. Accessibility primarily concerns people with disabilities, while usability, aesthetic experience, the experience of meaning, and emotional experiences include everyone. In other words, the difference between accessibility and the other P-E relationship concepts is that accessibility has a focus on age or ability while usability and the three levels of experiences can include other instances of exclusion such as gender, socioeconomic, geography, race, religion, or belief. A difference between the instrumental concepts and the non-instrumental and non-physical is that the three levels of experience occur before, during, and after factual human-environment interaction while usability and accessibility occur during factual interaction. Therefore, accessibility is a prerequisite for usability – first access, second understanding, and third use [12]. Access is not necessarily required for the three levels of experiences that can occur pre or post-use without factual physical, and/or instrumental interaction. However, particular experiences can activate other levels of experiences and influence usability. That is,

environments perceived as aesthetically gratifying allow individuals to perform in the best possible way and achieve their goals, or the other way around, usage enabling individuals to achieve their goal may lead to affective responses. This explains, according to Desmet and Hekkert [8] why the three levels of experiences and usability have strong correlations. Based on a literature review of links between aesthetic experiences, emotions, motor inhibition, and learning, Sarasso et al. [18] suggest that aesthetics should not be reduced to merely decorative aspects but should instead be taken into account as a key part of how environments can influence learning and adaptation processes. Desmet and Hekkert [8] argue that experience of meaning and aesthetic experience can elicit emotional experiences. Likewise, environments that in various degrees are accessible and usable, having beneficial or harmful consequences for the individual, may elicit the experience of meaning and emotional experiences. Environments that provide access and allow individuals to achieve their goals will more likely lead to positive emotions [19].

4. Discussion

The suggested compilation of P-E relationship concepts embraces a wide variety of human and environmental contexts of interactions. All of the five constituent P-E relational concepts described are closely related to UD. A P-E relationship approach to universal design*ing* has the potential to illuminate complexity, raise awareness, encourage cultural shifts and make the UD objectives an integrated part of design research, education and practice. To better understand the complexities of UD and to reach cross-boundary consciousness, this paper suggests combining concepts of P-E relationships as criteria to support the operationalization of universal design*ing*.

The definition of accessibility suggested by Iwarsson and Ståhl [10] is often criticized for being too instrumental in the context of design. That may be true, but there are other P-E relationship criteria to apply when the focus for example is on instances of inclusion beyond functional capacity. An advantage of Iwarsson and Ståhl's [10] definition is that it makes the accessibility criteria concrete and objective. The Housing Enabler instrument [20], is a research-based instrument for assessments and analysis of housing accessibility problems based on the Enabler tool [21], developed inter alia for designers to incorporate body-environment relations into their analyses. A unique value of the Housing Enabler is that it takes the individual's, or group of individuals' functional capacity into account, juxtaposing it against the barriers in the physical environment. Thus, enabling the calculation of the degree of objective housing accessibility problems, classifications, and certifications of housing accessibility to create bridges between housing supply planning, physical planning, healthcare, and the public. However, the prevailing understanding that accessibility is about minimum compliance with norms and standards, constitutes an obstacle for such a P-E relationship approach to have an impact. However, the accessibility criterion is not enough to accommodate the widest variety and number of people. Usability and the three levels of experiences must be taken into account to address several instances of inclusion such as gender, socioeconomic, geography, race, religion, or belief. A broadening of P-E relationship concepts adds greater depth to the understanding of the interaction between humans and environments and creates conditions for the design of health preventive environments. In line with Ryhl et al. [5], emotional aspects must be equally incorporated to ensure that all users to the greatest extent possible are included.

UD is a means of considering all the P-E relationship criteria and human differences. To prevent overlooking genuine and diverse need, human-centeredness and the involvement of individuals at every stage in the design process is at the core of UD [4]. There is a need to develop theoretical awareness and conceptual clarity regarding P-E relationship criteria and consider them in universal design*ing* to support the operationalization of UD. The suggested compilation of P-E relationships can be of value for all individuals involved in design processes because it can facilitate their structured and creative attempts to design for inclusion, independence, dignity, and social participation.

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State of Art and Perspectives of Universal Design: The Libyan Approach

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Abstract. Through this paper, we have highlighted the importance of a Universal Design orientation within the architectural community in Libya; it attempts to shed light on some of the different initiatives, experiences, applications, and projects in the field of accessibility and Universal Design to provide a hospitable urban environment that can accommodate all segments of Libyan society. The paper discusses the difficulties of architectural integration and the need for comprehensive education, training, and proof of concept applications by reviewing some inspiring projects undertaken in Libya to encounter this issue. The paper concludes by looking forward to practicing the design orientation for all in Libya by discussing the opportunities available after the tremendous political and economic change in Libya post-2011 and the need for reconstruction programs that adopt the Universal Design doctrine on suspended and future urban projects, furthermore the need to establish a national strategy, and law binding commitment in this context.

1. Introduction

The urban environment that responds to the requirements of the human being today is a topic that receives increasing attention at the global level, and the realization of a shortcoming in understanding the requirements of human diversity is increasing. The great challenge for architects and engineers to understand human limitations and diversity continues, creating urban environments that only complement the needs of the abled and neglect the less able segment of society. Moreover, this is more apparent in Libya. International regulations require us to follow a practical approach that responds to the needs of all segments of society. The "International Convention on the Rights of Persons with Disabilities" includes in its 9th article "Accessibility," in which it is indicated that the signatory countries are obliged to ensure that persons with disabilities can access the environment on an equal basis with others [1]. The 2002 Madrid International Plan of Action on Ageing also emphasized the built environment as a supportive environment for the movement and communication of older persons and the design of age-friendly homes and ensuring their access to buildings and open space [2]. The Libyan urban environment is specifically hostile regarding access for people with physical limitations as international regulations are not reflected and implemented, causing the reduction in their opportunities for a more developed standard of living.

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2. Historical overview

2.1. Disabled Persons Act

In 1976, the General Assembly proclaimed 1981 as the International Year of Disabled Persons (IYDP). The Assembly called for a plan of action at the national, regional, and international levels, emphasizing equalization of opportunities, rehabilitation, and prevention of disabilities; In response to this occasion, the Libyan state decreed a law for the disabled, under Law No. 3 of 1981, which was later amended in 1987 to be renamed Law No. 5 of 1987 [3].

In June of 2017, the Libyan Parliament (House of Representatives) ratified the international Convention; as a result, many organizations, specialists, and those interested in the field are calling for the amendment of Law No. 5 regarding the disabled to keep up with new concepts and developments internationally [4].

2.2. Libyan National Conference on Access for Persons with Disabilities

From the 13th to the 14th of December 2010, "The Libyan National Conference Access for Persons with Disabilities" was launched in Benghazi to address the Right to access for persons with disabilities and the built environment transportation design. The conference was the first Libyan social event where several international speakers highlighted issues concerning policies and practices that fully integrate the urban environment to accommodate people with disabilities and how to tackle the issues facing the implementation of a Universal Design doctrine [5]. The conference was considered a turning point for many designers and civil activists as it was the largest on a national level, including international experts in Universal Design; The event was perceived as a great success in assembling a large number of architects, civil engineers, planners and institutions responsible for infrastructure, housing and transportation projects in Libya.

2.3. Personal history and involvement

As a student at the Architecture and Urban planning department at the University of Benghazi, I suffered an accident that rendered me use a wheelchair for the rest of my life. During this unfortunate time, I was in denial of my current status, believing that this must be only temporary and life like this cannot be burdened, leading me to travel to Europe for treatment and rehabilitation, seeking a hope of full recovery; As I arrived there, my eyes were opened to two realities one harsh and the other of hope, the harshness of knowing and later acknowledging my status quo of never recovering, the hope I found as I experienced the consideration that was built into the urban environment.

When I returned, my graduation project was titled design and planning for the Disabled and dealt with the architectural obstacles in urban space residential, administrative, and educational buildings; As I had hoped, the research raised awareness of the subject and left its impact on the Department of Architecture. However, this was not enough. I was later inspired to embark to Austria in 2003 to study and work with recognized experts in the field of Accessibility & Universal Design with the support of the United Nations Development Program UNDP, which was an exceptional event and a very important milestone in my experience in general, my visit took the duration of the month which was primarily spent in Vienna and Graz were I met with governmental and private institutions and advisory bodies, and I got to know distinguished experts in the

field of Universal Design and was enlightened to their achievements the rest of the time I spent was not of less importance as I found myself admiring and analyzing urban areas, streets, squares, buildings, cafes, parks, everything I witnessed from Universal Design and design for the disability aspects had a rich material impact that formed a critical knowledge base and tributary that help me encounter the obstacles that faced this vital segment of society in Libya , and to provide the ease of access and maneuverability placing the less mobile persons and others on equal footing.

3. A hands-on approach

3.1. Establishing Al-Ttyseer Ltd

AL-Ttyseer consulting and training company was established in 2006 as a practical response to the lack of awareness and information regarding design requirements for all, the company was formed by a team of architects, engineers, and civil activists with a mission of providing specialized consultancy in the relationship between the built environment and its users, and a vision to create an urban environment that accommodates all on equal footing. After this field and Universal Design; the company was in a position it could present its experience in the form of a modest initiative to contribute to the development of urban planning and design and implement both the vision and mission that the company was set to accomplish; However the task proved to be more challenging than we first thought mainly to the lack of awareness and initiatives imposed on governmental and private institutions to make such considerations to their urban environment or seek such consultations in such a specialized area. Therefore, Al-Ttyseer needed to adopt a different strategy and take a back-route approach to re-establish itself as a traditional consultancy company that handles all design issues and supervises contracting companies executing projects. The company introduced concepts of Universal Design within its services, which became a factor of added value that distinguished it from the other consultancies; Furthermore, the company sought to get involved in the education sector to introduce future designers to the standing issue by conducting free Lectures and workshops incorporation with several local architecture schools to introduce and enlighten their students about the needs of persons with disabilities and how they must be a moral obligation of a designer to take into consideration the ease of navigation of all segments of society, and how their future designs must be enjoyed by all, and not seen as nothing but pretty urban obstacles to the less maneuverable segment of that society.

3.2. The first Universal Design model (Libya Children's Theatre)

The Children's Theatre was an unfinished project near the Benghazi National Zoo; The project was left in the skeleton stage, with only concrete and brickworks completed; the building was left without maintenance or completion for a long time nearing 20 years of neglect. In 2008, AL-Ttyseer was entrusted with the re-design of the building's interior and exterior; this was the first practical opportunity to showcase a living example in the application of Universal Design on a public building in Libya; through this project, practical ideas were presented in many elements and components of the building based on the concept of Universal Design, the structure was reintegrated with accessibility elements that are frequently executed incorrectly, such as the design and implementation

of ramps, Accessible WC, stairs, handrails, color contrast, details of the reception counter and lighting spots.

The Children's Theatre presented the argument that the design application was possible in a half-completed building filled with barriers and challenges, and this did not entail an increase or modification in the building implementation contract. Therefore, it is more appropriate to follow the Universal Design approach in the new projects in Libya, which should not be a subject of controversy or discussion. The theatre has contributed to being an educational model as well, as many meetings of architects and building engineers take place in it, and it has also become a destination for university students to visit, especially architecture and civil engineering students, such a living example for future designers was a vital introduction and primary motivation for adopting the idea of architectural education for Universal Design.

3.3. Training Initiative Arabian Gulf Oil Company (AGOCO) and Al-Ttyseer Ltd

In 2006 Al-Ttyseer Ltd presented a proposal to the Arabian Gulf Oil Company (AGOCO) to conduct a training program for the company's engineers in the fields of urban Design, Architects, civil; the program intended to provide architects and building engineers with knowledge and skills to design and construct buildings accessible and usable by all. The proposal contained an extensive program with a 20-hour course duration spread over five days, at a rate of 4 hours per day; with a core goal of establishing a design mindset for architects and building designers that accommodates the needs of all segments in a natural manner and primary focus on understanding human diversity before applying standards and specifications. The program syllabus was to take the already professional trainees through a multi-stage recalibrations process, starting with inaugurating awareness among the participants not only of the needs of people with disabilities but also of planning for the diversity of people; then elevating them to the Inspiration level where they naturally started to rethink traditional design concepts and gained a somewhat free-flowing consideration when thinking of end-users from a diverse point of view.

The program's final stage was to incorporate the awareness and inspiration with the necessary tools and skills to make practical use of the content learned as the trainees were introduced to Universal Design and explored issues of technical and operational solutions that are appropriate under various conditions of their built environment, and costs of intervention and loss if we do not intervene; Moving onto an overview of accessibility standards and legislation in Austria and Europe in general. Finally, exploring and discussing design applications during the planning, design, and implementation stages and how such Applications can be applied to projects under implementation or existing projects so that trainees work on applying what they receive from theoretical information in reviewing, evaluating, and developing. The program was met with widespread enthusiasm by AGECO and the trainees, as the program was continuously extended and conducted as part of the Company's Personnel and city's Engineers Development Program; seven courses were implemented, involving 200 trainees; Consequently, many learned concepts were later adopted by the company as design standards for all future design constructions.

3.4. The Shining diamond project for the National Oil Corporation buildings

National Oil Corporation (NOC) intends to construct a complex of buildings in Benghazi. Implementing the design was assigned to the Italian company Artelia [6].

Artelia had a subcontractor also in architectural design BOERI. The Oil Corporation has appointed 8 Engineers of its staff to supervise the design stages. The team hired three consultants from outside the National Oil Corporation; I was chosen to be one of the consultants by the Project owner to do a review about accessibility. What distinguished this experience is that the Universal Design consultancy is integrated with the rest of the consultancies related to their specializations which created a greater understanding and flexibility in modifications and additions required to implement the Universal Design standards on the project. The results were profound, with minor setbacks and concessions; However, the results created a Universal Design for an administrative complex in the heart of Benghazi that was fully accessible to all segments of society. In my estimation, the owner welcomed and supported the experience and received positive acceptance and interaction from the company and the project's designers.

3.5. The accessibility of the polling stations - the experience of the Electoral Commission

The "Persons with Disabilities Support Unit" was established after a group of National organizations concerned with persons with disabilities requested the High National Elections Commission of Libya to promote the equal rights of persons with disabilities in political participation. Based on these demands, the commission issued Resolution No. 49 of 2017 to establish a unit within the organizational structure of the commission to follow up on the awareness campaigns. Since the team received the tasks entrusted to them, they have put within its annual plans to raise the participation rate of voters with disabilities and work to overcome the difficulties and challenges they may face during all stages of the electoral process. Throughout the 2012 and 2014 election cycles, the commission equipped 174 polling stations with the requirement to accommodate the needs of persons with disabilities; However, this was challenging due to the difficulties of integrating such standards into the facilities due to long bureaucracy cycles in the Ministry of Education, such setbacks hindered the integrity of the perceived outcome; To tackle this obstacle and establish a long term solution, the commission trained active employees of the Ministry of Education on Universal Design. However, the officials lacked the commitment and empathy toward the needs and requirements of persons with disabilities and that they have the same civil rights as the other segments of society, resulting in many imperfections in the final delivery of the program, without neglecting the importance of the forward movement and improvement it achieved in general.

3.6. The Access campaign for disabled people's organization

Founded in January 2019 with a mission to ease the access of persons with disabilities to knowledge and other education facilities in universities by amending law No. (5) of 1987 Concerning People with Disabilities, activating the International Convention on the Rights of Persons with Disabilities, and raising awareness of the rights of persons with disabilities [7] [8]. The organization's members are composed of people with disabilities and parents of people with motor, visual, and mental limitations, as well as civil and human rights activists from all regions of the country; The organization has conducted many workshops and conferences to raise awareness in many higher education facilities in Libya, were the central issue of facilitating ease of access was brought to the attention of those respectable universities so they could work alongside with the organization to encounter this significant problem.

The organizations encountered and tried to resolve many issues and setbacks, such as the lack of educational rights of this segment of society, where many considered the issue to be a matter of charity, not a constitutional right, other matters that the organizations faced were the absence of plans to finance such improvements and implementations to the higher education sector facilities. The organization members conducted several rallies and social events to gain public support; this was done to implement socio-political pressure on the governmental authorities and legislative bodies in Libya to move toward change and improvement.

3.7. The Education on Universal Design in Architecture curriculum, The University of Berenice Experience

Berenice University of Architecture and Urbanism BUAU is an educational institution established in 2016 in Benghazi. University professors and academics established it based on their long experience in the field of architectural and urban engineering; Since its inception, the BUAU has always sought to raise the level of professional and academic practice as well as leadership, excellence, and creativity in the fields of university education and scientific research, and to consolidate its position in building a society based on science and knowledge. According to this mandate, the university felt that it had a scientific commitment and moral obligation to add Universal Design concepts into its teaching program, and I was honored to be chosen by the institution to develop and teach this course. In the 2020-2021 academic year, the university began accrediting an educational course under the name (Universal accessibility and design for all) and linked to Design studio 7, the course intended to bridge the gap between functionality and architectural harmony by integrating Universal Design concepts into buildings and urban environment to design and create an urban environment that can be marveled, and enjoyed by all.

The module was taught via 16 lectures 3 hours each, every session framed around an interactive lectures style that started with questions and issues and developed creative answers and then later explored how such results could be adopted. The course also explored concepts and definitions; Furthermore, the students were encouraged to debate, explore, and challenge mainstream solutions and concepts adopted nationally and internationally; the students had to conduct four exercises, the first being a global case study, several global examples are chosen in which the concepts of Universal Design are manifested, whether from the beginning of its design idea or modified later. This exercise inspires the overall design to be a renowned architectural design. The second exercise is about accessibility standards, where students are familiarized with accessibility standards. This course was essential for students to acquaint themselves with the Universal Design standards, and here a sample of international standards is selected as a focal point of study. During the last semester, students used five standards being ISO 21542:2021(Building construction – Accessibility and usability of the built environment), Dubai Universal Design Code, DIN 18040-1:2010-10 Construction of accessible buildings – Germany, ADA Standards for Accessible Design 2010 -USA, and CEN EN 17210:2021- Accessibility and usability of the built environment respectively. Then, the students are directed to conduct a comparison project between the five standards in terms of the specifications they include and the functional requirements of human diversity, where the students learn about how the standards deal with the functional elements of the building and the open spaces, how each standard deals with these elements, and to what extent they are Comprehensive, easy to understand and

navigate to the user, its applicability and how to explain it correctly within the designs. Finally, the student is instructed to conduct an application project where they have the opportunity to apply what they learned is evaluated alongside the design studio module to give a broader perspective on the students' knowledge. The application project for universal accessibility is done by each student choosing a complete, half-complete, or suspended building from any location within Libya and conducting an extensive evaluation and study about its accessibility, and presenting creative solutions and ideas without compromising the structural or functional integrity while maintaining full architectural integration concept desired by the original designer; In addition to all this, the students conduct a final theoretical exam at the end of the course. Through this experience, I can say that comprehensive university education is essential for the future generation of Libyan architects, where the gap between architecture and Universal Design can be bridged. One has come to realize in the discussions I conduct with students who have completed three years of studying architecture and are now in the fourth year that they are discovering something new, that they are reconsidering everything they have learned, and are capturing the true essence of function in architecture.

3.8. The Libyan Code Project for Universal Design

Addressing the issue of Universal Design to the built environment has been an ever-growing demand and concern of the disabled people within Libya and a mandate for the Libyan Social Solidarity Fund (SSF) to counter and overcome to meet the requirements of disability inclusion within society. However, this endeavor has been hard to overcome due to the absence of a legally binding standard that guarantees the implementation of Universal Design in the built environment. The SSF launched The Libyan Code project on the 23rd of December 2021 and contracted AL-Ttyseer Ltd on the 13th of April 2022 for seven months. The Attyseer Ltd project board established a four-stage plan to conduct and deliver the final product of this project.

The stages were broken down into the following: The first stage will be conducting a comprehensive study of the current status of the built environment in Libya and its accessibility for people with disabilities and identifying difficulties, problems and challenges, in addition to studying the relevant legal and legislative aspects, including planning and building legislation in Libya. The second stage composes of the preparation of a first draft of the Libyan code for Universal Design to the built environment, facilities, and services; The development of this draft will be based on the principles of Universal Design, and global development in accessibility standards, including application options for government and private agencies to three levels (compulsory - highly recommended - optional). The third stage consists of a full evaluation of the draft, which will be done by conducting a thorough review with the relevant authorities and stakeholders, including the SSF and Libyan House of Representatives (HoR), and hosting three workshops to discuss the possibility of implementation and any comments the in which the feedback will be collected and analyzed to reform and enhance the draft for end product delivery. The fourth stage will be formulating the final version of the Libyan design code to be delivered to SSF and later adopted by the Libyan legislative body to be implemented and enforced by law.

4. Conclusion

The orientation towards Universal Design in the reconstruction of Libya at an early stage and making the subject one of the focuses of the reconstruction process in all its stages, "planning, design, and implementation," is of great importance and will allow us to respond to multiple and overlapping social issues. Nonetheless, this implementation also has an economic and political dimension and an integral part that must be considered. The ideas and projects presented in this paper represent some applications in the form of isolated islands, but they certainly do not represent a general policy for Libya yet. The great diversity of construction projects contracted before the Arab Spring are mostly suspended; however, unfortunately, the majority of these projects do not consider the needs of a wide variety of people, including people with disabilities and the elderly. When the current designs complete these projects, Libya will ultimately fail to achieve the 2030 Agenda for Sustainable Development plan.

Libya needs more to establish an understanding and persuasion that Universal Design is not only limited to the human view but goes beyond it to economic, social, and political dimensions; this requires building a carefully prepared, enforced, and binding national strategy for Libya that guarantees to obtain tangible results in the final form of the urban environment, transportation, and information, and the extent of its ability to interact and respond to the requirements of today's human being. Libya has vast financial resources and human resources through an ambitious rising generation that lies in providing it with the necessary knowledge and training to fulfill these requirements. Perhaps the presence of suspended projects is a significant opportunity to complete them according to the Universal Design approach, and the experience of the Children's Theatre has proven that this is possible. The destruction caused by the second Libyan civil war, especially the centers of the city of Benghazi and Sirte, is unfortunate. However, it presents a valuable opportunity to implement Universal Design concepts in the reconstruction projects of those areas on a design and foundation level.

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'Frontrunners'' Understanding of Universal Design in Architecture

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Abstract. In Denmark, the building sector is in a state of transition towards Universal Design (UD). Thus, UD has not yet completely found its way into the practice of architects and their clients. Legislation about accessibility has dominated. This paper studies understandings of UD through a discourse analysis based on a survey among professionals with experience and interest in UD and professionals who were expected to keep their fingers on the pulse of the profession´s development. The findings illustrate the existence of five discourses: 1) Social sustainability, 2) Re-instatement of humans as a focal point, 3) It is not just about ramps, 4) Equality, and 5) Giving a voice. Across the discourses there exists a genuine attempt to legitimise and mainstream UD into the architectural practice, focusing on multisensory and architectural quality in the design of spaces for human diversity in all scales.

Keywords. Discourse analysis, Social Sustainability, Universal Design

1. Introduction

There is a growing awareness of Universal Design (UD) and the inclusive aspects of architecture. In 2009, Denmark ratified the Convention on the Rights of Persons with Disabilities (CRPD) [1], where the concept of UD is defined in relation to usability.

In Denmark, the building sector is in a state of transition from accessibility towards UD [2]. For the last fifty years, the accessibility requirements have dominated to such an extent that the field of accessibility has been black boxed, resulting in a fixed understanding of users [3]. In 2018, the new Building Regulations (BR18) mention UD in a guideline about users without any introduction. Furthermore, BR18 maintains the prescriptive requirements while simultaneously literally erasing the word accessibility [4].

When a new definition of UD as a process was launched by two US researchers in 2012, few professionals knew of the concept of UD [5]. Some years later, the situation was similar in Denmark [2]. In European countries, including Denmark and Belgium, professionals have primarily had a limited understanding of the inclusive aspect of architecture, tending to associate it with care, e.g., hospitals and assisted living facilities [6], [7]. In Denmark, the focus has been on accessibility, which is understood among architects [6], landscape architects [8] and clients [9] as the Building Regulations and is primarily associated with wheelchair users and blind and partially sighted people.

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According to Gramkow et al [8], landscape architects do not relate accessibility to the UN's Sustainable Development Goals (SDGs).

The situation in Sweden is different. A study shows that professionals with a relation to UD, i.a. architects, merge UD with accessibility. Accessibility is associated with requirements and guidelines for solutions that could be easily assessed. Guidelines are not only supportive, however; they can also be a barrier to creativity and innovation. UD, on the other hand, is associated with innovation and creativity, although some find the word universal problematic. In relation to the design process, they find that UD can support the initial state of the design process because it functions as 'a tool for ethical guidance'. Yet the situation is different in the rest of the process because UD seems to be too abstract and not suitable for practical solutions and evaluations [10].

Thus, it is understandable if the sector is confused and does not know how to understand UD. Someone must lead the way. Every professional field has its share of pioneers, professional stars and powerful actors keeping their fingers on the pulse of change – actors that the rest of the field looks up to or is inspired by. Such 'frontrunners' lead the way. The research question of this paper is: how do these 'frontrunners' understand UD?

This paper presents a preliminary discourse analysis of the understanding of UD among Danish 'frontrunners' across scales in the realm of architecture: urban space, buildings, and landscapes. The way they talk reflects the meaning they ascribe to the concept of UD and will thus have an impact on how the rest of the Danish sector will consider UD in the future.

2. Discourse theory

A discourse is "*a particular way of talking about and understanding the world (or an aspect of the world)"* [11, p.1]. Discourse analysis can be a useful method when we want to study how UD 'frontrunners' talk about UD and what understanding of UD they identify themselves with. Discourses create representations of reality. These representations are not just reflections or mirror images of the existing reality; they also contribute to the creation of reality, comprising knowledge and identity [11].

There exist many positions in discourse theory. Our analysis is based on the concepts of Laclau and Mouffe to map the fixation of meaning in a discourse. Thus, discourse is centred around a nodal point that characterises the discourse and its identity. A nodal point does not stand alone, but is articulated by a chain of equivalence composed of elements or signs that are transferred to moments when meaning is ascribed to them in relation to the nodal point [11]. In the analysis, we have focused on presenting the nodal points and their chains of equivalence.

3. Research design

Empirically, the paper is based on a questionnaire with open-ended questions. The strategy for the selection of respondents is information-oriented, focusing on paradigmatic [12] professionals: frontrunners. 25 Danish 'frontrunners' were invited in the autumn of 2021. They were selected based on either professional reputation as e.g. chair of an architectural organization or their stated interest in UD and experience with UD in a Danish context e.g. completed projects or initiatives focusing on UD. We

received answers from 16 'frontrunners' (Table 1), 15 of which were from the field of UD.

Table 1: Overview of the 'frontrunners'.

ID	Gender	Role
R1	F	Architect; architectural firm
R2	M	Landscape architect, Founding partner + chair of a professional organisation
R3	M	Architect, founding partner of an architectural firm
R4	M	Urban planner; municipality
R5	F	Constructing architect; architectural firm
R6	F	Landscape architect; architectural firm
R7	M	Landscape architect; architectural firm
R8	M	Client; central administration
R9	M	Client consultant; property asset management consultancy
R10	F	Project architect; architectural firm
R11	F	Project manager, Self-endowed philanthropic association
R12	F	Head of wayfinding and place activation; design agency
R13	F	Consultant and co-founder of an urban design consultancy
R14	F	Assistant general manager; professional organisation
R15	F	Universal design consultant; founder of consultancy
R16	F	Architect, founder of an urban design consultancy

The survey comprised four questions: 1) How do you work with UD in your practice? 2) Why do you think it is relevant to work with UD? 3) What do you see as the biggest hindrance for creating an inclusive architecture? and 4) What do you wish or dream that everybody in the sector knew about UD?

4. Results: Five discourses about UD

In this part of the paper, we present the discourse analysis of the interviews, which extends beyond individual responses. These discourses defined identities using the dominant qualities that the 'frontrunners' ascribed to UD. They clustered around five different nodal points that we have identified: 1) Social sustainability, 2) Re-instatement of humans as a focal point, 3) It is not just about ramps, 4) Equality, and 5) Giving a voice.

4.1. Social sustainability

It was clear that UD was seen as a key to creating social sustainability. Thus, social sustainability was a nodal point that had a chain of equivalence containing SDG2030 and the value 'Leave No One Behind' (LNOB) as concepts equivalent to UD.

Other moments in the chain were 'the material and sensory aspects of architecture', which were emphasised both as a driver of design and as a part of the design strategy to create experiences for users without incurring extra costs: "*If UD is an integrated part of our design strategies, it would feed into a more material, sensory and sustainable architecture. It does not have to cost more – it should merely become a permanent part of our design thinking.*" (R1). It was considered a part of socioeconomics as well:

"It is not more expensive to do it smart from the beginning - and not at all seen in relation to what each person and society can gain." (R11)

The sensory qualities were made equivalent to UD emphasising 'aesthetics': "*UD is not equal to bad aesthetics. You do not have to compromise."* (R12) They also pointed to the architectural experience: "*It is not only about making it possible to move from a to b or creating enough space. The actual experience is what we should frame.*" R6

It was problematised that most architects do not understand what it is like to be marginalised or stand outside the norm. Empathy and an in-depth analysis of user needs were described as essential to the UD approach and thus the creation of an inclusive environment. Hence, 'the human experience', 'knowledge' and 'empathy', were all parts of the chain of equivalence.

This discourse was about mainstreaming UD into the architectural mindset and practice under the umbrella of social sustainability.

4.2. Re-instatement of humans as a focal point

This discourse was related to the previous discourse 'Social sustainability' because their chains of equivalence shared a moment. The common moment was the idea of 'the sensory and material aspects of architecture'. Additionally, mindsets about 'diversity' and 'inclusion', along with 'a holistic mindset', were described as qualities of UD in a context of cultural heritage, preservation and restoration.

"*UD does reason well with the human presence and the great richness of materials, processing of materials, and details that exist in pre-modern architecture.*" (F8)

Years of regulative rules about sizes and designs had deprived architects and designers of possibilities for training bodily empathy and insight into our physical environment. This had, along with mass production, synthetic materials, and standardisation, contributed to an increased rigidity and narrowness of possible solutions, which resulted in a distance to objects and surroundings that we meet in our everyday life. Thus, the nodal point of this discourse was 're-instatement of humans as a focal point'. UD was seen as a solution to the problem of modern architecture since UD expanded ways of working with the relationship between people and their physical surroundings.

Likewise, in this discourse, a kind prejudice about UD was disproved when UD was described as a mindset that was liberating rather than limiting. Therefore, 'liberating' was a moment in the chain of equivalence.

"*It [UD] fosters a common realm of understanding and connections between the different scales within the design of our physical surroundings. And it contributes to the re-instatement of humans as a focal point for the design of our physical surroundings.*" (F8). This discourse was about a revival of forgotten architectural virtues focusing on the human body.

4.3. It is not just about ramps.

The nodal point of this discourse was "It is not just about ramps". In this discourse, an effort was made to distance UD from accessibility and to describe UD as something more than the accessibility defined in the Building Regulations:

"*It is not just about ramps, handrails, and lifts. It is also about organising buildings and outdoor space. It is about integrating light, shadow, acoustics, and tactility so we can show consideration for those people who are somehow challenged in their physical capability or have cognitive challenges that make it difficult to obtain a good everyday life at work, in school or in daycare.*" (R14)

Thus, 'integration of sensory architecture' was a moment in the chain of equivalence. A need for knowledge was significant for this discourse. Again and again, it was stressed that more knowledge was needed in general and in relation to groups of professionals. A more-thorough understanding of users´ diversity was requested, along with knowledge about barriers, users' needs and UD as a concept, as well as factual knowledge about design parameters. There was a focus on the need for operationalisation of UD in this discourse; thus, 'operationalisation' was a moment in the chain of equivalence.

This discourse suggested that UD was about a new kind of design that did not cost more but would require an awareness of the mindset and potentials among all professionals involved. 'Awareness' was a moment of the chain of equivalence.

This discourse was about operationalisation of UD, emphasising with the nodal point 'it is more than ramps' that UD was different from accessibility.

4.4. Equality

The concept of equality was a keyword used by respondents to characterise the relevance of UD and what they wanted the sector to know about UD. Thus, this discourse had equality as nodal point.

"*The people that use the buildings have very different abilities that cannot be predicted. Here, equality is an essential element. UD ensures that most people experience the architecture equally, without some being displayed as a person with 'special needs.*"' (R3). Equality was related to and understood as a basis for a democratic society and a democratic city.

The mindset of UD was seen as productive for the work with architectural projects because of its focus on all users and their needs – physical as well as mental. This discourse separated accessibility from UD and wanted to maintain the difference: "*It is essential to brand the concept of UD so that it becomes a concept that distances itself from 'disability accessibility' and focuses on people as a broad group.*" (R3)

Other moments in the chain of equivalence were 'integrated solutions' and 'a focus on UD from the start'. The latter was common to the discourses 'Social sustainability' and 'It is not just about ramps'. In this discourse, the focus was on 'integrated solutions' as one of the project requirements, on equal terms with social, aesthetic, biological and technical aspects. 'Project requirement' was a moment in the chain of equivalence.

This discourse with the nodal point 'Equality' was about integrating UD in the process and the solution from a perspective of equality.

4.5. Giving a voice

This discourse was about giving a voice to minority perspectives to obtain equal possibilities for everyone. Thus, the nodal point was 'giving a voice'. UD was a basic premise for the planning of inclusive urban spaces in terms of age, culture, social status, ethnicity, gender and disability – mental as well as physical.

'Inclusion' was a moment in the chain of equivalence and was understood as a social, mental and physical accessibility. The experience of accessibility on a profound level was emphasised. Here it was not merely a question of creating physical access for everybody – that was taken for granted – but it was about making the city open for different kinds of people in relation to social acceptance: "*For me inclusion is about giving a voice to the ones that normally not have been heard.*" (R13).

Attached to this nodal point was the moment about an inclusive process involving different minority groups: "*Our way of working with UD in design and building projects is based on involvement of minority perspectives from e.g. women, ethnic groups, citizens with mental and physical disabilities, vulnerable citizens, children and youth.*" (R16). It was emphasised that it was about ensuring diversity of the voices being heard by creating various opportunities for these voices to speak and be heard. There was hope that such an inclusive process could become a part of a common practice based on an awareness of one´s own situation and privileges; then it would become easier to determine who had not been heard. 'Awareness of one´s own situation and privileges' was a moment in the chain of equivalence, but it was related to the social sustainability discourse.

'Feminist urbanism' was also connected to UD: meeting the needs of women in the design of towns and urban space would create a space that would function for everyone. Feminist urbanism was a moment in the chain of equivalence. Here, this discourse touched an existing discourse that doubted the benefits of feminist urbanism for the general public.

This discourse was about involving minorities in urban planning processes, giving them a voice.

In summary, the analysis resulted in five different discourses of UD (Table 2) that showed how the frontrunners identified themselves with UD and the meaning that was ascribed to UD with their chains of equivalence.

Table 2: An overview of discourses and chains of equivalence.

Discourse	Chain of equivalence
Social Sustainability	'SDG2030', 'Leave No One Behind', 'material and sensory aspects of architecture', 'design driver', 'aesthetics', 'human experience', 'knowledge', and 'empathy'.
Re-instatement of humans as a focal point	'Material and sensory aspects of architecture', 'diversity', 'inclusion', 'a holistic mindset', 'liberating', and 'human'.
It is not just about ramps	'Integrated sensory architecture', 'knowledge', 'operationalisation', and 'awareness'.
Equality	'UD mindset´, 'integrated solutions', and 'project requirement'.
Giving a voice	'Inclusion', 'inclusive process´, 'awareness about one´s own situation and privileges', and 'feminist urbanism'.

5. Discussion

In the discussion, we will first focus on our contribution in relation to existing literature and then on the implications of the five discourses in relation to dissemination of UD within the building sector.

5.1. Another take on UD

Across the discourses, there was an understanding of UD as being about all kinds of architectural spaces, and not just buildings for care, as previously understood [6,7]. The discourses 'Equality' and 'Giving a voice' emphasised the scale of town planning as relevant in relation to UD. In general, all the discourses were based on an awareness of human diversity while pointing out a need for more knowledge about users' needs. Furthermore, 'Social Sustainability' and 'Giving a voice' problematised the privileged position of architects who had never been marginalised. Thus, these discourses emphasised empathy and the involvement of users.

Another finding contrary to [10] was that none of the discourses equated UD with accessibility. The discourses 'It is not just about ramps' and 'Equality' distanced themselves from accessibility by pointing out differences, while the discourse 'Giving a voice' was not afraid to use the concept of accessibility and understood it in a much broader sense, encompassing both social and mental aspects.

One element that linked most of the discourses together was the sensory and material aspects of the architecture. These aspects were associated not with regulation, but with architectural quality. None of the discourses understood UD as one specific solution for everybody, or reacted to the word 'universal', as argued elsewhere [10]. Instead, they focused on the relationship between humans and architecture, acknowledging that UD can recreate a stronger connection between humans and architecture in relation to senses, scale and perception. The discourse 'Re-instatement of humans as a focal point' criticised modernistic architecture for forgetting the humans using the spaces.

The discourse 'Social Sustainability' emphasised UD as a design driver. Nearly every discourse was about the necessity of thinking of UD from the start of a project – also in order to ensure that UD would not cost more. The discourse 'It is not just about ramps' seemed to find UD too abstract for operationalisation.

UD was indeed understood as a kind of ethical guidance as the Swedish study [10] points out. Especially the discourses 'Equality' and 'Giving a voice' were clear about this aspect, but so was 'Social Sustainability', which recognised the value of LNOB. They wanted to create spaces designed to contribute to quality of life for everyone, and especially for vulnerable users.

5.2. Implications

We can speculate that the adoption of UD will advance. In general, UD was understood by the 'frontrunners' as a mindset that was interesting from an architectural point of view, regardless of scale, due to the focus on the creation of architectural and multisensory experiences. This tendency could be understood as a kind of legitimation of UD, because when it is about multisensory experiences and aesthetics, it is accepted. It could also be seen as a kind of rediscovery – indeed, Mace also focused on aesthetics [13], but this was not integrated in the definitions from 1997 [14] or 2006 [1], where the focus was primarily on usability.

In the literature, social sustainability is hardly mentioned as a framework for UD, e.g. [6]. Understanding and articulating UD as social sustainability, together with the SDGs and LNOB, is a rather modern take on UD, and may be a crucial lever for UD. Furthermore, the relation to the SDGs can be particularly beneficial, as no one is opposed to the SDGs in the Danish context.

The eagerness about operationalisation of UD that 'It is not just about ramps' represented could result in a simplification of UD, where it loses it broadness and just becomes a new version of the accessibility, we know from the Building Regulations.

The discourse of 'Equality', however, emphasised a value that everybody can relate to. This may be constructive on a strategic level in relation to different actors. As a value that can be articulated throughout the entire process [9] and combined with 'Giving a voice' to minority groups by involving users, it could create a new dynamic in the dialogue between client and architect.

The discourses demonstrate ambitions for an architecture of high quality, designed for everyone and based on empathy and an interest in users that has not been identified

before. A strength of the study is that it has given us a unique overview of the Danish UD field however a weakness is that the study only is concerned with the Danish context.

6. Conclusion

The discourse analysis of the 'frontrunners' ´answers to the questionnaire reveals five different understandings of UD. One was about mainstreaming UD into the architectural mindset and practice under the umbrella of social sustainability, thinking of UD as a design driver. The second saw UD as a revival of forgotten architectural virtues due to the focus on the human body and its scale. Operationalisation of UD was the main theme in the third discourse, pointing out that UD was not just about ramps. The fourth was about integrating UD in both the process and the solution from a perspective of equality, while the final discourse was about involving minorities in urban planning processes, giving them a voice.

Despite their differences, the discourses presume that UD accommodates all kinds of human diversity, is relevant in all scales and should be integrated into the process from the start. Another general theme is the interest in qualifying the design through knowledge about the users and their needs. With all of these committed people working to establish UD as a self-evident part of architectural design, focusing on equality and multisensory experiences for everyone, the future of UD looks bright.

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User Insights for Better and More Inclusive Online Public Services: A Survey Study

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Abstract. This work discusses how to build online public services and feedback mechanisms such that they are usable and are actually used, while fulfilling the requirements for EU's Web Accessibility Directive, security, and privacy. By means of an online survey among impaired users of the Norwegian Labour and Welfare Administration's online services, it is analyzed which challenges these users experience with public services and feedback processes as of today, and how both can be designed for better and more inclusive online services.

Keywords. Feedback, complaints, Web Accessibility Directive (WAD), human impairment, public-service design

1. Introduction

At the time of writing, the Web Accessibility Directive (WAD) is about to be introduced in European and associated countries [1], including Norway. WAD requires, among other things, a feedback mechanism, so users can report accessibility problems in online public services and request information in an accessible format if needed. Also, the service provider should respond to any user request in an appropriate manner within a reasonable period of time.

How WAD can be incorporated in an online public service is being investigated in the research and innovation project "Accessible Online Feedback", which is a cooperation between Norsk Regnesentral (Norwegian Computing Center) and Tingtun AS and carried out from 2020 to 2022 [2]. The project team has studied previous research, related solutions, and conducted a survey as described later on. In addition, several prototypes of feedback mechanisms are being developed and tested together with a wide spectrum of users with and without impairments[2]. They will eventually be released as open-source JavaScript libraries.

Several questions have guided our research: What do citizens with impairments expect from public administrations' online services? What is their user experience? What kind of barriers do exist in today's services? How can citizens in general be motivated to give feedback and write complaints when necessary? How to design a feedback

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[2] In this article we use the term impairment in accordance with the International Classification of Functioning, Disability and Health, ICF [3]. A disability occurs when there is a limitation in activity and participation due to a gap between an individual's body function, structure, or personal experiences, and the requirements from the environment [4].

mechanism such that it is easy to use, secure, and useful, while fulfilling the legal requirements, including accessibility and privacy?

The context of this work are the online services provided by the Norwegian Labour and Welfare Administration (NAV), available at *nav.no*. This website is used to deliver a wide range of public services and social benefits in Norway with regard to work and unemployment, job seeking, illness, workplace facilitation, and many more. NAV provides both the context, guidance on their needs, and financial support for this project. The project group, however, carries the sole responsibility for the scientific results.

The main contribution of this work is the discussion of findings from a survey carried out in 2021 among users of *nav.no* and similar online public services. The survey respondents give valuable answers to the above questions and provide useful suggestions for implementing WAD in online services, both public and private ones. The remaining article is outlined as follows: First related work is discussed, after which the methods used in this study are presented. After the description of findings and their discussion, the conclusion is drawn.

2. Related work

Digital feedback systems are channels where users can notify product and service providers about flaws, feature requests, personal rating, appraisal, and send other comments. There are various possibilities for giving feedback in existing systems, such as by e-mail, social media posts, comments sections on the service provider's web pages, chat, or by using contact or feedback forms. Feedback has many faces, such as ratings or comments, in standardized formats or as free text. Also, textual feedback may be enriched by images, videos, sound clips, and links [5]. A user accepting the collection of data by the service provider can also be considered as a form of feedback [6].

There is little research on the accessibility of feedback mechanisms and on mechanisms for accessibility feedback. Alarcon et al. [7] outline an implementation of a feedback mechanism to support WAD. Their suggested solution, called Public Barrier Tracker (PBT), provides a mechanism for gathering user feedback about web accessibility directly on a website. They also give an overview of other existing approaches for gathering user feedback on accessibility barriers and discuss how the PBT can be used as a tool for gathering data to support effective implementation of the WAD at large, in addition to its function for users to give feedback on a particular issue. Steur and Seiter [8] studied the design of feedback mechanisms of more than 102 popular digital platforms and discussed design choices in the light of management control literature. They found that simplicity in the provision of feedback is essential but do not mention accessibility for people with impairments.

Two digital feedback channels, namely e-mails in applications and app store reviews for reporting accessibility problems were studied in a master thesis [5]. The accessibility of selected popular Norwegian apps was evaluated. Various user feedback on accessibility problems for visually impaired users was sent to the providers of 50 different apps, 25 via e-mail and 25 via app store reviews. Only one of the problems was fixed when they retested after 30 days, although 44% of the applications had been updated during this period. Only 16% of the e-mails sent out got an answer, and it was difficult to determine whether the responses were computer-generated or written by a human. It seemed that the developers neither prioritized responding to the accessibility feedback nor correcting the reported issues. The author concluded that sending

accessibility feedback through emails or app store reviews has a minor effect only for improving the accessibility of mobile applications.

Another part of the study was to investigate what habits, preferences, and experiences people with visual impairment have when it comes to sending digital feedback to application providers [5]. The participants' experiences with reporting accessibility issues varied. Usually they got some form of response to their feedback, but most often these were simple confirmation mails for received feedback. However, some also experienced that problems were fixed after they had sent their feedback. Many participants experienced challenges with using multiple feedback channels, and as a consequence they preferred text-based feedback. Visually impaired users may feel uncomfortable sending screenshots or videos because they cannot control the content. This group of users also felt that advantages of sharing feedback publicly, e.g. on Facebook, were that others also became aware of the issue and that they could then form a pressure group to influence the application provider to fix accessibility issues.

Analyzing feedback from users can complement other methods of gathering user needs. However, when the amount of feedback is large, the unstructured nature and varying form and quality of the feedback can make it very challenging to identify patterns and useful feedback. For many websites and applications, the amount of feedback may be too large to be processed manually. Therefore, various forms of user feedback analysis have recently gained a lot of research focus [9], [10].

User feedback may contain personal data. Groen and Ochs [6] found that the likelihood of finding usernames, email addresses as well as Twitter handles in textural user feedback is very high. Personal data are typically found in both structured and unstructured form. The structured part can for example include a username in a format allowed by the platform. User data in unstructured form can often be found in the title or the body of the user feedback. According to EU's GDPR Directive, an organization that processes personal data must inform the user about the processing of personal data and about user rights. Some users have low awareness about privacy and may not know what "personal data" means. Therefore, one should include examples in an explaining section. Also, some users want to be anonymous when reporting accessibility issues, for example because they do not want to reveal something about their disability. Also, many people do not have a digital ID or access to necessary information (for instance codes or passwords) to be able to identify themselves according to the requirements of the public service. If the user choses to be notified when the issue is resolved, either the service provider needs to store their contact information and GDPR applies, or the user needs to have some form of token or case number to check the status of the reported issue.

3. Method

An online survey was carried out in Spring 2021, primarily with the context of the services provided at *nav.no*, whereas a few of the questions also pointed to public services in general. The respondents were recruited among members of the Norwegian Federation of Organizations of Disabled People (FFO) and suborganizations through news articles on these organizations' web pages, social media, e-mail, SMS and a few other channels. FFO was chosen due to the wide reach among users with impairments.

The survey's primary objective was to answer the above questions by overviewing the landscape and getting quantitative indications of problematic areas. A secondary objective was to collect individual user voices and personal experiences, which was

achieved by the use of open text fields and thematic analyses of the answers [11]. Other than that, the answers were subject to a descriptive statistical analysis [12].

It is stressed that the number (N) of answers for each question varies as the applicability of a particular question for a respondent depends on his / hers previous answers.

4. Results and discussion

Subsequently, the findings from the survey are presented and discussed.

The survey resulted in answers from 818 respondents, the majority of which (70%) have indicated one or several impairments, ranging from reduced or no vision or hearing over various degradations in movement, motor functions, and speech to various cognitive challenges, including attention and memory disorders, reading / writing difficulties, and others. More than one out of three (36%) also tick the checkboxes for chronic illness(es) such as fatigue. Despite the high occurrence of impairments among the respondents, 86% do not make use of any assistive technology (AT). Among the rest, frequently used AT are screen readers, screen magnifiers and tailor made keyboards, mouses and other control units. The vast majority (92%) of all who responded claimed to be well experienced with NAV's online services.

74% of the respondents (N=785) have experienced at least once that a task at *nav.no* was either cumbersome, difficult or could not be accomplished at all. For 21%, this happens quite / very often. The remaining 26% have not experienced any problems. Apparently, there are multiple causes for the difficulties, see **Figure 1**. For 57% of respondents (N=567, multiple answer alternatives were possible), something was difficult to understand, and 53% complained that they could not find what they were looking for. Difficulty to get help was mentioned by 42%, and a cumbersome and time-consuming service by 41%. Not being able to answer what is asked about or to provide information was marked by 26%, and repeated filling out of form data by 25%. Something not accessible, or just not working, or trouble with login were respectively checked by 21%, 16%, and 12%. The list of causes continues with the respondents' free-text answers, of which only the most important are reproduced here: A form / service may not be capable of matching one's own situation, case processing may be very rigid and require documentation which could be fetched automatically elsewhere, frequent updates of services may lead to confusion, navigation may be inconsistent and confusing, today's systems may not support the role of a helper / assistant, and NAV's staff may not know the systems well enough themselves.

These findings are in line with two other questions regarding help. Asked how often it happens that they are in need of help at *nav.no*, in total 60% (N=807) answered "sometimes" (46%) or "often" (14%), while the remaining 40% never need help. To shed light on those helping, the respondents were asked to specify, and the answers, of which multiple were possible, show that the group of helpers is quite heterogeneous: An accumulated 56% (N=475) consists of family, relatives, and friends, while a share of accumulated 77% compounds of service owner staff, such as customer service, technical support personnel, and case managers. In only as little as 2% of instances, the helper is a personal assistant. Interestingly, a considerable share of accumulated 23% contains a wide spectrum of other helpers, ranging from volunteers and library staff over employer and co-workers to a variety of professional caregivers in the health sector. Those in need for help obviously use multiple strategies and communication channels, as the sum of

answers exceeds 100% by far. The lesson learned from these answers is that NAV's public services in fact are challenging for a great share of users for a variety of reasons, and many need help to accomplish their tasks. The groups of helpers is quite varied, too, which is likely due the wide range of different services but probably also mirrors the users' high need for getting their tasks solved.

More than half (52%) of the respondents (N=771) declare to never have given feedback to NAV. In fact, 88% say that they (N=398) have never sent complaints to other providers of public services. These findings seem to be in contrast to that so many experience difficulties with public services, and it is therefore natural to ask why not more users give feedback to service providers.

To start with, those who had given feedback previously were asked what channels they had used (N=423). No particular channel can be pointed out as users' favorite; however, the majority of respondents say to have used multiple channels, including digital forms, phone, chat, e-mail, and physical meetings. Social media appear to play a subordinate role only. From research regarding contact of hearing-impaired individuals with public entities [13], it is known that many prefer text-based channels, and a great share also prefers to have multiple communication methods to choose from, depending on the context. The same also seems to apply here, given that no feedback channel got particularly many marks.

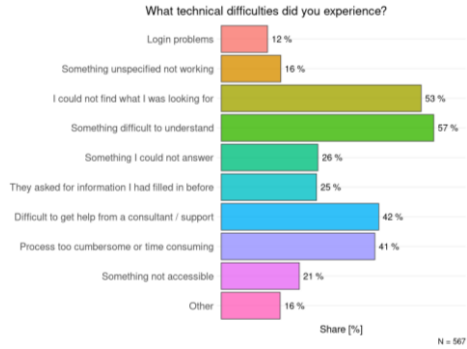

Figure 1: Bar plot detailing the distribution of answers for the question regarding the users' experienced difficulties in online public services

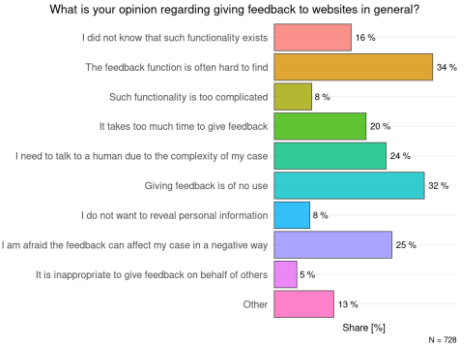

Figure 2: Bar plot detailing the distribution of answers for the question regarding the users' opinion on giving feedback

Next, the respondents' (N=409) personal experiences with giving feedback was collected. Among the pre-selection of answer alternatives, which allowed multiple answers, 38% put a mark at "I got a confirmation for my message, nothing more", while 29% said that they did not even get a confirmation. Another 29% checked the option "I would have liked to follow up my message", and 24% stated they got help. Only 8% got the opportunity to follow the feedback process further, while 13% reported that their issue either was solved or being addressed. The sentiments from the free-text "Other" category are combined with the answers to the survey's last question described further below.

The respondents (N=728) were then asked about their opinions regarding the process of giving feedback to online-service providers. Here, they could choose multiple alternatives from a pre-selected list and write down their own thoughts. See Figure 2. In the order of decreasing occurrence, 34% stated that such functionality is difficult to find, 32% think that giving feedback is of no use, 25% are afraid that their feedback could fire back on their case, 24% believe their situation is too complex to be explained in written form, 20% think that this process takes too much time, and 16% did not know that such functionality exists. 8% would not use it for privacy reasons. The sentiments from the free-text "Other" category are combined with the answers to the next question.

The survey's final question asked the respondents (N=509) with a free-text field about their wishes and preferences for a feedback function. A number of respondents also wrote about challenges with online public services and situations to avoid. Table 1 summarizes the categories and topics from the thematic analysis of challenges, which are combined with the sentiments from the above question regarding personal experiences.

Table 1. Categories and topics regarding users' suggestions of which aspects of a feedback mechanism should be avoided

Category	Topics
Organization	Poorly organized / non-flexible / confusing / cumbersome processes; much bureaucracy; difficulty to find things
Professionality	Dissatisfaction with an entity's communication and customer service; high latency; poor knowledge at service provider / customer contact point
Function & design	Low usability / user experience; non-universally designed systems; inaccessibility; obvious (reoccurring) flaws in technical solution
Communication	Difficulty to understand matters; unclear / ambiguous information

The respondents also listed a number of consequences these difficulties have for them. Among the most severe are citizen rights loss and financial loss, while a number of effects for the respondents' mental state is less visible: dissatisfaction, despair, frustration, irritation, anger, fear, burden, and "conflicts that impact the entire body". Previous research has shown that so-called prevention goals, that is, strategies to avoid negative emotions, are considered to be more important than promotion goals, which are strategies that promote positive emotions [14], [15]. It should hence be a high-priority goal to avoid the above difficulties in any online service. As public services usually are without competition, in contrast to private services, the need for prevention goals should be even higher in the public sector.

The respondents' sentiments further contained a number of preferences and suggestions for how to develop public services and a feedback mechanism. Table 2 summarizes the categories and topics from the thematic analysis of suggestions, which

are combined with the sentiments from the above question regarding opinions for a feedback mechanism.

Table 2. Categories and topics regarding users' expectation towards a feedback mechanism

Category	Topics
Function, design & communication	Simple; easy and fast to use; flexible; unbureaucratic; consistent; lasting (not shifting); usable / positive user experience; more effective than other strategies; universally designed; accessible; supporting AT; comprehensive
Access, organization & navigation	Easy to find; easy to access; relevant; clear; text-based; integrating oral communication; easy to get guidance and help / human contact; supporting helpers; supporting appraisal; supporting feedback about case and service; easy to navigate
Professionality	Professional, transparent, informative, and personalized process; confirming submissions; responding quickly, correctly, and effectively; driving the process proactively with a reasonable deadline; service-oriented; explaining the process; informing about rights; taking responsibility; informing about decisions, if any, and termination; having a competent staff; enabling easy contact with a superior; coordinating effectively with other administration
Usefulness	Useful; promoting feedback; welcoming new submissions; communicating the value of new submissions for the user, other users, and the service provider; communicating and showing evidence for the initiation of change
Security, privacy, trust, safety & humanity	Secure; privacy-aware; anonymous; non-traceable; trustworthy; safe; legally secure; non-intimidating; neutral; taking feedback seriously; meeting users with attention, respect, and empathy; not insinuating a bad user attitude

While the categories in both tables are quite similar, the latter table contains two additional categories. One is related to the usefulness of a feedback mechanism, and the suggestions here can be treated as enhancing user motivation to give feedback. The other addresses basic user needs related to trust, safety, and similar. On one hand, the user suggestions overlap with the formal requirements regarding privacy, security, etc. On the other hand, they extend the list of basic needs with ethical aspects such as safety and humanity, which obviously are of great importance to the user not only for the design of a feedback mechanism, but also during production / operation. The other categories deal with what features a feedback mechanism should support (organization), how they should be implemented (function / design), and administrative aspects (professionality).

In the following, the aforementioned findings are generalized to the group of impaired users of online public services in Norway. Many individuals in that group need to make use of the services provided by NAV for claiming their legal rights, job seeking, workplace facilitation, ordering AT, and others. At the same time, particularly this group experiences a variety of issues with online public services in general and NAV specifically. Despite the fact that the majority of these users due to their difficulties at least sometimes needs help to accomplish their tasks, only a few actually report back on their issues due to a variety of reasons. The wide range of aspects to avoid and expectations towards a feedback mechanism shows nevertheless that the users of online public services have a clear vision of how such functionality should be designed and operated.

5. Conclusion

In this work, the findings from a 2021 online survey among NAV's users with impairments were presented and discussed. The survey's focus was on the quality of

online public services and the process of giving feedback to service providers. From a user perspective, a feedback mechanism is most likely viewed as an integral part of an online service.

Even though a great share of respondents experiences various difficulties, only a minority actually gives feedback regarding these difficulties to the service provider. The analysis of survey answers has identified problems and barriers that exist as of today, and it has given valuable guidance regarding how a feedback mechanism (and basically any online public service) should be designed such that negative emotions are avoided and positive emotions are promoted at the user's side. Hereby, this work hopefully contributes to better public administrative services in the future, and feedback mechanisms which are accessible, usable, and motivate users of online public services to send their feedback to the service providers.

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Methodologies for the Design of University Teaching Spaces in Covid/19 Regime. A BIM Oriented Approach, Defined for the Case Study of the Buildings of the Department of Architecture of the University of Florence (DiDA)

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Abstract. The research, carried out at the University of Florence, investigated the tools and methodologies needed to manage the setting up of educational environments in a dynamic-emergency regime. It tested the interoperability of the digital tools deemed necessary for an integrated management of space management activities. And defining a methodology for setting up the spaces assisted by the use of digital systems capable of automating the design activities

Keywords. Safe accessibility; School building; COVID-19; Space management; BIM-Interoperability.

1. Introduction

As a result of the Covid-19 pandemic event, the need has emerged to redefine the rules concerning the management of the use of spaces in relation to the types of users, the types of activities and the environmental features of both buildings and spaces of social interaction. From this point of view, the pandemic revealed the need to manage the design of the use and arrangement of spaces and equipment with performance assessment methods which take into account different time requirements, modes and types of users. Identifying new quality solutions related to the relationship between man and environment, in accordance with the rules and dynamics dictated by the succession of emergency phases. In this new scenario, which is still changing and therefore difficult to predict, the buildings belonging to the world of schooling and education in general have been affected by wide-ranging spatial transformation activities involving access methods, the use of spaces and equipment, as well as the forms of communication and interaction between users. The planning paradigms used for educational spaces in the past, which were mainly driven by issues concerning density and costs, had necessarily to be

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modified according to new performance criteria, based on dynamic regulatory-dimensional references. Topics such as flexibility of use, adaptability, safety, control of user flows, or information management, which have always been references of Design for All, have brought about, mostly unintentionally, a widespread interest that has often generated confusing design solutions. In fact, the dynamic condition of the rules regarding the use of spaces and equipment has produced a series of obvious critical issues in the management of emergency phases. Issues which are also exacerbated by a substantial absence of support tools devised for dealing with the existing variables and therefore useful in assisting the operational choices of designers/managers. The research, carried out at the Department of Architecture of the University of Florence (DIDA), inquired into the tools and methodologies necessary to determine a compositional module of reference for the design of educational spaces in a dynamic-emergency regime. The methodology was tested using the building of Santa Marta, main headquarters of DIDA, as case study, and assessing the interoperability of the digital tools considered as necessary for an integrated organisation of space management activities.

2. Methodological framework and phases of the research

At the conclusion of the lockdown phase, with the gradual reopening of the university's premises under a contingency regime, both the issues of access control and of space design have necessarily undergone a general rethinking in terms of the organisation and distribution of environments. The first design responses, which regard issues specifically related to distancing, provided indications of a general nature based primarily on compliance with the ratios between the numbers of students and the square metres of classroom, the practices to be applied in the classroom regarding air changes, as well as indications concerning learning modes, which have mostly been held in blended format. In particular, the issue of the ratio between students and available square metres was the subject of indications which essentially omitted variables such as the spatial conformation of the classrooms and their articulation regarding the flow of users, learning modes, air change methods, and the types of furniture and equipment present in each school complex. In this context, the research process which was developed during the initial stages of the pandemic, was divided into 3 main phases and was aimed to provide initial answers, including those of a methodological nature, in order to optimise the set-up and management of educational activities. The first phase focused on the verification of the square metres/students ratio, in compliance with distancing parameters, introducing variables such as space distribution and types of equipment, which resulted in the development of a compositional module that allows customising and optimising the set-up of classrooms while respecting the distancing parameters. The second phase concerned the assessment of the digital tools necessary for managing the space set-up process, reducing and optimising the required time-frame for providing the compositional layouts for every complex, while also determining the framework of the software programmes to be used and their degree of interoperability, in order to establish an information flow which would, in real time, prepare the articulation of classrooms and their access methods. The third phase regarded the possible developments of digital process management, indicating the potential use of data within the systems related to the booking, access and use of spaces by students.

3. Definition of the compositional module

The first research activity analysed the possible classroom set-ups in relation to the maximum number of students allowed to attend lessons in presence, in compliance with the distancing parameters indicated in the national references established by the Technical Scientific Committee (CTS), as well as with the directives of the University of Florence. To this end, regular square mesh grids with the side equal to the diameter, measured according to the allowable distance between the labial commissures (in other words from mouth to mouth) of the students, were superimposed onto the average standard classroom. The analysis of the square mesh grid highlighted the redundancy of unused spaces and the limited elasticity of the module, especially when distribution corridors, entrance-exit systems, and safety routes were introduced.

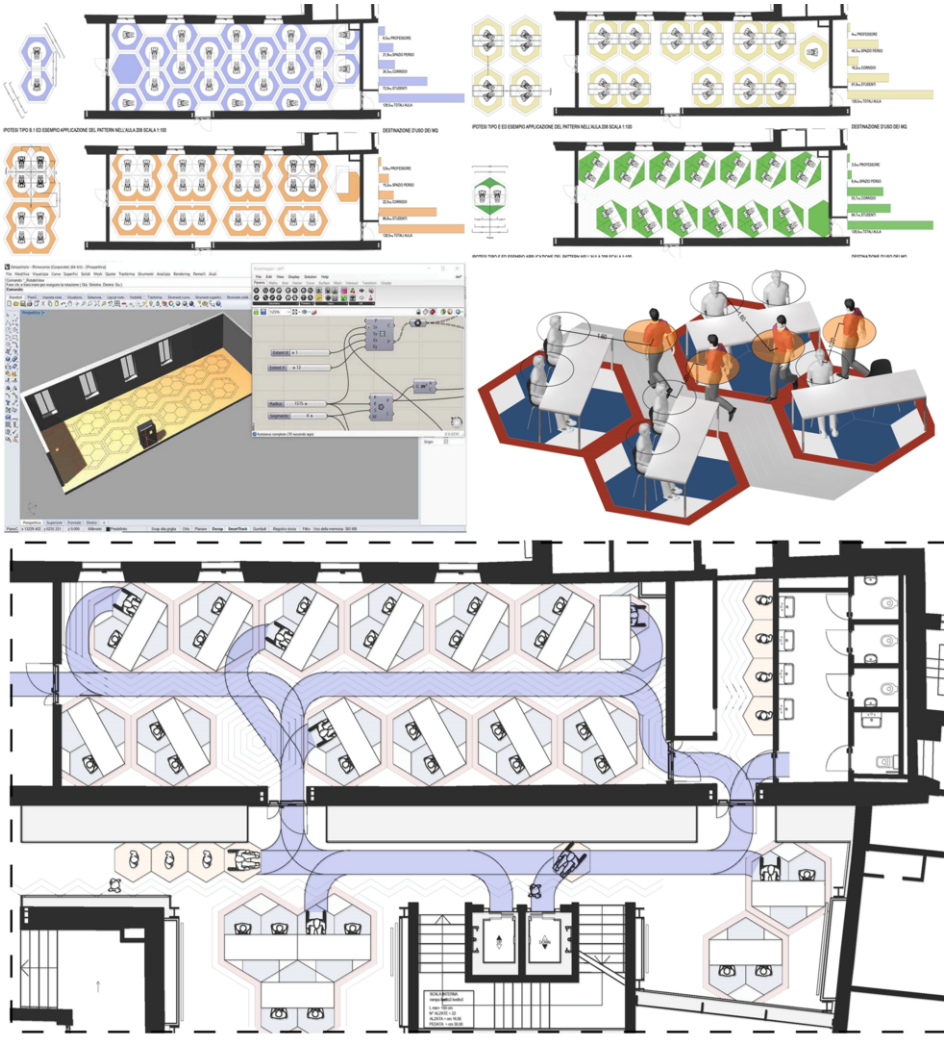

Figure 1. Design stages of the hexagonal base module.

A notable decrease of unused spaces, both regarding the composition of the students' workspaces and the possible usable articulations based on the different geometric conformations of the classrooms, was obtained by applying the same dimensional parameters regarding the distance between students, yet setting the relevant circles on a hexagonal tessellation. It is on the basis of this pattern of reference that the variables relating to the types of furniture present have been inserted, as well as those regarding teaching methodologies, or rather the possible safe interaction between teachers and students. The purpose of this is to reduce as much as possible the need to purchase new equipment and to ensure the continuation of laboratory educational activities. The proposed solution is articulated into three central hexagons which determine the individual workspaces of the students (with an apothem of 0.6 metres), included within a macro-hexagon (with an apothem of 1.40 metres) that sets the perimeter of every study-group, thus ensuring a social distancing equal to 1 metre-radius both in the interaction between students and teachers and in the flows along the distribution corridors (in the 2D domain, as demonstrated by J.L. Lagrange, the highest-density reticular arrangement of circles is the hexagonal arrangement). This macro-hexagon can accommodate all the variables of furniture present in the Department's classrooms and permits, in addition to the traditional frontal configuration, an inclined set-up of the students' placements (with a 30° degree of inclination), which improves visual performance and favours visibility of the teacher's location.

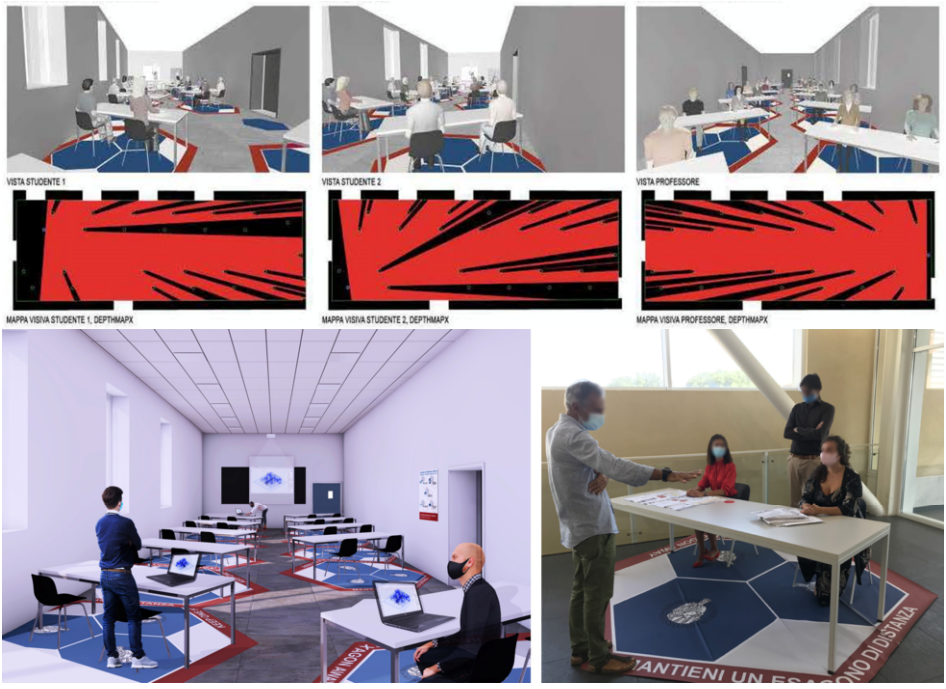

Figure 2. Checking interior: student-teacher visual angles ; usability: movement spaces.

4. Application to the Santa Teresa premises

As mentioned earlier, the solution was tested on the building of Santa Teresa, headquarters of DIDA. The building, which houses both educational and administrative functions, is articulated into two main blocks. The first is a historical building that originally accommodated ecclesiastical functions and which currently includes the offices of the Head of the Department, as well as some classrooms and laboratories. The second block is of recent construction and includes the main entrance and is primarily devoted to educational functions. Before the Covid pandemic the complex received an average of 1500 students per day, in addition to 50 other persons among teachers and administrative staff. In applying the different compositional modules to the teaching spaces involved in the case study, it was determined that by using the hexagonal-based module, a 15% increase of the available workspaces was obtained in comparison to the square-based module. This increase derives both from the optimisation of student spaces, and from the greater flexibility in the management of entry-exit paths set up in compliance with safety regulations. Furthermore, the possibility of using the module for the management of distribution corridors inside the building was tested in the context of the case study.

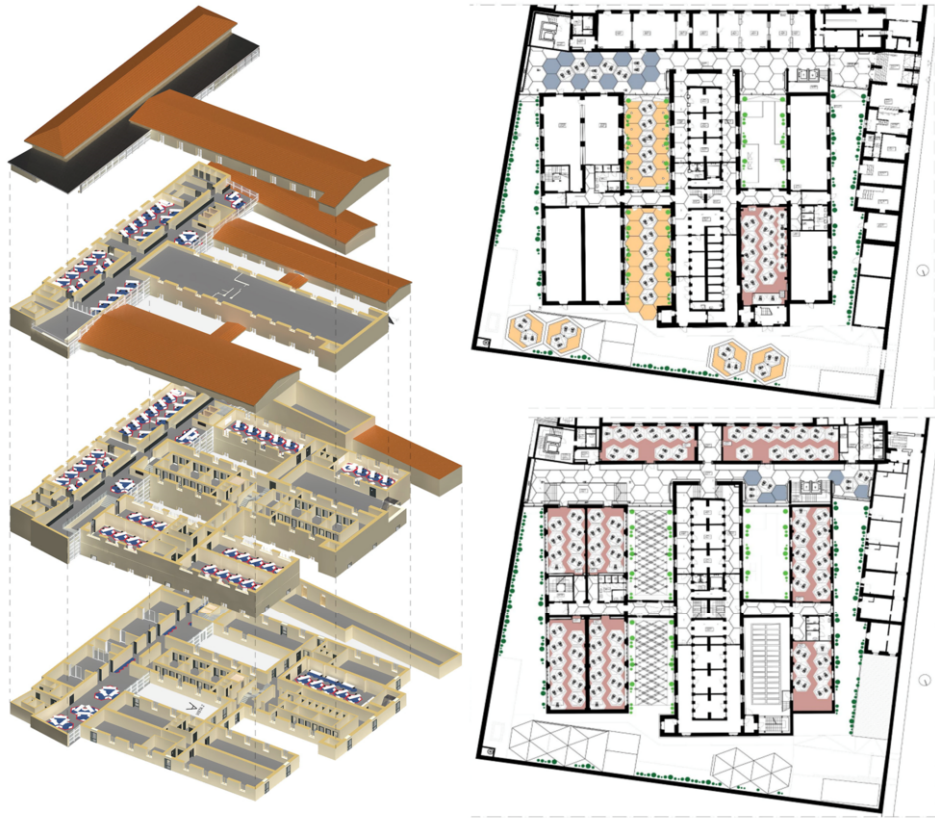

Figure 3. Setting up classrooms in the Santa Teresa complex. Modelling in a BIM environment.

In particular, a management plan for the flows involving both general connecting and service paths was determined through the analysis of the access points to the building, assuming staggered entry times, calculated on the average usage speed (about 0.8 m/s) and taking into account both the time needed to cover the distances and that which is necessary to carry out sanitation, identification and temperature measuring activities. In order to facilitate the management of paths and to indicate the proper use of spaces, a wayfinding project was developed proposing once again the hexagonal module as a design reference, with floor signage to be used both in the case of junctions (crossings) of the connective paths and in the setting-up of classrooms.

5. Determination of digital support systems for the management of the project and software interoperability

With the aim of systematising the proposed procedure and to render it applicable to all contexts of the University of Florence, the following phase of the research involved the development of specific digital plug-ins capable of preparing, in Building Information Modeling, or BIM-ORIENTED environments, the design of the spaces while taking into account the typological-dimensional variables of the classrooms, the parameters relating to flexible distancing measures, the types of furniture and equipment and the different varieties of teaching – training modes. The decision to rely on BIM-ORIENTED systems was taken following the analysis of the digital environment used at the technical offices of the university. In particular, the technical department manages the complex through two-dimensional digital bases linked to a management system of the buildings which in turn is part of a Computer Aided Facility Management (CAFM) system. Beginning from the recent regulatory references regarding the digital management of design processes in public spaces, the first objective was to establish an information flow that would ensure the interoperability of data on open formats.

In other words, on formats capable of ensuring the processes of collection, storage, production and updating of information so as to facilitate Space Management activities. From an operational point of view, a series of BIM models of the Santa Teresa complex were produced. These models, modeled using both Revit and Archicad software, were developed beginning from two-dimensional bases and importing the information contents regarding the destination of use and the features of the installations managed through the previously mentioned CAFM systems used by the university (Infocad). The choice of using Revit and Archicad as modeling software falls both into their methodology of using interoperable formats as specified bt Building-Smart-International (bSI-IFC), and their methods of allocating information with respect to environmental management tools (rooms and zones). Through (2x3) open formats based on International Foundation Class (IFC), the models were exported onto a geometric modeling software capable of interoperating with a parametric programming plug-in necessary for the management of the previously described tessellation project (Rhinoceros + Grasshopper). The programming module made it possible to determine the algorithm that manages the production of the layouts related to the space arrangement solutions, using the hexagonal module and defining the solutions based on the variables considered, such as the positions of the doors or windows, or the dimensions of the furniture and equipment. In summary, we have programmed the rules of the composition based on the interpretation of information content specifically identified in the

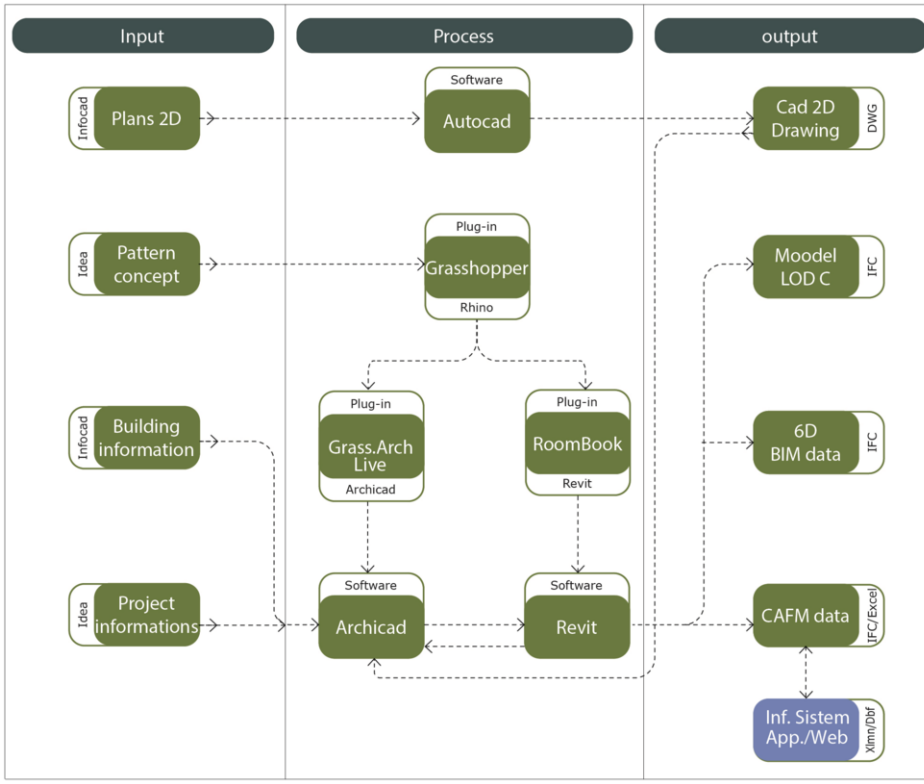

Figure 4. Information flowchart.

programming semantics of the BIM models. The possibility of managing the dimensional parameters of the compositional pattern through a programmable control allows for an agile updating of the layout, and therefore also facilitates the dynamic stages concerning the arrangement of spaces as dictated by the evolution of the emergency phases. The information concerning the layouts can be exported for subsequent processing and integration with other software programmes specifically designed for particular project-simulation activities, such as those relating to the management of installation systems or simulations of air changes, to mention some which are related to specific issues of the pandemic emergency. The information flow represents, in its articulation, a high level of complexity. The need to *surf* between different digital domains, in order to refine the information content of the model, denotes a management complexity that derives both from the characteristics of the software and from the need to adapt and allocate data in open domains. But it is also a demonstration of the potential of digital information management.

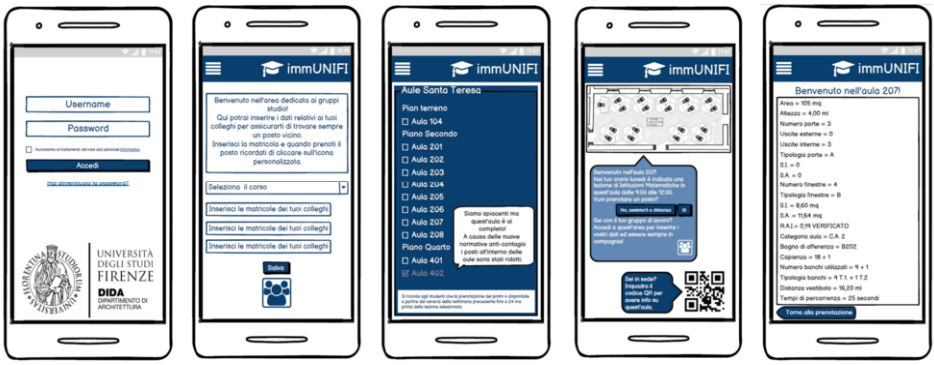

Figure 5. Design of an App. for reserving classrooms. Booking interface with user group verification

In order to demonstrate the potential of digital process management, at the conclusion of the research, and only in the form of a feasibility analysis, a space reservation system was designed for students which involves the identification of individual study stations. Digital tessellation permits identifying every single study station, relating it to a classroom and associating it to a unique identifier code. The information can be exported onto the CAFM database used by the university, and then published in specific existing web platforms accessible from any PC or smart device. The published data can be linked to a student space reservation system. Alternatively, the information can be managed by specific Apps which use and interact with space management software programmes, not only ensuring a proper method for the booking and occupation of spaces, but also tracking their use by students and teachers.

6. Conclusion

The experience described here has allowed us to identify a design path which, beyond the proposed compositional solution, identifies an operational procedure. A procedure that makes use of a methodology which correlates the functionalities of the software programmes in an information flow that is based on open formats, therefore available, adaptable and modifiable on different containers (buildings). The contribution aims to identify some of the potentialities of the digital management of built assets, which today has become increasingly important, also in terms of the dynamics regarding flexibility in the usage of spaces as related to transformations in the ways of using the said spaces. These dynamics must take into account the potentialities of the spaces so as to optimise decision-making processes. The experience, although limited and defined with open source digital applications or with licenses devoted exclusively to educational and research activities, can serve as the basis for the programming of specific plug-ins to be integrated with the main commercial software programmes, with the purpose of spreading the use of BIM-CAFM integrated systems also in the maintenance phases (6d), as specifically indicated in the recent calls for projects funded by the National Recovery and Resilience Plan (PNRR).

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Understanding the Quality of Life of Indian Elderly During COVID-19 Pandemic from Universal Design Perspective

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Abstract. India is rapidly growing towards a demographic future where a significant proportion of the population is over 60 years and above. In the COVID-19 pandemic, the restrictions imposed to minimize the virus transmission have a detrimental effect on the Quality of Life (QoL) of the elderly, limiting their mobility and social interaction. As a result, social isolation and loneliness have become significant health issues. This study attempts to understand the QoL of Indian elderly during COVID-19 pandemic from universal design (UD) perspective. The objectives were: (a) Discuss the QoL of Indian elderly during COVID-19; (b) Identify the factors affecting QoL of elderly during pandemic; (c) Find the link between factors associated with QoL and UD philosophy. These objectives were achieved by desk-based literature review and a pilot study of Solanipuram, a typical urban neighborhood in Roorkee located in Northern India. Personal in-depth interview sessions with limited number of (n=20) participants aged 60 years and above; belonging to upper-middle income group, are conducted and analyzed using the inductive thematic technique. The previous research suggests that, to date, QoL has been described as well-being resulting from physical, functional, emotional, social, and environmental factors. Whereas, UD allows for the inclusion of the 'cultural' dimension into the discussions. Especially in a country with diversity like India, where elderly discusses the impact of physical distancing, limited mobility, and social interactions on their QoL during COVID-19. This study indicates that the application of UD philosophy in response to pandemic can promote well-being and enhance the QoL of elderly.

Keywords. Quality of Life (QoL), Elderly, Universal Design (UD), COVID-19, India

1. Introduction

The World Health Organization (WHO) declared COVID-19 an epidemic, and since then, people aged 60 and above, including those with comorbidities, have been at a higher risk of mortality from this pandemic disease [1, 2]. As a result, similar to many countries, India imposed rapid restrictions of physical distancing, border restrictions, recommendations to stay at home, avoid contact with others and unnecessary travels to mitigate the spread and impact of disease [3].

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2. Impact of COVID-19 on QoL of Elderly: *An Indian Scenario*

The economic ramifications of physical distancing due to COVID-19 are well known, but the cultural implications are largely unexplored [4]. Therefore, it is necessary to have an insight into the perspective of Indian elderly on QoL. The first objective was achieved by understanding the impact of COVID-19 pandemic on QoL of elderly in Indian context.

Elderly have a higher risk of contracting COVID-19, due to which remaining active, and healthy can be challenging for them. This can complicate their situation and increase their dependence on others, including family members, health providers and care givers [5]. Physical distancing, limited mobility and social interaction will likely affect the independence and QoL of elderly by intensifying their physical and social isolation [6, 7]. Moreover, due to this pandemic, isolation and loneliness from social distancing have restricted their mobility and socialization with friends and neighborhoods [8]. The increased loneliness due to COVID-19 restrictions may impact social networks and social contacts [9]. These changes has a significant psychological impact on the elderly, affecting their well-being and QoL [10]. The WHO defines QoL as an individual's perception of their position in life in relation to their goals, expectations, standards, and concerns, as well as the culture and value systems in which they live. The concept of QoL includes physical, psychological, social and environmental domains [11]. In countries that imposed strict lockdowns and other restrictive measures during the pandemic, QoL has decreased significantly from pre-pandemic levels [12].

In India, family has remained the fundamental organizing unit for economic support, physical care, and social security. However, as families transform, intergenerational relationships and the role of women in the family have changed significantly, affecting elderly care and welfare [13]. Furthermore, their socio-economic conditions have changed, necessitating changes in their living arrangements. People prefer to live in their independent homes as a result of cultural shifts toward individualistic lifestyles, resulted in the increase of one-person households in India. There is a growing trend of living alone or with a spouse only which is becoming more common in India [14].

According to a survey conducted by Help Age India, approximately 6 percent of the elderly live alone, while 10-20 percent of the elderly suffer from loneliness [15]. In India, the older population is more vulnerable since the pandemic has exacerbated the psychological and behavioral health. As a result, the problem intensifies in terms of social isolation and loneliness [7]. Although previous studies have explored on contributing factors to QoL, the COVID-19 pandemic presents a unique context in which new associations may emerge.

India has a unique and diverse social fabric, which distinguish it from other countries in terms of culture and tradition [16]. Therefore, UD principles in Indian context were developed, focusing on Indianness, inclusivity and social differences related to culture, age, gender and disability. These principles are now part of revised “Harmonised Guidelines & Standards for Universal Accessibility in India, 2021” (MoHUA, Government of India). It aims to create inclusive environments for all, including elderly, through universal design approach [17].

3. Research Methodology

3.1. Study Context

The second objective was achieved by conducting a pilot study of Solanipuram, a typical urban neighborhood in Roorkee, a Tier III city in the northern state of Uttarakhand, India. The total area of Roorkee is 1066.83 sq.km. with a population density of 934 per square kilometer, and total population of 9,96,344 persons[18]. The study area is located in "Solanipuram", a typical urban neighborhood of Roorkee. The housing typology can be categorized as single-detached, low-rise structures (G+1). Besides residential plots, the neighborhood also comprises distinct infrastructure and service typology. (Figure 1) shows the location map of participants in the study area of Solanipuram, Roorkee.

Figure 1. Location map of study area, Solanipuram, Roorkee

3.2. Participants

Participants were selected using a purposive snowball sampling approach. Individual interviews with participants (n=20, ≥ 60 years) living independently in a residential setting were conducted. The exclusion criterion was elderly with any underlying severe medical conditions and those in need of assistance with daily living activities.

Participants were between 60 and 85 years (mean = 70.45 years) and predominantly female (55%). Participants belonged to upper-middle-income socio-economic group, fluent in Hindi or English. However, the group composition was kept culturally homogenous. Table 1 is the demographic characteristics of the elderly participants.

3.3. Data Collection

The study was conducted using a qualitative survey methodology. In-depth interviews were conducted to explore the factors affecting QoL of elderly during pandemic. Participants were informed of the audio recording and assured of anonymity and confidentiality. Verbal consent was obtained before the commencement of the interviews. Each interview was completed in the individual's home environment, lasting 45-60 minutes, and was audio recorded using a phone recorder and transcribed verbatim. A predetermined list of broad, research-driven questions was developed based on insights gained from a literature review. Each interview started with an explanation of purpose of the study, followed by open-ended questions based on the impact of ageing

on their lives, their views on QoL, the impact of COVID-19 on QoL, and their neighborhood experiences. At the end of the discussion, participants were encouraged to include additional information.

Table 1. Demographic characteristics of the elderly participants (n=20)

Characteristics	Number (n)	Frequency (%)
Age (years)		
60-64	02	10
65-74	13	65
75-84	05	25
Gender		
Male	09	45
Female	11	55
Marital Status		
Married	16	80
Widow/Widower	04	20
Education		
Graduate	07	35
Post graduate and above	13	65
Occupation		
Retired	13	65
Home-maker	07	35
Type of Family		
Joint	04	20
Nuclear	16	80

3.4. Data Analysis and Interpretation

The analysis of data generated five codes: limited mobility, fear and anxiety, physical distancing, social interaction, and neighborhoods. These codes are categorized into four factors: physical, psychological, social, and environmental.

Inductive thematic technique was used to analyse the data. Transcripts were coded in NVivo 12 to generate individual categories called “nodes/responses”. Data saturation was attained, whereby no new codes were presented upon reviewing new comments.

4. Results and Discussion

The key data point extracted from the interviews in the form of direct evidence, such as quotes and responses. The evidence from the data is moved, grouped and sorted into various codes. These codes are categorized into factors affecting QoL of elderly during COVID-19 as: physical, psychological, social and environmental factors. The key findings are discussed individually in following section. Table 2 summarizes the codes and categories generated from thematic content analysis using NVivo 12 software.

4.1. Limited Mobility

Maintaining independent mobility is key to active aging [19]. Previous study has linked a decline in elderly mobility to a decrease in participation in activities that allow them to interact with their community and society, affecting their QoL [20]. Mobility has also been identified as a well-being facilitator among the elderly [21].

Table 2. Summarization of the findings from Thematic Content Analysis using NVivo 12

Theme	**Factors affecting QoL of elderly during COVID-19**				
Factors	**Physical**	**Psychological**	**Social**		**Environmental**
Codes	**Limits Mobility**	**Fear and Anxiety**	**Physical Distancing**	**Social Interaction**	**Neighborhoods**
Interview Extracts/ Responses	Change in physical activity routine	Fear of getting infected with COVID-19	Inability to meet family, and friends	Inability to interact with people	Safety and security due to familiarity
	Lack of independence	Fear of being more vulnerable	Socially isolated due to physical distancing	Inability to attend social gathering	Attachment to the place due to known neighborhood
	Affects physical and mental health	Concern about family members	Inability to meet and greet physically	Lack of Social support due to decrease in interaction	Sense of belonging due to connection with people and place
	Restricted movement outside home environment	Lack of appropriate information	Feeling of loneliness and depression		Familiarity with the place

"Since COVID-19, there is a fear in us. What if something happens? I don't feel like going out and meet anybody. And people don't visit now, may be due to the fear of contracting the virus. All this has not only affected my physical health but also impacted me psychologically." (72-year old, retired male, living in nuclear family)

"Earlier I was very active and independent. Going out for a walk or for grocery shopping in the evening was my daily routine. Since I am not a mobile person, I prefer to walk most days except for days when I take battery rickshaw. But everything changed since pandemic. Now, I avoid going out alone. I can't walk much. These restrictions and isolation from the outer world affected my level of independence a lot." (67-year old, retired female, living in nuclear family)

Majority of the elderly (72%) reported that home confinement and lockdown restrictions had a significant impact on their physical activities. Elderly gradually lost interest in interacting with their friends and neighbors (60%), affecting their mental well-being.

4.2. Fear and Anxiety

Majority of the elderly (92%) reported a sense of fear and anxiety due to COVID-19. The situation got worse due to lack of appropriate information about the preventive measures from this disease. There was a fear of getting infected and concern about their family members.

"I was shattered after losing my husband to COVID-19. Since then, I had a constant fear of getting infected which created so much anxiety and stress in me that even a minor cold or cough seems like COVID-19 to me." (70-year old female, living in nuclear family)

Majority of the elderly (89%) expressed 'uncertainty' about the current pandemic situation, which has added anxiety and mental stress. As a result, one of the elderly (76-

year old, retired male) stated that they miss their lives prior to COVID, and that the incorrect and incomplete information on social media had only increased our fear as the most vulnerable group in society.

4.3. Physical Distancing and Social Interaction

COVID-19 has impacted not only the economic but also the cultural aspects, which are mostly unknown. As a result, the psychological well-being and quality of life of elderly are affected [22].

> *"Before COVID-19, I had a fixed routine of morning and evening walk with my peer group. But now I am only confined to my home."* (61-year old female, living in nuclear family)
> *"I used to do all my work by myself like banking, grocery shopping, medical requirements, if any, until pandemic. But now, my family don't allow me to move out of the house for any work. If I need anything, I should let them know but restrict myself from going anywhere due to my age and vulnerability to the COVID-19."* (74-year old, retired male, living in joint family)
> *"Both of my sons are settled in the United States. It was a ritual to get together twice or three times a year. Being a doctor, my life was going as a routine, and the situation was relatively better than it is now. But this is the first time since pandemic, I could sense the desperation and anxiety of being away from them. We connect via WhatsApp and video calls, but I want to be with them, near them. I have never missed them more than I do right now."* (75-year old, retired female, living in nuclear family)

Various codes such as inability to meet friends, family, and neighborhoods (75%), social isolation (80%), inability to meet and greet physically (55%), inability to attend social gathering (90%), feeling of loneliness and depression (60%) depicted the implications of physical distancing, as expressed by the elderly.

4.4. Neighborhoods

COVID-19 pandemic has significantly changed neighborhood environments and the way elderly age in place. It was found that some elderly (25%) reported less social interaction with their neighbors, while others (75%) reported more. Majority of the elderly (80%) experienced social and mental support, and concern for well-being from their neighbors.

> *"We live in a neighborhood where most of us belong to the same socio-economic background. During COVID-19, neighbors keep an eye on the people like us; of our age, especially those who are medically vulnerable."* (68-year old, retired male, living in nuclear family)
> *"Due to COVID-19, I am confined to my home and therefore depend on my family to meet my basic needs, such as purchasing medications and groceries, etc. I am not allowed to go for a walk or meet my friends or neighbors. Nor anybody is allowed to visit me. Though I am in contact with them via phone calls, and text messaging, but there is no emotional attachment. And this feeling creates a lot of mental distress."* (69-year old female, living in joint family)

5. Conclusion

The third objective is accomplished by utilizing the UD philosophy to the findings of the second objective. Table 3 establishes link between factors associated with QoL of elderly and UD principles through design strategies.

Table 3. Relation between Factors associated with QoL and UD principles through Design Strategies

S.No.	Factors associated with QoL	Principles of UD	Design Strategies
1.	**Physical factors –** *Limited Mobility* Restricted movement; change in physical activity routine; affects physical and mental health; impact well-being and independence.	**(1, 2, and 7)** *Equitable Use* *Flexibility in Use* *Size and Space for Approach and Use*	Spaces can be re-arranged and modified to accommodate the change in daily activities; change in layouts and functionality of interior spaces can create walking areas; an unobstructed view of outside.
2.	**Psychological factors –** *Fear and Anxiety* Misinformation or lack of appropriate information; fear of getting infected with COVID-19; increasing concern for family members.	**(5 and 6)** *Tolerance for Error* *Low Physical Effort*	Designating separate entrances to encourage physical separation of visitors and family members; designate the signage's or symbols related to exit, entry, pickup and drop items outside the home environment to limit the error of visitors and family.
3.	**Social factors –** *Physical Distancing & Social Interaction* Inability to meet and greet family and friends; decreased interactions; and inability to attend social gathering; feeling of loneliness and depression.	**(1, 2, and 7)** *Equitable Use* *Flexibility in Use* *Size and Space for Approach and Use*	Changing the layout and functioning of the spaces ensure safer meeting place;; reduce furnishings provide more space to create interactive areas; re-arranging and accommodating the existing space making it adaptable to specific needs of elderly.
4.	**Environmental factors –** *Neighborhoods* Familiarity and connection with people and place; safe and secure environment; attachment to the place; sense of belonging.	**(3 and 4)** *Simple and Intuitive Use* *Perceptible Information*	Making navigation through the public spaces more easy, allow the use of public spaces more efficiently.

The study revealed that implementing UD strategies within home environment and in public spaces, may reduce the isolation and enhance QoL of elderly. Small open sitting areas with restricted capacity can help elderly to physically connect with their friends, family, visitors and neighbors in order to maintain their social and emotional well-being. Also, the layout and functionality of spaces can be re-arranged and modified to accommodate specific needs of Indian elderly thus reflecting equitable use. So, to accommodate the change in their physical activities requires both flexibility for use and size and space for approach and use.

Thus, UD is a promising philosophy that requires attention from architects, planners, designers, and decision-makers. The issues faced by Indian elderly during the pandemic can be resolved by implementing UD principles at architectural and spatial levels. Even though the daily activities of elderly were affected in both private and public settings, there are still spaces where interaction occurs, such as marketplaces, streets, courtyards, and areas outside of homes. As a result, future research is necessary to make physical environment safer and more accessible for the elderly in view of this and foreseeable crisis.

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Public Space Accessibility in Vulnerable Areas in Post-Covid Times

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Abstract. Public space has become a relevant factor for cities since it increases people's quality of life. These areas help reduce physical and mental problems that may arise in society, and in addition, they increase the sense of community and improve the development that children may have. The Covid-19 virus and confinement made this type of space necessary. Although public spaces are taken more into account in the city, they do not take place on the edges of the urban area, as is the case in the community of Paso del Norte in the city of Chihuahua in Mexico. The community has two spaces that can be considered recreation areas, but the reality is that they do not have adequate infrastructure to make them safe and formal places. These make us wonder what the people of this community do in their free time, how they use these public spaces, and how they have evolved over the years. So people in the community were surveyed to solve such unknowns, revealing that these spaces have changed in the last two decades. Especially with the arrival of the Covid-19 pandemic. These green areas added value to the areas where they are, plus many adapted the spaces for recreational, educational, commercial, and productive use. Design is a great tool that can take the detected weaknesses of a community and turn them into strengths to create a good quality public space.

Keywords. public space, vulnerable community, environment

1. Introduction

The Covid-19 pandemic has undoubtedly influenced the way in which urban public spaces [1] and shared spaces [2] are experienced. Furthermore, the impact that the pandemic has had on societies around the world is certainly not the same and the most vulnerable communities have been affected more than those with better living conditions [3, 4, 5, 6]. While the architectural urban debate is increasingly moving towards the enhancement of public space as a place where sustainable practices for city living can sustainably flourish, the impacts of the pandemic on access to public space can further increase social differences and put them at risk.

The Tecnológico de Monterrey, School of Architecture, Art and Design has been working for a couple of years with the vulnerable Paso del Norte community in the city of Chihuahua (Mexico). The research project "Design for Vulnerables" [7] which has this community as its main case study, aims to understand how urban-architectural

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design practice must change to give appropriate responses to the needs of vulnerable communities in the coming decades. These complications of Covid regarding accessibility to public space oblige us to develop a reflection on the role and meaning that these spaces have assumed in vulnerable communities in recent decades and in particular in recent years, during the pandemic.

1.1. Paso del Norte, one of the urban vulnerable communities of Chihuahua capital city

Paso del Norte is a community that originated around 1950 on the slope of a hill that serves as a de facto limit within the urban area of the city of Chihuahua. The River Sacramento, which flows at the foot of the hills and which limits the city of Chihuahua, separates the Paso del Norte colony from the formal city. The community originated as families migrated from the countryside to the urban center and sought areas for new homes. These new developments were built in low-cost areas, as a result. Urban services have needed several years to reach the colony, leaving the inhabitants without basic services for a long time.

Over the years, the colony's first structures have become more and more formal, while new homes and infrastructure have been added, as the population has grown. The colony, even though it has thus enjoyed greater "formality", has always remained excluded from the formal urban processes that took place in the city. On one hand, the bridges built to cross the river have always served as a basic physical connection between city and colony but have never been able to offer a more important connection that would reduce the colony's sense of segregation. The lack of accessibility has therefore become very important and has contributed to forging that sense of exclusion that is at the root of many current problems.

Currently the Paso del Norte colony must be considered as a vulnerable colony of medium severity, in which many residents can count with a form of formal and legal employment, in which most of the houses are permanent and in which some services arrive. Despite this, various accessibility problems remain within and to the colony, with an important implication in terms of social vulnerability.

In particular, accessibility to public spaces is an aspect of vulnerability that appeared very relevant in the early stages of the research [8]. For this reason, this more in-depth study was carried out, focusing on the change in the accessibility of public spaces during the decades of life in the colony and with a particular focus during the changes that occurred during the Covid pandemic.

1.2. Covid-19 and vulnerable communities in low- and middle-income countries

While the Covid-19 pandemic affected everyone, vulnerable communities on the margin of the city were most affected. [9] Though many people had the opportunity to work from home, most individuals in the periphery community did not have this chance due to their type of employment. Therefore, they needed to continue going out to the streets to make money for their family's needs. These are people whose majority of their jobs do not have adequate facilities to achieve proper social distancing. [10]

The lockdown also brought about numerous maladies, not only physical but mental. Many children and young people presented illnesses such as anxiety and depression due to the lack of contact with other children. The lack of outdoor spaces was notorious. Now we realize that these spaces are essential for our daily lives. These spaces are required, not only because of recreational terms but in the workplace, in health, among others. [11]

1.3. Accessibility in public spaces of vulnerable communities

Accessibility to public spaces is a privilege that most people can enjoy. Unfortunately, this accessibility is not the case for many communities on the fringes of cities. [12] The infrastructure of these neighborhoods is moderately low. It's difficult to think of having good quality public spaces if houses are barely there; informality of public and private assets is a urban matter that deeply influences the levels of vulnerabilities.

There are priorities within the neighborhoods, such as housing, lighting, having primary services such as electricity, drinking water, etc. Public space is one of the last problems municipalities think about. As a result, public spaces in vulnerable communities are often informal spaces, like an unpaved open court that can be difficult to access due to lack of maintenance and inadequate facilities. In these contexts, two scenarios likely occur: (1) people stop using these public spaces, which easily become stages for illegal events, exacerbating even more the lack of appropriation or (2) people try to arrange some permanent or ephemeral intervention to promote spatial appropriation.

1.4. The changes in the use of public spaces

According to the two previous points, it seems relevant to understand how accessibility and use of public spaces in vulnerable communities changed in the last decades and during the Covid pandemic, especially in neighborhoods located on the periphery of the city. Understanding the evolution of these spaces and the way they have been used in these periods helps us to identify areas of opportunity for the improvement of accessibility in public spaces and to define the possibilities that design has to help these neighborhoods in terms of accessibility. [13]

2. Methodology

Design for Vulnerables is a research project funded by the "*Observatorio de Ciudades*" of Tecnológico de Monterrey which started in January 2021 and was composed of various initiatives and research activities that highlighted various urban aspects that are related to the different forms of vulnerabilities in this vulnerable community [7]. Among the most relevant aspects, the way in which residents access and experience public spaces emerged. For this reason, ethnographic meetings were held with some residents of the neighborhood, during some of the periodic meetings that the research group carries out in the colony.

2.1. Public spaces of Paso del Norte

In the Paso del Norte neighborhood there are essentially three public spaces that are used, in different ways, as a meeting space between residents. These three spaces are:

- Baseball Court, which is in the higher area of the community and it is occupied all the weekends, all the day long for the local baseball championship;
- Basketball Court, located in the middle of the neighborhood, is used just for some informal youth sports;

- Plaza, at the main pedestrian entrance to the community (pedestrian bridge) is used mainly by the civil organization Accionética, which works here with children and teenagers.

Figure 1. Public space (Baseball Court) of Paso del Norte (Chihuahua, Chihuahua).

Figure 2. Public space (Basketball Court) of Paso del Norte (Chihuahua, Chihuahua).

Figure 3. Public space (Plaza) of Paso del Norte (Chihuahua, Chihuahua).

2.2. Conversational semi-structured interviewing

We will collect information without pre-conceptualizing the categories of analysis. The researcher will engage the person in a conversation that engages them in hopefully most,

but not exclusively planned topics, asking carefully worded questions that invite the interviewee to feel comfortable engaging in extended talk. In a conversational interview, the person being interviewed is asked to tell stories, to describe and contextualize specific events or activities. These stories express the interviewee's interpretations of those events and their significance, what the subject imagines are their causes and possible consequences. Stories are in many ways the richest form of data the qualitative researcher can obtain.

2.3. Interviewing people - Ethnographic Encounters

To understand the evolution of the landscape and public space we need to ask and listen to the people who have lived in Paso del Norte. Knowing their perspective will help us understand how their neighborhood has changed. So, through these anecdotes, we can analyze the agents of change in architecture, public space, accessibility, and society.

Below are the methodology and the results of the ethnographic encounters with people from the neighborhood. We asked different questions regarding their childhood in the locality, the elements that have changed, and the aspects that would improve, among others.

3. Results

The neighborhood holds events every Saturday to create a sense of community. It also raises funds for future events or needs and makes activities to keep children off the streets and prevent them from doing things that harm them already. During these events, we created a relationship with the people we interviewed.

People were excited to remember and tell us what we asked, especially since they were memories of their childhood. We noticed the environmental and social changes that the community has had and the successes and failures that exist. They gave us valuable information to improve accessibility to public spaces in vulnerable communities.

3.1. Interview 1

> We met Mrs. Laura, who invited us to her house to talk about the neighborhood. The conversation began with anecdotes from when she was little, - “At night it was very dark because there was no light, however, I remember a happy childhood. We would go out and try to catch fireflies…” She longed for those moments while telling us all those things that have changed in the place. - "The colony has changed, but I don't know if it's for the best," she said thoughtfully. She told us that those public spaces they have are often problematic. – “on Sundays when there is a baseball game, the players start drinking…”- “those children whose parents are absent and do not have activities in the afternoon tend to be delinquent…”, she said in dismay. Although these negative things exist, there are positive things. Before the pandemic, people went out to use these spaces for good. –“Before they gave Zumba… classes used to be in a plaza below the neighborhood, but the group grew and began to use the baseball field.”

Analysis: Paso del Norte used to be a place with a strong sense of community and respect for nature. The unpaved streets were the public space. People celebrated important days there and children also went out to play and have fun. People were in constant contact with nature by eating fruits of the native flora and making proper use of the bodies of water that existed before. They also had orchards in their houses. People adapted to space, not the other way around.

Over the years, families grew, and the population in the area expanded. New ways of living came along with it. Orchards were left aside and people destroyed nature due to the construction of new houses and spaces for private recreational use. Nature was no longer seen as a benefit but as an obstacle for living.

The baseball field and the basketball court cannot be used entirely by the community since they are private ownership. Some physical activities took place in these spaces. As a result of the pandemic, these activities ceased and until now they remain like that. People don't have a proper space that belongs to them to do these kinds of activities and to reactivate that sense of community that was left out years ago.

3.2. Interview 2

> We also met Rodolfo and Susana who have lived in the neighborhood since they were born. Children of the founding fathers of the community. We talked about their childhood and the connection they had with nature was quite strong. - “The field used to be a stream, we would go to play and we started to fill in and level the land. This is how the baseball field was made…” said Rodolfo. “We played inside the river, the water used to be very clean, you could see different fish…”. Their childhood was happy, they remember it with great nostalgia. About the existing public spaces, Susana told us they like the area in front of their home. - “Every afternoon, children go to play there. I can take care of my grandchildren from home. We like that place”,"I do like the park," said Susana. They showed particular affection for the baseball field. - “People have wanted to remove the field, but we don't want them to. They want to use it to build houses...”, Rodolfo told us. But those spaces that children have adopted to play and live together are not entirely safe. - “You can find the court neglected. The fence is in poor condition, it can become dangerous for children…”, Susana said.

Analysis: Nature was a big part of children's play in the past. People used to play in the river as well as in unpaved streets. Although better infrastructure in the neighborhood, such as paved streets, primary services, etc., make life in the locality easier, they would prefer to stay as before. Although they had fewer things, they were happier.

People feel more attached to what they build. The baseball field used to be uneven and had a river running over it. The people of the community worked to flatten and level that land. Now some people want to build on it. The community doesn't allow it because of the memories and sentimental value the court keeps. Proving that people tend to value those things that they worked for, and treasure it more.

This court is the main space where children go out to play. However, this place runs little sometimes, when children from nearby neighborhoods go to play. This place is still dangerous due to the ravine that exists. Not only does this exist in the principal court, but in the basketball court they have. The community does not have accessible or safe spaces.

4. Discussion and Conclusions

Paso del Norte used to be a place where people connected to the natural environment. As the years passed, this practice disappeared, revealing how new infrastructure searches for something that people believe is better. The three people interviewed agreed that before, life, although it was more difficult, was more pleasant. Having contact with nature as children made them happy and created a strong sense of community. Public spaces were accessible to everyone since everything belonged to everyone. There were no private spaces. In the present day, the public spaces in the neighborhood have minor infrastructure, security, and accessibility so that everyone can enjoy them. The sense of community only occurs among children when they go out to play, but it stays in those spaces. They don't keep practicing it outside of the basketball court or the baseball field. The activities carried out before the pandemic are very important for those in the community. Giving these spaces some daily use created these community ties, which disappeared with the confinement.

Nature is an important factor: accessibility to public spaces in the childhood memories is often related with plants, bodies of water, and green landscapes. By destroying these environments for the construction of inaccessible urban areas, the connection between public spaces and nature, as well as the sense of being in contact with the environment, has been lost.

Public space infrastructure are key elements for the sustainable development of a community only if it is well done, taking into account not only issues for physical accessibility, but also issues for environmental connection. Otherwise, people may feel alienated from these spaces and do not take care of them, causing them to be dangerous and inaccessible for many. Accessibility, in essence, means everywhere, and particularly in the most vulnerable communities, as it relates to the human right to physical connection and spiritual connection with the environment. Public spaces help people feel safe by getting to know each other and creating community in the plazas through recreational activities, those that not only Activities that not only help them to relate to each other, but provide physical conditioning and improve mental health outcomes.

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The Missing Voices of Disabled People

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Abstract. This paper presents the development process of a graph database that connects statements posted by disabled people on various web-based platforms with accessibility requirements in the Danish Building Regulations (BR18). The aim is to bring the lived experience of disabled people into a vocabulary of space-making for architects. By elevating the missing voices of disabled people – describing what matters, how and why – the project supports the decision-making processes of architects to make the built environment more inclusive. The developed database relates statements posted by disabled people with sentences from paragraphs of BR18 through specific architectural features of room, element, and object. Using the architectural features as point of reference, the database not only highlights some of the most common building situations encountered by disabled people, but also allows anyone interested to explore their relationship to the real lives of disabled users and the statutory requirements.

Keywords. Accessibility, Disability, Danish Building Regulations, User Statements, Graph Database

1. Introduction

Architecture still excludes disabled users by not complying with their basic needs and preferences [1]. This is despite more than 1 billion people worldwide living with some form of disability [2]. In recent decades, increasing emphasis on providing equal opportunities for users has improved the inclusion of disabled users in the built environment, but there is still a long way to go [1]. Codified rules and building standards have played a significant role in the reduction of inequalities. However, these rules and standards abstract the relations between humans and the built environment and simplify the complexity of use, leading design solutions to be more generic and standardized [3, 4, 5]. In response to this, several design concepts, such as Universal Design, Inclusive Design and Design for All, have emerged. They all advocate for inclusion through qualitative understanding of human-environment relations. However, their applications to design are still limited in present architectural workflows [6].

Broadly speaking, there are two different approaches to tackling the urgent problem of access disparity in design, both of which have drawbacks. The first is rule-based, drawing on the objectified human body and specified standards, the other is user-based, being characterised by embodied and highly subjective understandings of architectural experience. What we strive for is a strategy that combines the effectiveness and impact of regulatory frameworks with the qualitative approaches found in the people-centred

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design concepts [5, 7]. In the effort of providing practical foundation for such a strategy, this paper presents the initial development process of a graph database that connects statements posted by disabled people on various web-based platforms with accessibility requirements in the Danish Building Regulations (BR18). Employing mixed-methods that accurately draw on quantitative scalability and qualitative descriptions to adequately transpose user experiences, the project seeks to provide architects with insights into specific aspects of users' experience in the build environment. Increased access to data and the proliferation of database technology constitute an opportunity to support the decision-making process of architects to make the built environment more inclusive.

2. Background

Codified rules and standards have played a significant role in reducing inequality of access and usage in the built environment by defining minimum obligations and basic architectural performance measures. The Danish building regulation BR18 [8] prescribes requirements and guidelines in various parts of the built environment. The requirements for residential buildings are described in BR18 as most common building situations encountered by users in their everyday lives. Situations such as 'access' (§48-62), 'kitchen work' (§202) and 'outlook' (§378) are articulated through specific requirements that are formulated as descriptions and measurements of architectural elements, spatial dimensions, and/or minimum performances required. The codified rules and standards, based on generalized and decontextualized expert knowledge, provide the essential point of reference for architects. And yet, they suppress the differences that human bodies possess and simplify the complexity of bodily interactions with objects, buildings, and their surrounding environments. These shortcomings raise questions about how well these rules and standards can respond to the real experiences of users [4, 5].

As opposed to this top-down approach of regulations, several design practices have emerged, which advocate for inclusion through qualitative understanding of human-environment relations. Though these approaches vary in name - such as Universal Design (UD), Inclusive Design or Design for All - they all promote designed environments that are more responsive to diverse bodily differences and situations [9]. These practices engage with a broader group of users, through which they contribute to making the built environment more accessible and inclusive [6, 10]. However, their instrumentality on design is often questioned - especially when they are codified into legislation [3, 5, 11]. Debate continues over the applicability of people-centered methods, as they focus on highly personal and subjective bodies, which could lead design solutions to be too specific to the selected individuals. To gain a holistic understanding of human behavior and to develop evidence-based knowledge that is applicable in architectural praxis, we must systematically combine findings from different studies.

In recent times, the availability of user data and a growing awareness of user-environment relationships has created renewed interest in data-based user perspectives in architectural design [12, 13]. Parallel prevalence of tools to collect, process, and store data has made data-based descriptions of user experience accessible for many [14]. This we take as an opportunity to combine the qualitative approach of people-centred methods based on data from disabled people with the quantitative approach of legislation. In what follows, the paper describes how we developed a graph database that relates the situated

experience of disabled users – statements posted on various web-based platforms – with accessibility requirements in BR18.

3. Methods

3.1. Data collection

The data deployed in this project was scraped from personal blogs written by disabled people. Our criteria for the selection of blogs were: 1) the blog is written in English; 2) the blog is written by wheelchair users whose content primarily consists of personal matters; 3) the blogposts are open to the public and the blogpost is not considered sensitive or exposing. We chose English due to highly limited numbers of Danish bloggers. We focused on wheelchair users due to the large concentration of blogs made by wheelchair users in virtual space. This focus aligns with the fact that the guidance regarding accessibility in building regulations is largely based on the capabilities of independent wheelchair users [15]. We discovered 108 blogs from all over the world that cover a variety of topics: some post about food, fashion or travels – while others post about activism, culture, or use the blog as a public diary. Even though the topics are divergent there is a common focus – sometimes explicit, sometimes very subtle – on the 'life as a wheelchair user' with personal stories and a high degree of ecological validity.

Although many of the blogs are built as webpages using standard templates from web services like WordPress, there are always unique aspects which challenge the application of a one-size-fits-all scraping solution. For this reason, and for the sake of easy replicability, we tested three 'off-the-shelf' browser-extension scraping solutions. Although we had the best results with Web Scraper, an extension for Google Chrome, its performance was still limited; it successfully scraped just 57 of the 108 blogs. The main problem in the scraping process was entries based on multiple links, dynamically loaded pages and inconsistent URLs and pagination links. The outputs from the scraping process are the blogpost URL, the author of the blogpost, and the actual blogpost content. 4165 blogposts (with text equivalent to 6200 standard pages) were scraped from the 57 blogs. The extent of data from the different blogs varies: some bloggers wrote more than 500 blogposts, while others wrote fewer than 5 blogposts.

3.2. Natural Language Processing (NLP)

The raw data is first cleaned and fragmented into individual tokens and metadata is subsequently extracted for each token. The transformation and creation of metadata involves a number of sub-processes. These processes are carried out using an open-source Python Natural Language Processing (NLP) library called spaCy [16]. The scraped data is highly disordered, with HTML code, image links and other irrelevant information. Therefore HTML and ASCII character filters are deployed in order to filter out irrelevant and infrequent characters from the scraped data. The blogposts are then divided into individual sentences using the spaCy syntax-driven sentence segmentation feature. Following this is a process of tokenization, which breaks the text/sentences down to single tokens. Words that appear very frequently in the English language, but which do not carry any relevant information, such as "the", "at", "is", "on" and so forth, are called stop words. The standard list of stop words provided in spaCy is used to remove

them, which helps to minimize the extent of irrelevant data in future searches, as a search for a word like "the" would otherwise result in many hits with highly varied content.

In linguistics, the concept of dependency refers to the syntactical structure of directed links between words [17]. The keystone of clause structure is the finite verb; all other words have either direct or indirect links to it, which are known as dependencies. For example, in the sentence "The door was wide and accessible", the word "accessible" is directly related to the word "wide" and serves as a conjunct. The parsed dependencies reveal the syntactic relation among the tokens and provide an understanding of how the same word can be used differently in various contexts. Dependencies also reveal who or what is the grammatical subject and object of a sentence. The subject is often found as the individual or thing that is performing the action and is often related to the main verb of the sentence. Objects are often found as the receivers of the action in a sentence. Knowing the subject and the object can provide information to distinguish relevant sentences from irrelevant.

In natural language, anthimeria (the usage of a word in a different grammatical forms) is relatively common and can cause confusion, both in terms of understanding the meaning of the word, and as the cause of incorrect statistics. For example, the word "book" is used both as a noun "a book" and as a verb "to book a ticket". Part-Of-Speech-tagging (POS-tagging) identifies the corresponding part-of-speech of each word. The entire dataset that contains statements from blogposts and paragraph sentences of BR18 is processed, and each word is stored with its dependency relation and POS-tag as metadata. The metadata is used in the following process described in 3.3, both to define the relations between sentences and words, and to create the index categories based on architectural features. By developing such a structure, we seek to enhance the usability of the database for non-specialists with limited previous understanding of linguistic labels.

3.3. Graph Database

A Graph Database (GDB) is a database that uses graph structures consisting of nodes and edges for storage of data and for semantic queries [18]. A node is comparable to a spreadsheet cell and represents an entity or an instance. Nodes are labelled according to predefined sets and can hold different datatypes that describe the entity it represents as key-value properties. Edges are labelled relations between the nodes and can also have assigned properties. A central aspect of the GDB schema design is the distinction between data stored as nodes, edges and properties. The GDB is chosen due to the main objectives of this project, which are to: 1) handle complex and interconnected data which challenge table-based relational databases [19], 2) create meaningful relationships between different data sources and 3) present the interconnected data in a way that it is usable for third parties through web-based publishing. The processed blog data and the paragraphs of BR18 are loaded into a NEO4J GDB according to the schema in Fig. 1.

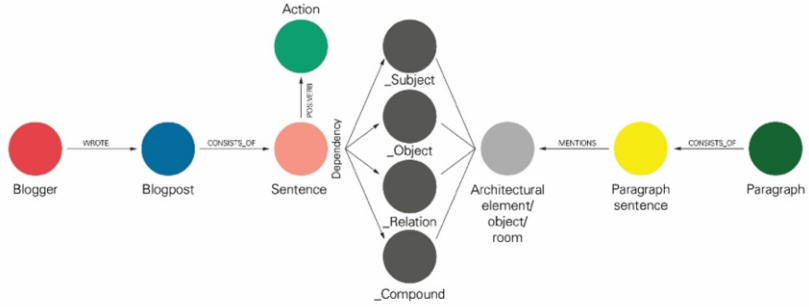

Figure 1. the Blogger-node

Starting from the left in Figure 1: the Blogger-node holds the name used by the blogger. The Blogpost-node contains the URL of the actual blogpost. The blogpost is stored in the database as individual Sentence-nodes that contain each individual sentence in the blogpost as key-value properties. The Action-node contains verbs used in the sentence that match a list of predefined verbs found potentially relevant to architectural context and use. Examples of these "actions" would be verbs such as, "move", "sit" and "see", among many others. The four dark grey coloured nodes represent how features in the Architectural element/object/room-node are used syntactically. If an architectural element such as "wall" is mentioned in a sentence, the connection between that specific sentence-node and the architectural element-node named "wall" describes its use. Besides "subject" and "object" described in the above sub-section 3.2, two additional categories are made for the syntactic use of words as "relation" and "compound".

A relational use of "wall" would be in a sentence that describes the wall in relation to something else, e.g.: "…the space between the *table* and the *wall* was too narrow.". A connection through a compound-node shows that the word is used in combination with others, such as "a *wall mounted* handrail". Architectural element/object/room consists of 58 pre-selected elements such as wall and floor, objects such as door and chair, and functionally defined rooms such as bedroom and kitchen. These nodes provide an overview and allow users of the database to compare how the architectural features are mentioned across the sentences from both blogposts and BR18 paragraphs. The asymmetric relationship between blogpost-sentences and paragraph-sentences of BR18 emphasizes the differences between the legislative information and narrative information describing embodied experience. Much like their Sentence-node counterparts, Paragraph-sentence-nodes contain individual sentences from the entire paragraphs of BR18. These paragraphs are, in turn, represented by Paragraph-nodes that hold a URL to that specific paragraph published on the official BR18 website.

3.4. Querying/using the database

The graph database is published online [20] and can be queried using three different search methods as seen in Fig. 2. The first of these is by using the search bar, where literal string searches can be conducted. This means that the search engine only matches the search results when the spelling and the word order are the same. The second is by choosing the nodes of interest from a list containing the different node types described in 3.3. Different nodes can be combined to specify the search. This feature can be used to create abstract narratives, using the linguistic labels in combinations with the

architectural features. As an example, if an architect is designing an entrance hall and wants to know if any blogger has described specific situations related to an entrance, a search could be combined of: (1) Entrance (subject), 2) Door (subject), 3) Floor (object), 4) Wall (object), 5) Wall (relation), 6) Enter, open, and turn (Action/Verb). Sentences that contain any of these words in the specified grammatical form are related to those nodes and it is easy for the user to understand which sentences relate to which nodes, and to see those with the highest number of node relations.

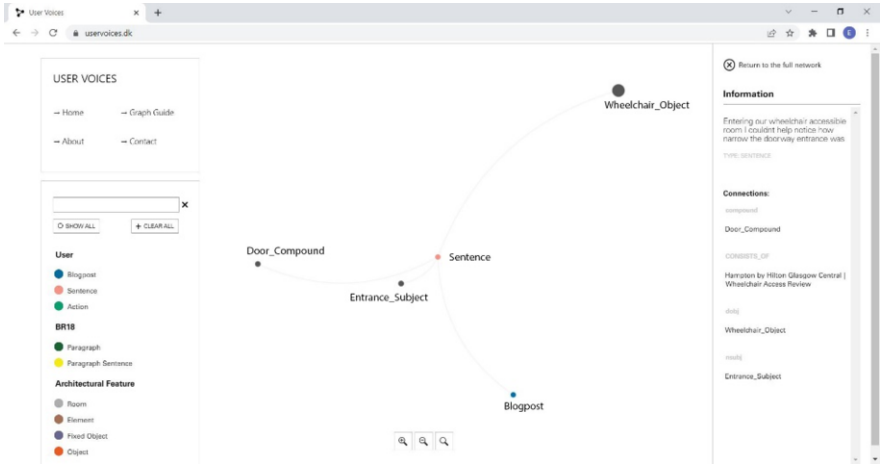

Figure 2. Screenshot from our website uservoices.dk, showing a Sentence-node containing the sentence: "*Entering our wheelchair accessible room I couldn't help notice how narrow the doorway entrance was.*", and its relations to other types of nodes.

The first two search methods can be combined with the third: intuitive exploration of the database by clicking nodes and uncovering their relations. This approach can be used to expand the initial search in unplanned directions guided by reading of nodes, relations, and properties. It can be a useful tool to gain a deeper understanding of the relations between different nodes through several links, and to reveal when parts of the design task are inadequately described. In addition, the intuitive search approach technique is often used to arrive at the blogpost-nodes and the paragraph-nodes, where a link to the actual blogpost or the specific paragraph at the BR18 website can be found. Here, both sources of information can be further investigated in their original context.

4. Results

In this project, we creatively explore a new way to develop knowledge of inclusion that enables architects to gain more nuanced understanding of spatial experiences. The project approaches this challenge by visualising data sets collected from web-based platforms that are highly personal (qualitative) and by establishing relations to the regulatory definitions of BR18 (mainly quantitative). The developed database – presented as a website - is an alpha-version of a framework based on Web Scraping, Natural Language Processing and a Graph Database System that integrates profound subjective perspectives on the everyday lives of disabled people into a vocabulary of space-making for architects. The website is supplemental to BR18 and should support

architects in making appropriate decisions in their planning and design processes of inclusive architecture. Accordingly, it adds to, and must be read in conjunction with, the existing body of regulations that ensure the built environment functions in the interests of public health and safety – by defining basic performance standards for design, construction, and alternation.

The database stores paragraphs of BR18 and statements from disabled users which can be accessed through our website. The structure of the graph database and the architectural index categories provide an overview of which architectural features are mentioned, and where, across the dataset. This makes it easy to find the paragraphs and/or user statements that include specific combinations of architectural features and thereby to identify relevant personal and regulatory information for specific design processes. The database structure connects the paragraphs with the user sentences through shared architectural features. These connections support investigations of the personal and regulatory aspects of common building situations encountered by disabled users. It is important to state that the indirectness of the connections underlines that paragraphs and user-sentences that are related through the same words by no means necessarily have anything in common on a semantic level besides the shared word. However, we, who have professional architectural understanding, concluded that a majority of the linked statements add a potentially relevant personal perspective to the paragraph sentences of BR18 – and that additional useful information often can be found in the blogposts where the sentences originate.

Not surprisingly, we found that the database contains a far greater diversity of situations described by the bloggers than those covered in BR18. This emphasizes that the database can be used to gain insight into specific real-life situations experienced by users that are not covered by regulatory definitions. Exploring the database for blogpost content with few or no node relations to BR18 paragraphs could help to identify these missing regulatory aspects. The relations found in the database might also reveal discrepancies between user stories and regulations relating to the same architectural feature; as such, it could be a tool for the evaluation and improvement of regulations.

5. Conclusion

The project is at an early stage of development and while results seem promising, we are not in a position to draw any justified conclusions on the general validity of the data connections and applicability of the system. Further research needs to be conducted in order to finalise the system into a suitable format for architects and other actors in the building industry to utilise effectively. In continuation of this, we must underline that none of the researchers contributing to this project are educated linguists, programmers, or data scientists. We encourage anyone with specialized knowledge within these fields to point out any errors, suggest changes or reach out for potential cooperation on similar projects.

The database system presented in this paper can be used to query for specific experiences and situations encountered by wheelchair users with or without relation to paragraphs of BR18. The queries can be conducted to gain insights into the narratives of the wheelchair users and to understand what matters to them, how, and why. Moreover, queries can be conducted to find statements that add a personal dimension to the regulatory definitions in BR18 and thereby potentially provide a better understanding of the challenges that the legislation seeks to address. The developed database is a prototype

tool which showcases, at least in principle, that qualitative and quantitative datasets can be structured in such a way as to reveal relations between them. At this point our system is not 'universal' per se and focuses explicitly on a group of wheelchair users, however, it represents a crucial first step towards our aim of combining the effectiveness of regulatory frameworks with the qualitative approaches found in people-centred design concepts into a coherent design strategy.

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Transforming our World through Universal Design for Human Development
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Making Research More Inclusive: Is Universal Design of Research the Answer?

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Abstract. Researchers typically declare in the methods section of scientific papers that the study included a representative sample. A closer look at the composition of participant groups, however, reveal that these samples are typically based on criteria such as age, educational background, and a binary gender division. Nothing is mentioned about other characteristics e.g., functional, or neurocognitive variations. Consequently, many "representative samples" do not really represent the whole population, but rather the majority. In this perspective paper, we argue that there is a need for more inclusive research considering the broad diversity of people. We discuss whether Universal Design of Research (UDR) is a purposeful approach. We go through the proposed definition of UDR and apply three topics as examples, namely participant characteristics, communication, and study design. The overall conclusion is that UDR might be purposeful for many studies but is not ethical or purposeful in all types of research. There is, however, a need for a more precise and comprehensive definition of UDR to comply with ethical requirements and to be purposeful for researchers. We therefore conclude by suggesting a revised definition.

Keywords. Universal design of research, user diversity, experimental design

1. Introduction

Empirical research must comply with rigorous requirements related to recruitment, data collection, and data analysis [1]. In many scientific papers, researchers claim to have studied a representative sample of participants. This statement is usually based upon the distribution of characteristics such as age, educational background, and a binary gender division. Characteristics such as cultural background, gender identity, functional diversity, or neurocognitive variation, are generally not mentioned. Neither is the need for adjusting settings in the experimental setup, whether participants rely on assistive technology or whether an interview guide must be revised so all participants comprehend the questions and can communicate with the researchers. Consequently, the so-called "representative sample" is often just representative of the majority population, and a significant portion of people is left out. There might be many reasons for lacking diversity in samples. Some examples are recruitment challenges or bias, experimental design or interview guides that do not consider people with functional or cognitive variations, or lacking awareness in the scientific communities.

In this paper, we will use research fields such as human computer interaction (HCI) and interactive information retrieval (IIR) as a starting point. A typical experimental

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design within HCI or IIR measures variables such as performance or preferences, often by comparing different modalities or system components presented to a selection of users. In other cases, qualitative studies are conducted to explore e.g., how people search for and evaluate information. Sometimes, different cohorts are compared to evaluate the impact of certain characteristics, such as domain knowledge or system experience. In other cases, researchers are studying specific parts of the population or exploring research questions that do not address the whole population, such as the design of an airplane cockpit intended for pilots only. In such cases, limited diversity in the samples may be required to answer the research questions and to reduce the number of variables. Other studies compare people with different abilities [2], for example people who are blind versus people with no visual impairments. In the latter case, the purpose is to examine the impact of impaired vision and investigate how to develop more inclusive systems. Such studies are important to ensure accessible systems for all types of users. This paper will, however, mainly address the "mainstream studies".

This paper is structured as follows: The background introduces "the average user", the capabilities approach, and Universal Design of Research (UDR). This is followed by an examination of the UDR definition through the lens of three key areas that needs attention in context of inclusive research, namely participant characteristics, communication, and study design. This section is followed by a discussion of using a capabilities approach within research and the applicability of UDR. Finally, a revised definition of UDR is suggested.

2. Background

2.1. Is there such a thing as an average user?

As stated in the introduction, most mainstream research does not include a broad diversity of users in their samples. We refer to diversity as "*the existence of variations of different characteristics in a group of people. These characteristics could be everything that makes us unique, such as our cognitive skills and personality traits, along with the things that shape our identity (e.g. ethnicity, age, gender, religion, sexual orientation, cultural background)*" [3]. The question is whether a representative sample is possible to attain. A representative sample is based upon the assumption that there are certain "average users", which can be identified by researchers.

Many research projects study user performance or preferences, often comparing groups or cohorts. A consequence of such comparisons is that each participant is turned into an "average person" who can be compared with other "average persons", where certain specific qualities are regarded as essential. According to Rose and Ogas [4] there is no such thing as an average person. By focusing on the sameness of people, an important perspective is lost. Consequently, Rose and Ogas [4] argue the need for embracing and acknowledging user diversity rather than focusing on stereotypes. This is a key issue within the "*science of the individual*" perspective [4], and has also been addressed by critics of universal design. If we design for everyone, we end up designing for no one [5].

2.2. The capabilities approach

The capabilities approach has been discussed in various fields over the years. For instance, Sen [6] emphasised that traditional economic models have omitted debating which activities people are able to do and what kind of people they can be. Nussbaum [7] discussed how women have been given unequal human capabilities due to political and social circumstances. Nussbaum argues that the capabilities approach represents universalism, and can be related to human rights, political justification and implementation [7].

Capabilities are also relevant in context of impairments. In many settings, "disabled people", "people with impairments" or similar terms are used when referring to people who deviate from certain norms regarding physical, sensory, or mental abilities. Consequently, a division arises between "people with and without disabilities". An alternative approach is a capabilities approach, which acknowledges that all people have varying capabilities due to many factors. For example, a person who has dyslexia may read slower and with more errors than others. However, people who are very tired, ill, or multitasking may experience the same reduction of reading speed and decoding errors. It might therefore be purposeful to pay more attention towards different contexts and diverse abilities. A related concept is situated abilities, suggesting that an aim should be to design for situated abilities over a narrow focus on people with impairments [8].

2.3. Universal Design of Research (UDR)

Many definitions of universal design exist. Common for all definitions is the underlying principle that one main solution should be applicable to as many people as possible without adjustments for specific groups. The type of characteristics and the terminology applied vary, but many definitions refer to age, gender identity, sexual orientation, cultural background, functional diversity, and neurocognitive variation [9]. In addition to the definition, a set of principles are also put forward to provide more tangible guidelines on how to make things universally designed [10]. Universal design has also been introduced and applied in specific contexts, such as the Universal Design for Learning (UDL) and Universal Design of Research (UDR).

Williams and Moore [11] discussed the need for a broader representation of users in biomedical research and proposed the concept of UDR, defined as "*the design of research so that all people can be included as potential participants, to the greatest extent possible, without the need for adaptation or specialized design*" [11]. This definition builds upon the original definition of universal design by Mace [12]. Williams and Moore [11] also suggest a set of four "rules" for UDR, such as i) plan research to include all types of people despite disabilities, ii) only apply inclusion criteria when necessary, iii) provide multisensory options in the research design, and iv) consult people if you do not have the required knowledge about a disability.

3. Applying Universal Design of Research (UDR)

UDR may be a useful approach to achieve more inclusive research. There are, however, some potential challenges related to this approach. Rigorous experimental design and data analysis methods do not always make it possible to design research that consider all types of abilities. In other cases, just a few small measures are needed to comply with

UDR. In the following section we address the different parts of the definition of UDR through examples from participants characteristics, communication, and study design.

3.1. All people as potential participants

Participants can be described in many ways, and a broad diversity of attributes are associated with universal design. Examples of characteristics are age, gender identity, sexual orientation, cultural or socio-economic background, education, digital literacy, in addition to functional and neurocognitive variation. Important questions, however, are i) which characteristics comprise relevant variables in a study?, ii) which characteristics should be documented?, and iii) how should such data be collected? In most cases, many of these characteristics are not relevant, and might be uncomfortable for participants to provide. Others may be vital, depending on the research questions and study design. In this section we will apply gender identity as example on how studies can exclude potential participants due to a lacking awareness among researchers.

According to the UDR definition, all people are potential participants. Nevertheless, most commonly, samples are presented in a binary gender division, typically in percentage distribution of females and males. This might be an erroneous way of referring to the participants. Moreover, such an approach may be perceived as highly exclusive, and offensive for certain participants. In all populations, there are people with gender identities that do not fit into these binary categories, for example people who are gender-fluid or non-binary. Another question is which category researchers apply to trans people, who do not identify as the sex they were assigned at birth. Are they included with the gender assigned at birth or the gender they identify as when participating in the study? Documenting gender identity can be stigmatizing and result in erroneous data. It might therefore be purposeful to consider whether data on gender is even relevant for the data analysis. If not, do we need to ask participants about that?

Gender identity might be challenging for researchers to address. For instance, participants may not want to state their gender identity, and the categories provided by the researchers may not fit. Moreover, terminology changes quickly. In anonymous surveys, it might be better to get participant data on gender identity by providing several alternatives rather than using a binary division. A commonly reported problem in surveys is that people who do not identify with a binary division often terminates answering surveys when met with stereotypical categories. In interviews or experiments, researchers might erroneously assume a gender identity based on appearance or name.

How can we then achieve a more inclusive research design in context of gender identity? In surveys, several categories can be provided, including the options to self-describe or "prefer not to answer". It may be challenging to decide how many and which categories that should be included. There is probably no right solution to comply with all identities and an ever-changing terminology. It might therefore be helpful to contact user organizations to get advice on the proper, updated, and respectful terminology. Another issue is how questions of gender identity are formulated. Instead of the traditional "*Gender:*", the question could rather be "*To which gender do you most identify as?*". In personal meetings, the researcher can ask the participant what gender the person identify as and which personal pronoun the researcher should use, rather than making assumptions based on appearance or name. To conclude, it is vital that researchers have all types of identities in mind when recruiting to ensure that all people are regarded as potential participants. The first part of the definition is there both purposeful and necessary.

3.2. To the greatest extent possible

In the field of HCI and IIR, certain user groups, such as people with aphasia, have been heavily overlooked [2]. A characteristic related to aphasia is impaired language skills. This group is therefore often excluded from research, since most study designs depend on the ability to produce and comprehend language [2]. Moderations of rigorous methodological requirements may be necessary, for example by offering response alternatives and suggestions during interviews. Without such adjustments the researcher can miss out on essential information. For example, blank sheets of paper for drawing, communication support in handouts and sufficient time, can accommodate communication with people with aphasia. (See [13] for a more detailed discussion of this methodology.)

It would not be ethical to include people with aphasia in a general study, knowing that there would be challenges in understanding and communicating with the researcher. The same applies for people with dementia and some people with severe cognitive impairments. Some of these users may not have the ability to consent or there might be other reasons why the mainstream experimental design is not sufficient. In such cases, UDR will neither be purposeful nor ethical, because special considerations are required to protect the participant. Consequently, it is important that this is acknowledged within the UDR approach, which is confirmed by the inclusion of "*to the greatest extent possible*" in the definition. This does not mean such participants should not be included in any types of research, but UDR may not be the answer for such users.

3.3. Without the need for adaptation or specialized design

Functional diversity comprises a wide range of senses and abilities, such as vision, hearing, and motor skills. All these characteristics can vary without being related to an illness or impairment and occur on a spectrum. For example, one person can have reduced vision and rely on visual aids such as glasses. In contrast, another person can be legally blind relying on more advanced assistive technology. Nevertheless, functional diversity is rarely mentioned in research papers, unless the study comprises people with functional variations regarded as impairments, e.g., being blind, deaf, or paralysed. An exception might be studies referring to participants wearing glasses, which is sometimes mentioned in for instance eye tracking studies because it may impact the data quality.

According to the definition of UDR, there should be no need for adaptation or specialized design. An important component of study design related to functional variation is assistive technology. Through assistive technology, many people with impairments can perform equally well as others. An important question, however, is where the border is set between common adjustments in the setup and "*adaptations or specialized design*" in the UDR definition. For example, there are many settings included in operating systems, such as font size, contrasts, brightness, sound options, sticky keys, and colour settings. In other cases, the participants may depend on using assistive technology such as speech recognition, speech synthesis or a refreshable braille display. Which of these adjustments or assistive technologies would be regarded as adaptations or specialized design according to the definition, and which, if any, would not?

If one decides that all settings adjustments are regarded as adaptations, a large group of people will be excluded from the UDR definition. One could argue that for a study to comply with UDR, all types of assistive technology should be available in the original design, thus regarding assistive technology as a part of the setup. This goal, however, is

not realistic, among others due to funding and expertise. As a minimum requirement, however, the experimental design should allow for some level of user control of basic settings, so the study resembles the participant's regular setup as much as possible. In some cases, the research questions may not allow for such modifications. Researchers should as a minimum ask the participants about their usual setup and the one applied at the test. By including some simple accessibility adjustments as a part of the research design, less people will fall under the category "*adaptations or specialized design*".

Neurocognitive variation is seldomly addressed when reporting on the sample. The exception is when the study includes people who based on a formal diagnosis are not regarded as neurotypical, e.g., people with intellectual impairment, autism spectrum disorder (ASD), dementia, or aphasia. Nevertheless, when including all types of people in a study, neurocognitive variation will naturally occur because abilities are also affected by e.g., situation or context. A person who is nervous or tired may for instance produce more spelling errors than a rested and confident participant, while a person with a headache might perform tasks more slowly than others. This is a good argument for incorporating more cognitive tests in experimental design, such as tests for short term memory, concentration, and language skills where these variables are regarded as relevant, to get an overview of the person's situated abilities. At the same time, researchers should not include more tests than necessary, again keeping in mind the research questions, study design, and considerations of the participants.

Neurodiverse abilities tend to occur on a spectrum. For example, speech, and reading or writing skills may vary in degree rather than being present or absent. Consequently, the questions arise regarding which types of users that can be included in a mainstream study design, and when there is a need for special considerations in the study. A vital point in research ethics is informed consent. The researcher must ensure that all information provided about the study and consent form is understood by all participants. For example, if people with dyslexia are included, it might be necessary to ensure informed consent by confirming that the content in the written recruitment letter is understood.

Informed consent can be ensured by providing information through different channels and formats, such as pre-recorded videos, voice recording of texts and easy-to-read information letters. Accessible and easy to read information can be produced through plain language, highlighting important points, and visual support. Such measures would benefit all participants, which entails that such considerations make the research more accessible for all types of people. There is, however, again the question of where to draw the line for defining such measures as special considerations.

4. Discussion

By limiting research to "representative samples" and "typical users" a valuable perspective on user diversity is lost. Moreover, a faulty impression is given that the persons included in the study are representative for all types of people. The performance of all types of users may vary over time, due to for instance illness, tiredness, fatigue, or temporary injuries. Including all types and levels of abilities in research will therefore benefit all types of users and result in more usable systems. This is not meant as an argument against all studies of specific cohorts, e.g., accessibility studies. In many settings, it is purposeful to apply research on narrower user groups. What we are referring to here, are the more general studies, which may benefit from a broader perspective on

user diversity, for instance when exploring search interfaces or other types of products and services applied by a broad diversity of users.

By acknowledging that people are neurodiverse and supporting individuals as they are, researchers can gain important knowledge about user behaviour. This expertise can in turn contribute to the development of more inclusive and user-friendly information retrieval systems. Successful and usable interface design builds upon research and user testing. If such knowledge acquirement is limited to stereotype thinking about users and search behaviour, there will be several shortcomings in the system. This simplified view benefits neither users nor system developers. By establishing data collecting methods that include a wide range of user behaviour, one can design for a broader group of end users. Moreover, information systems that support the information behaviour of neurodiverse people, can benefit all users. Research that builds upon simplifications and stereotypes can be purposeful when creating information systems that works for most people. However, when universal design is the goal, one must aim to design for the edges rather than the average. In this context, an understanding of human complexity is essential. Consequently, this needs to be reflected in all aspects of the research process.

One problem with categorizing people is that we end up defining a person only based on one characteristic [4], for instance that a person is blind, has a learning challenge or a gender-fluid identity. People are complex, and there are many different characteristics that affect user behaviour. A person with autism spectrum disorder can for instance be a teenager, gender-fluid, extremely talented in computer gaming, and speak three different languages. By including this person in the sample of "neurodiverse people", all the other aspects of this person are lost, such as high digital literacy. Participant categories such as gender, sexual orientation, socio-economic status, religion, age, nationality, and ability relate to both sameness and difference. Identity categories consist of various characteristics that overlap and interconnect and do not necessarily function as mutually exclusive entities. The UDR approach can facilitate for intersectionality which can mirror a diversity of users and user behaviour. This intersectionality can in turn provide a truer picture of complex human information behaviour.

The original definition of UDR put forward by Williams and Moore [11] was "*the design of research so that all people can be included as potential participants, to the greatest extent possible, without the need for adaptation or specialized design*". In this paper we have regarded this definition as consisting of three parts, as discussed above. The first part of the definition addresses who should be regarded as participants. This requirement holds as a premise that researchers must be aware of the various characteristics and identities people hold and not make assumptions about stereotypes. Moreover, some characteristics may not be necessary to address if it might result in stigmatization or exclusion of certain users.

The second part of the definition includes an important limitation, emphasising that that it will not be possible to design research studies which include everyone. Including everyone is not possible without violating ethical guidelines. Examples are certain people who have challenges with communication or cannot provide informed consent. In some cases, a few considerations will accommodate user needs, in other situations, people will not understand what they are giving consent to or are participating in, making the research highly unethical. We therefore suggest adding an ethical aspect to the definition.

The third part of the definition is a demand for no adaptations or specialized design. We argue that several small adaptations can be purposeful without affecting the research design or results. Examples are allowing some user control over certain parts of the setup if using a computer or by providing information about the study or asking questions in

different modalities to make sure all participants comprehend. We therefore suggest modifying this part of the definition by adding a modification to the demand of no adjustments or specialized design.

We suggest the following revised version of the definition applied by Williams and Moore [11]: *"The design of research so that **as many people as ethically justifiable** can be included as potential participants, to the greatest extent possible. **The research design shall enable and empower people to participate with equal opportunities** without the need for **extensive** adaptations or specialized design"*

5. Conclusion

The Universal Design of Research approach may be useful as a framework to increase the awareness among researchers that a representative sample must represent the whole population. To be applicable as a framework or methodology, however, there is a need for a clear definition of the concept. Our suggestion should not be regarded as a final definition, but rather an attempt to develop the concept further. Moreover, it seems necessary with additional principles, for example inspired by the principles of universal design [10], but revised to fit within a research context. Williams and Moore [11] suggested four rules, which seem purposeful. They are, however, limited to people with disabilities. We therefore suggest as future work to both look into the definition of UDR, but also at a set of principles to guide researchers in making their research more inclusive.

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Towards 3rd Generation Universal Design: Exploring Nonclusive Design

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Abstract. In this paper, we identify and describe early signs of a shift towards 3rd generation UD, of which "nonclusive design" is an essential part. The paper explores the significance of such a shift using examples of the built and designed environment and of signage. Nonclusive design means design that resists categorisations of bodies/roles and that does not come with predefined or presupposed limits in terms of who it is meant for. We outline seven themes characterising the shift towards nonclusive design: 1) from included to undefined users, 2) from person to function, 3) from adaptism to variation, 4) from separation to convergence, 5) from reactive to proactive, 6) from unaware to aware, and 7) from explicit to tacit. Nonclusive design directs attention to context instead of the individual, focusing on possibilities, functions and facilities. It has a convergent character, highlighting variation and unity rather than separation. Nonclusive design presupposes awareness, knowledge and proactive development void of adaptism. It incorporates human variation without reiterating patterns of norm-deviation. We argue that the continued growth of UD demands, is part of, and contributes to a shift in culture, with nonclusive, intersectional thinking as a key future driver. In such a culture, 3rd generation UD can contribute as a common guiding mindset, as a source for innovation, as a way to listen for diversity in all its forms, and as a way to lead towards a sustainable society.

Keywords. *Universal Design, Intersectionality, Norms, Norm-Deviation, Diversity*

1. Introduction

This paper identifies early signs of an ongoing shift towards a 3rd generation Universal Design (UD) and argues that such a shift will need to move beyond patterns of norm-deviation to incorporate variation. The paper explores the significance of such a shift using examples of the built and designed environment and of signage and introduces the notion of "nonclusive design" as an essential character of 3rd generation UD.

From its early days, UD has always been concerned with processes and societal development. The understanding of UD as primarily a process concern can be traced back to Mace and the mid 80's, and has repeatedly over the years been highlighted by Steinfeld and colleagues [1–3]. In 1985, Ron Mace put this as "Universal design is ultimately about changing attitudes throughout society, emphasizing democracy, equity,

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and citizenship. Universal design denotes a process more than a definite result." (Mace 1985, cited in [4]).

However, a lot of research has focused on UD as something primarily found in finished design solutions. One reason for this could be the definition of UD by Connell et al [5]: "The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." This definition, and its accompanying seven principles of UD (ibid.) have led people to understand UD as specific characteristics found in finished design solutions, features that can be ticked of a checklist [6].

In this paper we highlight a need to return to UD's original concern with processes and societal development. This is also in line with the development of the field of design more broadly: the understanding of the term 'design' has matured during the past three decades from being about surface, form and finish to being seen as a force for transformation and solving complex social problems. As part of this development, its focus has shifted from "design as styling" to "design as process" [7,8]. A similar development regarding UD has also been articulated by others [1,3].

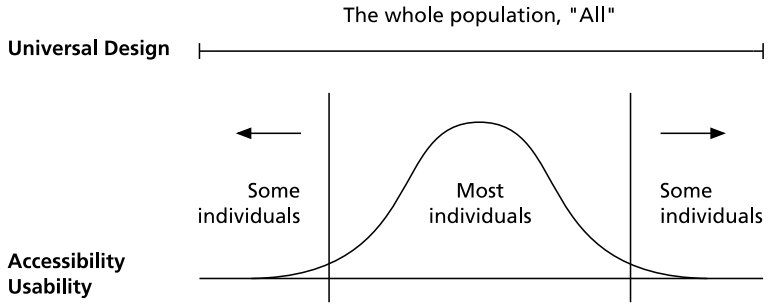

Figure 1. Illustration of two different thought models; norm and deviance on the bottom and diversity at the top (Adapted from [9]).

UD was originally conceptualised based on the idea that there is only one population. It was a reaction against and an intentional move beyond the notion that there is an imagined "normal" person, and then there are the ones deviating from those norms. However, UD has always been accompanied by the hedging statement "to the greatest extent possible" [5]. This has often been regarded as a compromise and a response to the claim that UD is a utopian concept. It might also be seen as a sign of influence from the terms 'accessibility' and 'usability', which are conceptualised as measurable concepts with predefined limits (Figure 1). The understanding of accessibility has been established over several decades and seems to easily rub off on how UD is understood and dealt with in practice. Accessibility is operationalised based on norm and deviation, which makes it suitable to be applied in standards and guidelines [9]. When treated as a laundry list of measurable features, UD takes on a similar character – despite its origins.

1.1. Purpose and research questions

For UD to succeed on a societal level, it presupposes a shift from thought patterns based on norm and deviation to thought models resting on variation as a core tenet. The purpose of this paper is to exemplify and critically discuss what a shift from norm-deviation to variation means when it comes to signage and the design of the built environment. We

illustrate and analyse this shift by means of photographs from our research. The research questions that we pose are:

RQ1. What characterises patterns of norm-deviation and variation in finished design solutions?

RQ2. How can a shift towards a variation-based UD be understood?

2. Method

The paper is based on photographs from three major research projects on norms, categorisation and UD, in total about 300 photographs collected from 2018 and on [10,11]. Some of the photographs we have taken ourselves during observational studies and some have been contributed to us as part of a citizen science-based study. While the paper deals with UD as a process character, the photographs show end results. The reason for analysing finished solutions is that they show the kind of thinking that went into the design processes yielding the design. We also utilise the material below to illustrate and support our lines of argumentation. The underlying analysis has had a hermeneutic [12] character and consisted of both formal analysis sessions using NVivo and informal activities such as discussions at project meetings, seminars and presentations. This has continuously advanced our understanding of the material as a whole, what the photographs individually express, and over time allowed us to identify and mature in our interpretation of patterns in the material.

3. Findings

The growth of UD has so far progressed from "barrier-free design" to "inclusive design" (Figure 2), the currently predominant understanding of UD. Our study identifies some early signs hinting towards a 3rd generation UD on the horizon. There is potential for a shift in design (both practice and patterns) from inclusivity to a phenomenon we would like to call nonclusivity. Like inclusive design, nonclusive design deals with people, but it resists categorising people/roles and resists introducing predefined limits in terms of expected users. We see nonclusive design as including intersectional thinking, where power structures are seen as overlapping, interacting and mutually constituting [13].

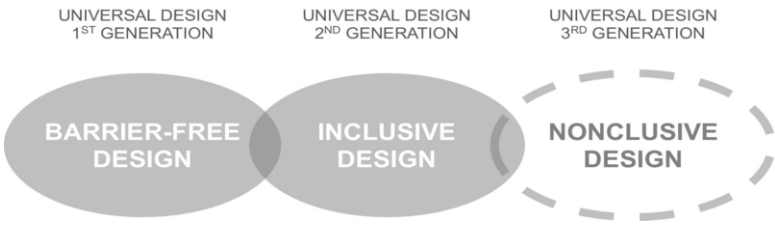

Figure 2. Overview of generations one to three of the development of UD.

Below we outline seven themes regarding what such a development of UD might entail:

- From included to undefined users

- From person to function
- From adaptism to variation
- From separation to convergence
- From reactive to proactive
- From unaware to aware
- From explicit to tacit

3.1. From included to undefined users

Figure 3-4. Two photographs of toilet doors portraying two different ways to convey that the toilets are for all people

Two photographs of toilet doors portraying two different ways to convey that the toilets are for all people. The door to the left has four pictograms depicting a person in a wheelchair, a man, a woman, and a mother changing diapers. The strategy is *inclusive*, including more and more pictograms of who the toilet is meant for. On the photographs to the right there are two doors, a narrower door to the left and a wider door to the right. These doors that do not carry any signs of persons. Instead, there are patterns of dots and lines on them showing their different widths. The signage on the doors do not come with predefined or presupposed limits. In fact, the signs on the doors do not say anything about persons and their gender at all. The two photographs together show a shift from included to undefined intended users.

3.2. From person to function

Figure 5-6. Two photographs of toilet doors portraying different signs

Two photographs of toilet doors. On the door to the left there are three signs depicting a person in a wheelchair, a family (child, dad, mom), and a father changing diapers. On the door to the right there is a sign saying, “Toilet with wall grip” and a pictogram of a

toilet grip handle. The two photographs together show a shift in design practice from person to function, i.e., a shift from identifying which kinds of people are to use the facilities to showing what the facilities consist of.

3.3. From adaptism to variation

Figure 7-8. Two photographs showing the different approaches to dealing with differences in level/height

Two photographs showing the different approaches to dealing with differences in level/height. To the left there is an entrance to a café. It is in a newly built environment. There is a slight difference in height between the doorway and the outside level, which is solved with a step and a ramp. The solution solves the mechanical problem of getting in, but it is also a solution to a problem that did not exist before the introduction of the step. There is plenty of space outside the door, and entrance could easily have been solved without a ramp. As it is, the main solution is solved with a (contrast-marked) step, and those who cannot use the step will have to take a rather long detour to reach the door. The solution as a whole is built on a traditional approach for realising accessibility by implementing a tacit norm position for the imagined "normal" person and solving the rest with separate solutions. The solution is an expression of what we would like to call "adaptism", i.e., a form of ableism caused by the tendencies to rely on a "normal" solution and "adaptations" to solve other needs. In the photograph to the right, there is a set of stairs with an integrated flexstep solution. This solution opens up for variation, diversity and difference, a fundamental character of the human condition. The two photographs together show a shift in design practice from adaptism to variation.

3.4. From separation to convergence

Figure 9-10. Two photographs from entrances

Two photographs from entrances. To the left there is a sign saying “Entrance” and an arrow pointing to another door, separate from the main entrance. This solution creates a separation between different persons approaching the entrance. It treats persons with impairments as separate cases, to be dealt with as a separate issue. To the right there is a newly built main entrance to a several hundred years old building. The old main entrance, in the form of a staircase, is not used anymore. The two photographs together show a shift in design practice from separation to convergence.

3.5. From reactive to proactive

Figure 11-12. Two photographs showing dedicated parking spaces

Two photographs, where the left shows a “wheelchair parking space” in an auditorium that has been marked by orange taped rectangle on the floor. There is also a sign on the floor saying, “Reserved for wheelchair”. This parking space has been added temporarily, as a reactive measure since there is a conference in the disability field going on. On the photograph to the right, there is an embedded tactile path to follow for persons using a white cane. The solution is well integrated in the environment and was part of the design from the beginning. The two photographs together show a shift in design practice from reactive to proactive.

3.6. From unaware to aware

Figure 13-14. Two photographs from toilet doors

Two photographs from toilet doors. On the door to the left there are two signs: a person in a wheelchair where a rabbit head has been added to the person and a baby where an

alligator head has been added to the baby. This play with pictograms suggests some discomfort with the binary nature of the original signs, but the addition of animal heads neither disrupts the binary nor clarifies who is meant to use which toilet. On the right there is a sign saying "Toilets" and an ideographic all-gender pictogram. The sign deliberately moves beyond pinpointing separate genders. The two photographs together show a shift in design practice from unawareness to awareness.

3.7. From explicit to tacit

Figure 15-16. Two photographs showing prioritised seating places

Two photographs. To the left, there is a sign saying "Prioritised seating places" combined with three pictograms: a bent over person with a cane, a pregnant person, and a person with a leg injury and a crutch. The sign explicitly tells who is prioritised, and who is not. The photograph to the right shows the counter in a pharmacy store. What is not evident until one approaches the counter is that it can be raised and lowered electrically by the cashier according to the customer's height. This functionality is tacitly embedded in the design, without categorising its users. It is there when needed by someone. Anyone. The two photographs together show a shift in design practice from explicit to tacit accommodation.

4. Concluding discussion

In this paper, we have identified and described some early signs of a 3rd generation UD, of which nonclusive design is an essential part. Nonclusive design means design that resists categorisations of bodies/roles and that does not come with predefined or presupposed limits in terms of who it is meant for. We have outlined seven themes characterising the shift towards nonclusive design. The concept directs attention to context instead of the individual, focusing on possibilities, functions and facilities. It has a convergent character, highlighting variation and unity rather than separation. Nonclusive design presupposes awareness, knowledge and proactive development void of adaptism. It incorporates human variation without reiterating patterns of norm-deviation.

Despite the claim of UD being for everyone, which has been reiterated for almost 40 years, it is still understood primarily to be intended for disabled persons. The existing thought models have yet to achieve the intended shift towards all people. We argue that

nonclusive UD offers design patterns supporting a development where variation is the norm. Difference is a fundamental part of the human condition. For decades, the response to human difference have been one of norm-deviation, causing a range of separate solutions, i.e., "adaptations" for the one understood as deviating from the norm. Here, nonclusive design hints towards a move beyond adaptism as a response to variation. By resisting categorising people or explicitly defining specific users (one, all, some), it also offers a way out of the one-size-fits-all vs. one-size-fits-one debate.

Nonclusive design brings about solutions where people do not have to negotiate categorisations and predefined expected users. This replaces the current chatter of pictograms and other images of people with a silence that was not there before. A sweet silence that allows people to go about their day as they are. But it is also a potentially dangerous silence, if mistaken for a reduced need for knowledge. Just as before, a society for all can never be realised without a rich understanding of people and the swarm of differences and variations they constitute. We argue that the continued growth of UD demands, is part of, and contributes to a shift in culture, with nonclusive, intersectional thinking as a key future driver. In such a culture, 3rd generation UD can contribute as a common guiding mindset, as a source for innovation, as a way to listen for diversity in all its forms, and as a way to lead towards a sustainable society.

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Adaptive Refurbishment for Aging in Place: Design Scenarios of Case Studies in Turin, Italy

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Abstract. The "aging" world implies a rethinking of housing models, to meet the needs of the elderly for physical and mental well-being, independence, social interaction, safety, and accessibility. "Aging in place" is recognized by experts and international literature as a fundamental strategy for maintaining conditions of well-being and reducing public spending on health care. However, often the houses do not have the requirements to easily adapt to the needs that change with aging and possible downsizing of the family unit. For the elderly, maintaining their own home can become unsustainable due to problems of costs, oversizing, physical and perceptual accessibility, and safety. The contribution, taking as a case study the residential building heritage of Turin (Italy), illustrates and critically compares scenarios of adaptive recovery of homes to make them suitable for the needs of the elderly, intending to promote "aging in place" and housing adaptive refurbishment as a sustainable strategy.

Keywords. Aging in place, adaptive refurbishment, residential building stock, circular strategies

1. Introduction

The "aging" world implies a rethinking of housing models, to meet the needs of the elderly for physical and mental well-being, independence, social interaction, safety, and accessibility.

Instead of hospitalization or institutionalization, the elderly should stay in their own environment as long as possible. "Aging in place" is recognized by experts and international literature as a fundamental strategy for maintaining conditions of well-being and reducing public spending on health care. Hence the importance of the home, the main context of the elderly people's life, in which they generally wish to remain as long as possible in conditions of security, independence and comfort [1].

However, often the houses do not have the requirements to easily adapt to the needs that change with aging and possible downsizing of the family unit. For the elderly, maintaining their own home can become unsustainable due to problems of costs, oversizing, physical and perceptual accessibility, and safety.

Italy, in particular, has a rapidly aging population and has an old residential building-stock, built mainly before the adoption of accessibility and energy efficiency regulations.

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On the other hand, the recovery of existing assets rather than the construction of new housing interprets the concepts underlying the circular economy and it drastically reduces the negative impacts on the environment.

In particular, flexibility and adaptability are key-strategies in the frame of design for circular economy, aimed at prolonging the lifespan of the building and accommodating changes in requiring modifications. As defined by Addis and Schouten [2] a flexible building is “a building that has been designed to allow easy rearrangement of its internal fit-out and arrangement to suit the changing needs of occupants”. Moffatt and Russel included flexibility and convertibility as sub-strategies to design for adaptability: according to the authors, adaptable buildings should be maintainable, versatile, and capable of responding to changing circumstances, for example, with a more efficient use of space, with minimum quality loss and environmental impacts [3].

Moreover, a circular approach to the refurbishment of existing residential buildings can extend their useful life and generate multiple benefits by contributing to economic and social development, considering several variables (such as the context and the changing needs of users [4].

2. Objective and methodological approach

Starting from the World Health Organisation guidelines [5], several researches have focused on adaptating of housing units to favour aging in place. However, the proposed solutions are linked to country-specific characteristics, which are difficult to adapt in a 'universal' way [6].

From these considerations, the research “Circular approach to aging in place in existing buildings”, taking as a case study the residential building heritage of Turin (Italy), illustrates and critically compares scenarios of adaptive recovery of homes to make them suitable for the needs of the elderly, intending to promote "aging in place" and housing adaptive refurbishment as a sustainable strategy.

The adaptive refurbishment scenarios of housing, to make them suitable for "aging in place", are built based on an analysis of the residential building stock of the city. Based on the information available from the national housing census and the Real Estate Observatory, some representative dwelling typologies are defined, different in size, construction period, level of physical accessibility. Circular refurbishment interventions are simulated, taking into account the obstacles (e.g. identification of the most efficient interventions, costs) and opportunities (grants for the recovery of assets) and associating the typologies with different kinds of elderly users (e.g. alone, in couples, with the need for partial assistance, with physical disabilities, owners, tenants, with different income levels). Figure 1 summarizes the methodological approach.

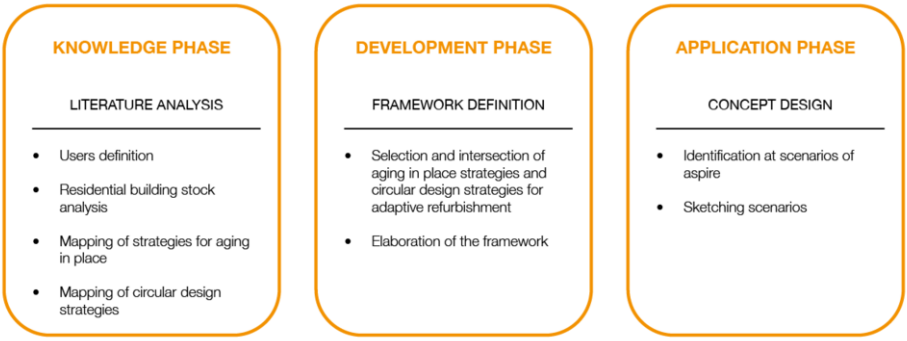

Figure 1. Synthetic scheme of the Research Methodology.

2.1. Italian residential building stock

Aging in place refers to the possibility for individuals to live as long as possible in their own home and community in a safe, independent and comfortable way regardless of their age, economic status and level of habitability [7]. The provision of new housing options is crucial to enable older people to "age in place". Despite the fact that there is a trend in the housing market to offer new housing solutions for the elderly who are still independent, designed with good levels of accessibility and security, the possibility of buying a new home remains an option for a few and implies a removal from the social context of origin.

However, the option of adapting housing to the new needs and changes in the households of the elderly comes up against as many difficulties, which are in part due to the characteristics of housing in our country. The Italian residential building heritage is largely made of historic buildings, which have undergone deep transformations and adaptations over time. 74% of residential buildings were built before 1980 and therefore before the laws and regulations that established minimum requirements for safety, energy efficiency and accessibility.

In addition, about 30% of the buildings constructed before 1945 are in a state of conservation considered of low-quality or very poor, and the percentage drops to only 25% for buildings constructed between 1946 and 1970.

The houses built in response to the housing emergency after the Second World War have been designed for large families, but the contemporary family models have radically changed.

The introduction of minimum requirements for the accessibility of houses dates back to the late 1980s, as well as the obligation to provide a parking space. Most of the residential buildings in urban contexts are currently without the minimum accessibility features of parking the car and getting to the house by a lift.

However, there are some opportunities provided by state incentives and tax deductions for building renovation, both on individual residential units and on the common parts of buildings. Incentives concern not only the improvement of energy performance, in line with the objectives of the European green deal, but also accessibility, with specific measures for disabled users, and the purchase of new furniture. The research on age-friendly assessment of housing [9] by University Federico II of Naples

gives a complete picture of the problems related to the adaptation of homes to the needs of the elderly user and, analyzing the main obstacles to the adaptation of homes, highlights not only the costs but also the difficulty in understanding how to carry out the work and the difficulty in finding honest and responsible professionals to whom to entrust the work.

2.2. Housing situation of older people in Turin

The research took into account different kinds of elderly users. On the one hand, the family unit was specifically analyzed (e.g. alone, in couples, with the need for partial assistance, with physical disabilities). These characteristics are linked to the need for accessibility and security with a view to making the elderly person's life autonomous in their own home. A survey carried out on a sample of 1118 people with an average age of 74 years reveals that 34% of the users live alone while 61% live with one or more family members. 74% of the sample are homeowners; about 50% of their homes are between 80 and 120 m^2, with an average size of 90 m^2 [8].

As regards the income, at national level ISTAT data show that the average amount of the pension is 1,616 euros which is the only source of income for 92% of the users over 65 years old [9]. House maintenance commits 11.3% of income for users over 65. The percentage drops considerably for the lower age groups.

2.3. Identification of a reference framework

Based on the analysis of scientific literature, the research linked circular economy strategies for adaptive reuse of residential buildings with the specific needs of adaptive-refurbishment scenarios in relation to elderly users.

As regards the circular approach, the analysis of the relevant publications on circular economy strategies for building design suggests several ways of action. In particular, the framework suggested by BAMB [10] identifies guidelines based on the main reuse and transformation criteria and their interactions, interdependencies and importance. Four key design criteria define spatial reversibility (dimension, position of core elements, building disassembly level, capacity of the core) and eight key design criteria define technical reversibility (functional decomposition, systematization and clustering, hierarchical relations between elements, base element specification, assembly sequences, interface geometry, type of the connections, life cycle coordination in assembly/disassembly). These criteria can guide the adaptation of a home to the new needs of the elderly. Interventions according to spatial and technical reversibility by adapting the existing apartments to new housing options are necessary to enable older people to "age in place".

3. Intervention scenarios on a representative case study

With the aim of outlining different possible scenarios on the recovery of a house that become unsuitable for the needs of an elderly user, an example, representative of the housing stock in the city of Turin, is illustrated. It is a flat of about 90 m^2 in a house with balcony access. The building is constructed in load-bearing masonry and has already undergone some interventions to improve accessibility, while the flat is in its original state with the insertion of the lift in the stairwell.

We assume an elderly user, over 75, owner, still self-sufficient and alone, for whom the size of the flat and the costs related to its maintenance and management are not compatible with his needs. In the hypothesis it is considered that the flat has reached the end of its life cycle and needs a complete renovation of the internal finishes and systems and that there is a general condition of unsustainability and incompatibility between the elderly person's life needs and the characteristics of the flat. Several scenarios can be considered:

- A, new dwelling;
- B1, minimal adaptation of the existing flat;
- B2, adaptive refurbishment;
- C, social care facility.

In scenario A, the user sells the flat and moves into a new home designed to suit his or her needs. Figure 2 illustrates a layout of a dwelling designed for ageing people that ensures complete accessibility, use and safety. First of all, it presents an optimal orientation and distribution through a large balcony conceived to be also a space of aggregation and meeting with other users. There is a large living area that allows use without physical obstacles (open space) connected to a terrace and the toilets are also accessible by a disabled user in a wheelchair. The strength of scenario A is the guarantee of maximum accessibility and usability for the user, the risks are the economic unsustainability of the operation (the original unrestored flat could be sold at a minimum price) and the separation from the original urban and social context.

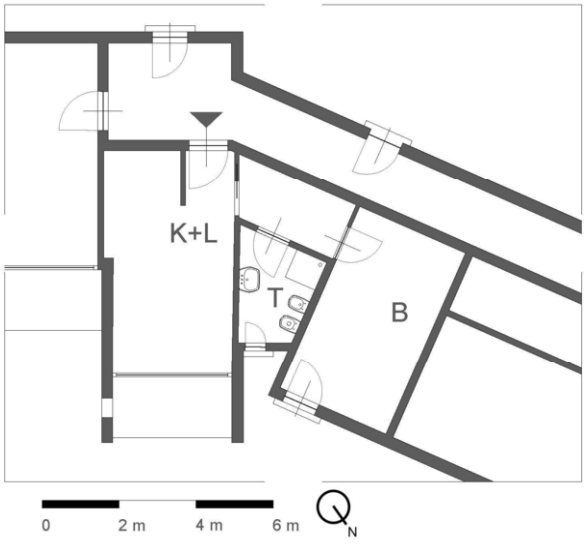

Figure 2 Scheme of a new age-friendly house based on the project of Bianchetti Greppi - dwellings and services for ageing people, Collebeato, Brescia, 2008.

In B1, the user keeps the flat by adapting it with minimal interventions, such as the replacement of furniture (safer and more functional and minimal adaptations of plants) without modifying the internal distribution or carrying out masonry works. Figure 3a shows the original state, with an interior layout characteristic of this type of building very common in the historic urban context: three rooms and a bathroom and kitchen facing the inner courtyard. In this case the problems of internal accessibility (e.g. of the toilet)

are not solved and the problem of the expenses for maintaining the flat, which is too large for the user, is not solved too.

In scenario B2, the user transforms his home (fig. 3b), dividing it into two units. The elderly user keeps one, while the other can be sold or rented. In this scenario, which is more complex to implement than the others, the elderly person could remain "in place" and find a financial balance that allows him to live in a fully accessible, safe, usable and circular home. The constraints to the transformation are multiple: the structure with load-bearing masonry does not allow a free redefinition of the layout, just as the external openings cannot be modified, it is difficult to suppose a free relocation of bathrooms and kitchen far from the drainage stacks, the user must in any case adapt his living habits to a smaller surface giving up part of his goods and furniture. In addition, the house is unusable during the adaptation work. It should be taken into account that the current legislation on home accessibility prescribes that renovations of private dwellings must guarantee accessibility for users with physical disabilities or demonstrate adaptability with simple adaptation measures for the full use of the toilets and living areas of the dwelling.

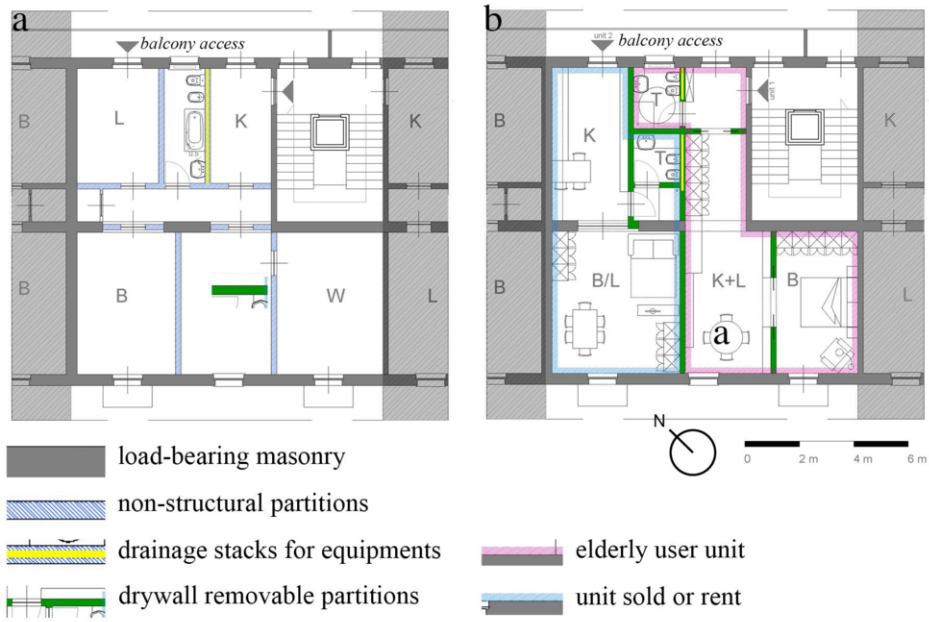

Figure 3. Figure 3a shows the 90 m2 dwelling in the original state, while 3b shows a possible transformation in scenario B2.

However, the benefits are manifold, environmentally, economically and socially. The renovation of the existing building reduces the environmental impact, the consumption of new resources and the use of land. Retrofitting is carried out with light reversible technologies, allowing the restoration of the original dwelling unit or further modifications that may become necessary over time. From an economic point of view, the conversion of the dwelling is sustainable through the sale or rental of the additional dwelling unit. From the point of view of social well-being, the independence and familiar setting and routine is maintained.

In C the user, even if still with a good level of self-sufficiency, is transferred to an assisted structure. This scenario, besides being often not very sustainable from an economic point of view, not only for the user, but also for the burden on the public social-welfare system, leads to a radical change of the living conditions, which can be in some cases traumatic, and to a considerable reduction of the autonomy of life.

4. Results

The comparison of possible intervention scenarios allows pointing out problems, opportunities, strengths, and weaknesses of "aging in place" with particular reference to the national context. The scenarios are compared with each other and with the opposite scenario of transfer to a care facility.

Scenario B2 is probably the least frequent, not only because of the complexity of the architectural intervention, but also because it requires determination and commitment on the part of the user and in a certain sense a capacity for vision and planning (fig. 4). However, it represents an interesting perspective that can be facilitated by a proactive attitude of a series of subjects supporting the elderly person. Support from relatives in helping to encourage and assist the elderly person in a complex intervention is crucial. The professional is required to make a greater commitment to design solutions that are compatible with the many architectural constraints and knowledge of appropriate technologies, often different from traditional ones, to meet the requirements of reversibility. It is also required to focus more attention on project management and effective coordination of contractors.

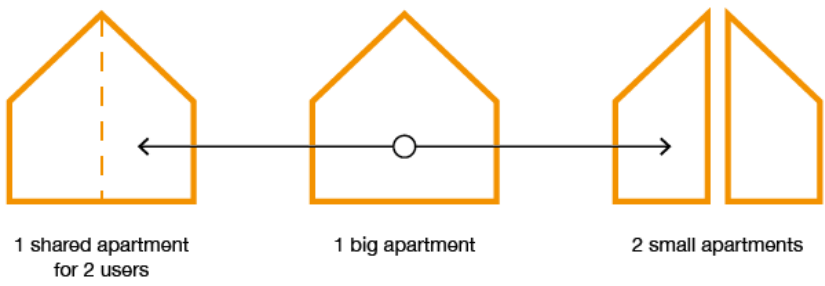

Figure 4. Adaptive refurbishment for aging in place.

5. Conclusion

According to the World Health Organization, cities should develop new housing options, to allow citizens to "age in their home". The contribution illustrates the scenario of a typical and recurrent condition, with the awareness that the problem is very complex and that the most effective solutions must be developed on a case-by-case analysis, taking into account the specific needs of the user. The advantages are individual and collective: the overall well-being of users, the decrease in public spending on health care, the

recovery and continuous maintenance of the building stock in a circular economy perspective. However, in the national context, there are numerous problems related to the characteristics of the buildings (accessibility, safety, poor state of conservation, poor energy performance, comfort), to the burden of costs for refurbishment interventions, but also to a lack of attention in architectural design and the difficulty in establishing the priority of interventions. However, "aging in place", by adapting homes, is a sustainable strategy, for which it is necessary to build the necessary conditions (regulations, technical support, grant opportunities) towards a new horizon of social housing.

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Section 2

System and Standards for Universal Design

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Transforming our World through Universal Design for Human Development
I. Garofolo et al. (Eds.)

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Can I Get There? Can I Play? Can I Stay? Creating an Inclusive Playspace Guide in Australia

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Abstract. Playspaces bring children and adults together for fun and social interaction but are rarely designed for the inclusion of all community members. In Australia, local government authorities (councils) are responsible for parks and playspaces. The New South Wales state government launched their inclusive playspaces policy in 2017. A guideline document was proposed but a guideline does not guarantee implementation. Consequently, an inclusive design process for developing the guide became the strategy. The task was to develop a guide that explained the concepts of inclusion and universal design within the playspace context. The project took an iterative and collaborative approach to the design of the guide. Intended users were those involved in creating playspaces, not playspace users *per se.* The participatory governance structure involved three levels of collaboration: a small steering group of experts, a larger group with key stakeholders, and a wider group of stakeholders and interested persons. This collegial and participative process consisted of a series of meetings and workshops which fostered learning and ideation for all participants. Through this process three underpinning concepts emerged: Can I get there? Can I play? Can I stay? The process educated and informed stakeholders, encouraged participants to contribute to the outcomes and provided community-led guidance for those contracted to design the guideline. The result was an inclusive playspace guide that recognized the design guidance required by council personnel in the context of universal design. The process and governance structure provides a good working model to build on. The success of the guideline was recognized with a national award from the Institute of Landscape Architects for Community Contribution. The purpose of this paper is not to comment on or evaluate the outcome of the guidelines. Rather, it is to document the inclusive and participatory governance structure and iterative process from a professional participant perspective.

Keywords. Playspaces, universal design, participatory action research, local government, guideline

1. Introduction

Play is widely recognized as an important part of a child's physical and social development [1]. Play is also fun, and designated playspaces at a local level offer children and adults an opportunity to interact informally. Ensuring that everyone can

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participate in play activities is therefore important for all children, their parents and caregivers. However, children and adults with disability are often excluded from the benefits of play and related social interaction because playspace designs are not accessible or inclusive. Playspaces in New South Wales (NSW) range from a swing and slide set in a pocket park in a residential area to large scale regional playspaces in parklands that offer a wide selection of activities.

Existing guidelines and frameworks for councils, practitioners and the broader community on the design and development of inclusive playspaces [2, 3] contain useful information and are set out in logical formats. However, a document alone does not encourage implementation or understanding of why and how a playspace should be inclusive. Educating stakeholders about the "why" as well as the "how' were considered an essential factor for the success of the project.

2. Background

In NSW, local government authorities (councils) are responsible for the design and upkeep of playgrounds and playspaces. Many councils refer to catalogues of modular playground equipment, which by default, become the playspace design especially in small parks. Larger regional playspaces are usually designed by landscape architects and contain a greater choice of activities. Historically, few parks or playspaces were accessible for people with disability. Advocacy on this issue led to a movement in specialised playspaces for children with disability. These were typically fenced and accessed only with a special key.

The next wave of playspaces were known as "All Abilities Playspaces". Whilst unintentional, this terminology signals that these playspaces are somehow "different" and "special" because they are designed for children with disability rather than everyone. Consequently, it does not meet the aim of being inclusive for social and communal interaction. The aim of the project therefore was to make all playspaces inclusive for anyone and everyone of any age.

In November 2017, the NSW Minister for Planning announced state-wide funding to create inclusive playspaces based on universal design principles. In a media release [4], the Minister said, "I want all playgrounds in NSW to be reviewed as part of an in-depth audit that will see them assessed and rated against universal design principles. To make it happen, we are introducing a clear set of playground and park design guidelines for councils and developers to follow…"

The NSW Department of Planning, Infrastructure and Environment (NSW Planning) became responsible for the project and the allocated budget of A$20m over five years which was to be awarded to councils through a grant application process. This budget allocation encouraged councils to participate because there was a government commitment to action. The Office of Open Space and Parklands within NSW Planning was given carriage of this initiative.

The production of a guideline document was the overarching task. The document-making process was used to educate stakeholders about inclusion and universal design to increase the likelihood of successful implementation. Communicating the design guidance in straightforward and engaging ways was also an important part of the project. Hence the project took a universal design approach using iterative co-design methods. The literature refers to this method as participatory action research and has been applied across a range of public policy settings [5].

3. Participatory Action Research

Participatory Action Research (PAR) is an approach to community development that involves researcher, practitioners and participants working together to examine a problem and change it for the better [6]. This approach is usually associated with solving a social problem. The aim is to find ways to take action to ameliorate or remedy the situation using the input and experience of those experiencing the problem. An iterative process provides an opportunity for all stakeholders to share understanding and knowledge and consequently, this method is sometimes known as Action Learning [7].

PAR also involves actors who have a stake in the outcome of the process. It is typically used where service providers and governments want to deliver high quality and responsive services such as health and education to vulnerable populations. Importantly, the process itself, through participating, contributing, and learning, encourages the community in question to own and accept responsibility for the decisions and outcomes, and if appropriate, act on them. It is therefore more than a simple community consultation. Rather it is an iterative process [8] that is well-documented and where the ideas and solutions are evaluated through a continuous feedback loop. It was during the succession of meetings and workshops that it became evident that this process most closely matched the elements of the PAR methodology.

In this case those most affected by decisions were council staff who would be using the guideline and who were then expected to use an inclusive process to consult with their communities in the development of new playspaces. Members of advocacy organisations and universal design champions were taken as *de facto* representatives of those who use playspaces.

4. Method

A small group of people who had experience in inclusive playspaces, universal design, and local government processes were invited to the first exploratory meeting and workshop. Office of Open Space and Parklands staff, and a representative from a consulting landscape architecture firm were present as observers. The landscape architecture firm was commissioned to provide technical design expertise. Terms of Reference were developed and agreed by all parties. On the basis that it was not possible or desirable to have all relevant stakeholders at all discussions and workshops, an iterative approach was devised in four parts, each building on the one before.

The Advocacy Group was formed from the initial small working party of champions for universal design and inclusive playspaces, together with representatives from councils that had previously established inclusive playspaces. A small group allowed for roundtable in-depth discussion, analysis of ideas, and knowledge sharing. NSW Planning staff gathered the knowledge shared, reflected on the information and planned the next iteration in the process. This is conceptualised in Figure 1.

The firm of landscape architects consulting on the project attended all meetings and workshops. They provided technical design guidance and worked with Steinfeld and Mailsel's 8 Goals of Universal Design [9] to contextualise them into playspace terminology at the commencement of the process. This was an important step because it framed the work going forward. The 8 Goals were transitioned to 6 Design Principles: Find, Fit, Choose, Join In, Thrive, and Belong [10].

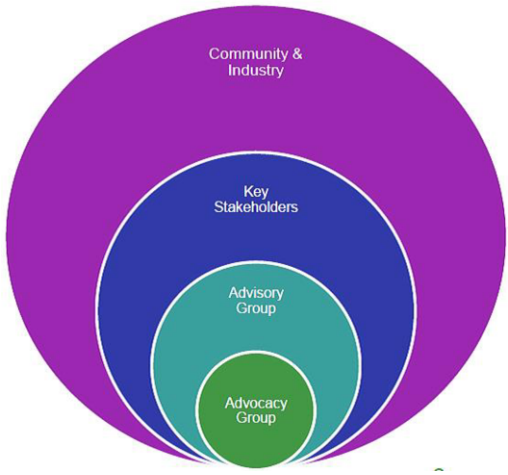

Figure 1: Four tiered iterative approach to inclusive development of the Inclusive Playspace Guidelines (source: NSW Planning)

It was acknowledged that not all councils would be willing participants in this new initiative, many having reservations about cost and ability to comply. Council areas in NSW vary considerably in size, staffing levels and budgets. Consequently, the financial and staffing abilities of all councils were considered in the process. The guideline, therefore, needed to be persuasive, educative and easy to apply. A participative approach – a universal design approach – assisted with the acceptance of the project at a local level.

5. The process in detail

The small Advocacy Group used the 8 Goals of Universal Design as a starting point for discussion [8] Briefly, the 8 Goals are: Body Fit, Comfort, Awareness, Understanding, Wellness, Social Integration, Personalisation, and Cultural Appropriateness. To assist with conceptualising and operationalising the Goals in the playspace context, six principles were identified: being able to find things easily; being able to physically access equipment and places; being able to choose activities; the ability to join in with others, being able to develop motor skills, and to have a sense of belonging. Table 1 shows how the 6 elements link to 6 of the 8 Goals of Universal Design.

Table 1. 6 Key play principles linked to the 8 Goals of Universal Design

Playspace elements	**6 of the 8 Goals of Universal Design**
Find	Awareness and Understanding
Fit	Body Fit and Comfort
Choose	Personalisation and Understanding
Join In	Social Integration and Cultural Appropriateness
Thrive	Wellness, Comfort, and Understanding
Belong	Social Integration

Further discussion of the 6 principles resulted in a distillation of words to plain language expressed as: Can I Get There? Can I Play? and Can I Stay? The Advocacy Group also discussed the most appropriate use of language and terminology to ensure the concepts of inclusion were emphasised. This meant ensuring language did not default to terms that represent disability. For example, it was agreed that "all-abilities" and "accessible" were not to be used anywhere in discussions or in written drafts. To support the concept of universal design, the terms "checklist" and "compliance" were also avoided. A document based on the three Can I's and six principles was taken to the first Advisory Group (second tier group) workshop to seek feedback. The title of the guideline was affirmed as "Everyone Can Play".

The second tier Advisory Group was formed by inviting all councils in NSW and other stakeholders to participate in the first workshop. The Advisory Group eventually comprised approximately 50 participants: council representatives, professional stakeholders, community group representatives, play equipment suppliers, childhood educators and academics. The Minister for Planning opened the workshop with a short encouraging address to reinforce his commitment to "Everyone Can Play".

The workshop process began with a video of personal stories from families who related their experiences of playspace design and how it can exclude and include. This set the scene for the small group work that followed in the workshop. The thoughts and ideas generated in the workshop were followed by a feedback session and an open forum for questions, discussion and comment. A professional facilitator was engaged to lead and guide the process. Members of the Advocacy Group, staff from the Office of Open Space and Parklands, and the consulting landscape architects were also present at the workshop to monitor and record feedback.

The Advocacy Group met again to review the feedback from the workshop and made amendments to the draft document accordingly. A second and final Advisory Group workshop was organised to present the latest iteration of the document for analysis and comment. Specific workshop questions that encouraged detailed interrogation of the document were used. The Advocacy Group met immediately afterwards to review the feedback and discuss next steps. The initial three elements, Can I get there? Can I Play? Can I Stay? were reaffirmed. Minor re-adjustments to the document were agreed.

6. Document design

The design of the document was a critical factor in communicating the information to the target group – council staff, landscape architects, and play equipment designers. The content of the guideline was drawn from participant feedback and NSW Planning policy. The challenge was to take a universal design approach to language and to visual presentation within the document. Images, headings, graphics, colour, size and type of font were all carefully considered. Fun and play were the key elements of the design style which was a major shift for a government document which usually has set standards for official publications. Figure 2 shows the design theme for both printed and virtual versions of the guide.

The document uses photographs, case studies, and personal stories from children, parents and grandparents to explain the importance of inclusive playspaces. The final pages of the document have a checklist based on the 6 principles devised at the beginning of the process. Hard copies of this draft were printed and distributed and used to elicit further feedback. With the document in hand, staff from the Office of Open Space and

Parklands visited regional councils in NSW with the purpose of explaining the guideline and to gain further feedback. The penultimate draft document was then used as the basis of a final one hour workshop at the annual Parks and Leisure Australia Conference to g gain further feedback.

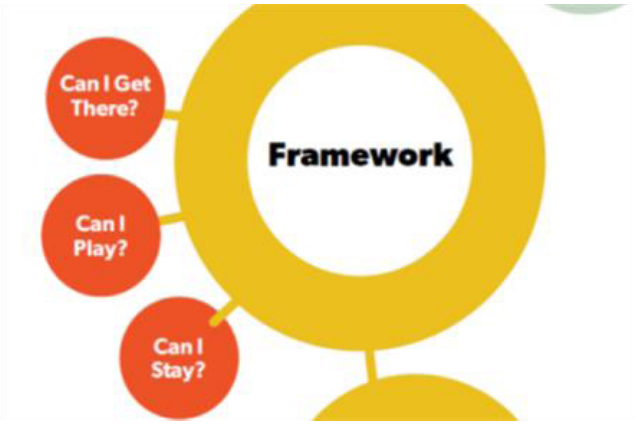

Figure 2. Example of document style

The guideline was also provided in digital format on a designated website with more examples, videos of family stories, and comments from Advocacy Group members. The style of the webpages included the same principles as the printed document. The online resource includes several short videos [11] featuring the experiences of participants in the process, and the three Can I's are expressed in the words of adults and children.

The project was undertaken within 15 month period, and the guideline was launched in early 2019. The process for developing the content took eight months. The final months included two months for the statutory public exhibition time, and time for the last fine tuning before the Minister signed off the project.

7. Advocacy Group feedback and analysis

Following the conclusion of the cycle of meetings and workshops, a two-part question was asked in a survey questionnaire seeking the reflections and comments of Advocacy Group members on the guideline development process.

Question: Considering your role in the Advocacy Group and attendance across the subsequent meetings and workshops in the development of the Everyone Can Play guideline,

a) What do you feel worked well as a part of the inclusive process? For example, who was present, how people engaged, the nature of knowledge sharing and gathering, what you liked most; and
b) What could be done differently next time?

The responses were tabulated and analysed according to content. These responses provide insight into how a participatory and inclusive approach to developing universal design guidelines can be replicated or improved for future applications.

Five features were observed as significant definers of the guideline development:

- Innovative thinking beyond a "checklist" of universal design features
- Understanding the possibilities of multiple platforms to educate and inform universal design practice
- Use of language in an inclusive context
- Effect of participatory process at multiple stakeholder levels
- Process of translating universal design principles and goals to an industry relevant guide
- Having the three Can I's… (Can I get there, Can I play, Can I Stay) makes it easy to remember

While the three Can I's were developed in the playspace context, it was soon realised that these three basic concepts could be applied in other settings: Can I get there, Can I do what I went there to do, and Can I stay for as long as I need or want to, and feel welcome and comfortable.

8. Conclusion

The aim of the initiative was to devise a guideline document that would be both appealing and useable by council staff responsible for playspaces with the information they need and in a format they can understand and use. The intention was to encourage creative inclusive design outcomes. Contextualising the 8 Goals of Universal Design into the 6 principles for playspace design was an important first step. Maintaining the universal design approach with the document style was also a key factor in making the document useable and accessible to a range of stakeholders.

The process of developing the guideline from first exploratory ideas through to the style of the document was universally designed. It served to educate stakeholders, overcome resistance, and is now an exemplar for others to follow. Can I get there? Can I play? and Can I stay? remain the key memorable phrases. The simplicity of these statements can be applied in any context with "play" being replaced by any action. Such simplicity is the essence of universal design.

9. Epilogue

The Everyone Can Play guideline won the 2019 National Landscape Architecture Award for Community Contribution [12]. The Jury citation was:

> *"Everyone Can Play* provides a comprehensive suite of principles, case studies and "toolkit" examples that support more inclusive play spaces in New South Wales. The well-presented and easily accessible document advocates for three core considerations – Can I Get There? Can I Play? and Can I Stay? – informed by detailed research, design thinking and extensive engagement. The guidelines

empower councils, community leaders and design professionals to design and deliver more inclusive, safe and attractive play spaces and settings."

The guideline content was developed throughout 2018. In 2021 the Office of Open Space and Parklands called the Advocacy Group together to review the guideline and update the content. The content will be based on further feedback from stakeholders and shifts in community expectations. The key elements to be added are acknowledgement of First Nations people and connection to country; nature and water play; and connection to place and play. The work continues in 2022.

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Accessible-to-All Cities. A Project of Networking Italian Experiences to Raise Awareness and Promote Universal Design

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Abstract. In 2016 the Italian National Institute of Urban Planning (INU) launched the project *Accessible-to-all Cities*, aimed at fostering the creation of an inclusive environment for improving universal accessibility to places and services at both scales of the city and the territory, by networking accessibility good practices and stakeholders from all corners of the country. Since then, a community of public and private subjects gathered by INU has been established and growing, sharing experiences, problems and solutions. Through the organization of dozens of meetings, seminars, workshops, conference sessions and webinars, more than 200 experiences developed in Italy have been collected, including studies and research, public policies, projects and actions, both material and immaterial, concerning the overcoming of different kind of barriers: physical, sensory, perceptive, intellectual, cultural, social, economic, health and gender. On these bases, in 2019, the INU *Accessible-to-all Cities* Community launched an open web archive, an initiative that intends to contribute to increasing awareness and knowledge, as well as to facilitate the implementation and development of actions and policies, by leveraging the good practices widespread, but often little known, in Italy.

Keywords. Urban accessibility, Urban planning, Integrated policies, Urban wellbeing

1. Introduction

In countries where the concepts of accessibility, inclusion and usability have been applied for years in different contexts of society, so-called 'Accessible Communities' are beginning to be structured. This is one of many definitions: an accessible community is barrier-free and doesn't limit anyone's participation in everyday life. In accessible communities, people with disabilities can be active participants. Ensuring that such communities exist — and thrive — is important because both people with disabilities and their neighbors benefit. Accessible communities: allow for the interaction and engagement of all members, reduce social isolation, and improve mental health for people with disabilities, increase economic gains for local businesses, and improve physical health opportunities and outcomes for all. Being part of a community means more than just living within its borders. It involves embracing opportunities for socialization within that community [1].

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These are initiatives of great value, pushing all members of a community, both public and private, to raise performance levels in order to become more accessible in a perspective of hospitality and recognition of the rights of all to participate in life in society. This follows the trend of shifting the focus from the single individual to the community in which he or she lives, with the idea that it must be the community that takes charge of all its members so that no one is left out, thus strengthening the right of the individual under the "umbrella" of the community [2].

To date, there are still many urban and regional contexts in which, however, the concepts related to Universal Design (UD) are struggling to find acceptance. This is also the case in Italy, even though the Constitution of the Republic itself establishes that the State has the duty to remove the economic and social obstacles which limit the freedom and equality of citizens and therefore prevent the full development of the human person and the actual participation of everybody to the political, economic, and social organization of the country [3].

Since the late 1970s Italy has technical norms to make buildings accessible to disabled users, which have been followed in the mid-1980s by a National Law that makes them mandatory for new public or open-to-public buildings and obliges all institutions to adequate the existing ones. In 1992 the same principle was extended to public space and services, e.g., public transport and bathing facilities at the seaside. Since then, all Municipalities must draw up Plans for the Elimination of Architectural Barriers (PEBAs) (national Laws no. 41/1986, 104/1992). More recently Italy has ratified the *UN Convention on the Rights of Persons with Disabilities* (2006), with a specific law (Law no. 18/2009) which establishes the National Observatory on the conditions of Persons with Disabilities.

Unfortunately, these principles and rules are often disregarded or applied in a very partial, narrow-minded, formal, or boreoarctic way; there are still many obstacles to putting UD principles into practice. The biggest challenge to face is not about regulations or finding funding, but a profound cultural change. In fact, in Italy accessibility is still mainly understood as the elimination of individual barriers (architectural, but also of other nature) rather than the creation of interconnected systems and services usable and inclusive according to UD criteria. There are, however, several good practices that, although minority, show an attempt to go beyond these outdated conceptions. The foresight of administrators, professionals, and researchers who, finding the right contexts, have decided to explore approaches, processes and tools from a UD perspective is the premise on which the *Accessible-to-all Cities* initiative, promoted by the National Institute of Urban Planning (INU), is based.

The paper will report on this important project, which has led to the establishment of the largest Italian network of both public and private entities that since 2016 have been working to create more accessible spaces and contexts for all. The main goal of the network is to contribute to improve the knowledge base, as well as to facilitate the implementation and development of actions and policies: the lack of dedicated policies and integration is nowadays, in fact, one of the most critical issues to be addressed to deal more effectively with issues related to accessibility of public spaces, private places, collective and individual services, transport.

2. From the birth of the cluster to the consolidation of the project

INU is a non-profit association, member of the European Council of Town Planners, which in 2020 turned 90 years old. Since 1949, the Institute is recognized by the Italian State as a "high culture and technical coordination institution" and, since 1997, as an Association for the Protection of the Environment. Members include urban planners, architects, engineers working as professionals, scholars or public officers, as well as other experts concerned on the issues of the city and territory, like economists, sociologists, lawyers and so on; but also public institutions, universities, professional orders, other associations, etc. INU is present in each Italian region with a regional division, but it is also organized into thematic groups or “communities”, focused on different planning issues, like transport and infrastructure, climate adaptation and mitigation, urban regeneration, etc. Communities work together in a cross-disciplinary way and are also open to external contributions.

The *Accessible-to-all Cities* (AtaC) project was born within the Community of the same name, which presented it in the framework of *Il paese che vorrei* (The country I would like), a collateral event of the 29th INU Congress, held in Cagliari on April 28-30th, 2016. The initiative is aimed at fostering the creation of an inclusive environment for improving full accessibility in activities and services, at both scales of the city and the territory, by networking accessibility good practices and stakeholders from all corners of the country.

One of the most relevant aspects of the project is its adherence to the UD principles, which teach that the accessibility of places, goods and services cannot be understood exclusively in terms of motor and mobility aspects. To intervene on total accessibility, otherwise known as ‘360° accessibility’, objective data on the dimensional and motor characteristics of the population are not enough; it is also necessary to investigate the needs, perceptions, desires, and dreams of all potential users. Great importance is given, in fact, to meeting, listening and participation initiatives, where technicians and decision-makers can collaborate with stakeholders in order to find shared solutions.

2.1. Development and consolidation of Accessible-to-all Cities

Since its start, the AtaC project has been developed through three-year programs, the first of which, finalized in 2018, has focused on the development of the community through the implementation of numerous public actions in regional, national and international contexts. Through the participation and the organization of dozens of meetings, seminars, workshops, conference sessions, where ideas, experiences and perspectives on ‘360° accessibility’ were shared and discussed, facilitated by moderators according to the design thinking methodology [4], a wider community of public and private subjects has established and is still growing around the INU promoting group, including civil associations, representatives of disabled people, Italian regions and municipalities, universities, trade and professional associations, single freelancer and scholars. Some of these occasions have been held in the framework of national events supported by the INU, like the Public Space Biennale in Rome, the Urbanpromo and Urbanpromo Green conferences in Venice and Milan, and the INU Study Day in Naples.

A first collection of about 100 good practices was published at the end of 2017 by INU, including studies and research, public policies, projects and actions, both material and immaterial, concerning the overcoming of different barriers, that is:

- physical, sensorial, and cognitive barriers, which affect the independence and quality of life of the individuals and community, as well as the access to mobility, urban facilities and public space;
- cultural barriers, concerning the access to heritage, museums and natural areas;
- social barriers, which affect the mutual relationships between people, and the degree of inclusion of the living and working environments;
- health and safety barriers, with regards to the access to health-care and the right to live in a safe environment;
- economic barriers, depending on work conditions and the affordability of housing, consumer goods, leisure and tourism opportunities.

Since the publication of the book, the number of collected practices is more than doubled. Mobility is one of the recurring topics, along with accessibility to public space and cultural heritage and tourism.

2.2. Initiatives to expand the network

The project is currently in its second phase 2019-2022 (the one-year delay was imposed by the ongoing Covid-19 health emergency) and is aimed at promoting two main initiatives: the *Accessible-to-all Cities Award* dedicated to students and young researchers, and the implementation of the experimental *Pact for Urban Planning, towards Accessible-to-all Cities* in eight pilot cities (see Chapter 4).

The activities of the community continue to promote the actions of listening and comparison to strengthen the constantly growing network. The network is also becoming a tool with which to stimulate the debate on accessibility, and through which to encourage the launch of new strategies and solutions to create truly inclusive cities.

In the current three-year period, two other directions are also being explored: the European opportunities offered by the Structural Funds in view of the 2021-2027 programming; relations with other networks that deal with the well-being of the individual, such as those related to soft mobility, housing, public city services and the environment.

3. The Atlas and the importance of online dissemination

The ongoing Covid-19 pandemic has showed the strategic importance of the web and ICT tools that have allowed the creation of networks despite the forced isolation. The peculiarities related to the web have emerged clearly with the decision in 2019 to create a website dedicated to the dissemination of the projects collected over the months, considered the best tool available, today, to systematize knowledge, data and experiences stimulating their use for the purpose of the widest replicability.

The online portal[2], called 'Atlas' in reference to the fact that it is intended to be an extensive collection of data, materials and information, was also conceived to be a point of reference and a work in progress: a platform designed to be implemented with new cases and experiences, which by returning the state of the art provides at the same time a series of lines and directions to build new tools, new processes, new training courses on the theme of accessibility for all. The Atlas is aimed at all those public and private

[2] The portal is available on atlantecittaccessibili.inu.com

entities that intend to start planning investments in the field of accessibility, offering methods, techniques and models already tested at the local level and potentially replicable. It makes available a large amount of data and information related to the projects collected with the specific purpose of creating a shared project base able to support institutions and organizations in the start-up of new projects. The sharing of data and practices in a single container facilitates networking at the national level by allowing a broad comparison on common research goals, actions oriented to identify complex areas of need, common fields of innovation. By being able to easily frame similar contexts, many of which use practices that follow the principle of replicability, an organization's design effort can turn to developing the solution set with a lower expenditure of resources, while also limiting the number of so-called pioneers [5] and reducing the uncertainty of choices. Another important aim of setting up the network is to connect those promoters who, facing similar experiences, can benefit from the comparison and make the experimentation of new solutions more effective. Sharing critical issues and errors is essential in avoiding low project scalability, while reducing the risk of failure.

Joining the network is an opportunity to learn from the experiences of other members and to enhance one's own through the creation of a community of practice. Promoting project laboratories and seminars, the network becomes a place where different competences with divergent points of view have the possibility to confront each other concretely in order to try to overcome obstacles, through the sharing of languages between planning and programming in a perspective of real integration [6].

3.1. The interrogable map and integrated policy guidelines

A dedicated section of the Atlas is devoted to *Practices and places*. All the collected good practices are mapped in a web-gis map[3] and indexed in a database to be easily searchable. By clicking on the map, the user is directed to the downloadable sheet of any project, which provides the full description of the project itself, chronology and state of the art, costs, a description of the process followed by the initiative from the very beginning to present, the list of proposers and involved stakeholders, and one or more contact addresses. The mapped items are searchable, by spatial or thematic keys. Spatial keys distinguish between practices at the local or regional scale; the thematic keys, include the following four items: projects, tools, processes, training.

- *Projects* refer to the use of spaces, time and services in the city and the territory. The most recurring application fields are sustainable mobility, public space, tourism for all; all projects are intended as a contribution to urban welfare and addressed to promote the autonomy in urban living of every citizen.
- *Tools* refer to spatial planning and organization. The objective is integrating 360 degree-accessibility into urban and regional planning, as well as into public works programming, from the level of ordinary maintenance to the construction of new urban infrastructure.
- *Processes* refer to the building-up of integrated, inclusive, and interactive policies. The collected practices are examples of how establishing a stable and constant dialogue between stakeholders, to share, discuss and monitor accessibility projects.

[3] The map has been created using the dedicated software uMap, through the open source platform "Open Street Map", and is available by typing "Atlante Città Accessibili"

Promoting participatory co-design is assumed as one of the main objectives to be pursued for achieving 360 degree-accessibility.

- *Training* refers to all those practices aimed either at increasing social awareness or the know-how of professionals, communities, public officers and so on, in the making of accessibility projects and initiatives, considering their actual feasibility, management over time, fund-raising.

Figure 1. screenshots of the map in the atlas. The initiatives present are categorized by type and color. Choosing to view the initiatives carried out in Milan, i.e., a window appears with links to download the detailed sheets.

Another section is devoted to the so-called *Network of knowledges*, where the reports and summaries of workshops and conferences are recorded. Public meetings and discussion tables are the main source of the issues and proposals discussed inside the community and of the knowledge of real-life experiences which is the basis for innovating policies and planning.

A third section is devoted to the *Guidelines for integrated policies*, which are derived from the discussions held during the seminars and workshops and from the "lessons learnt" from the good practices. The Guidelines have been elaborated by a work group of the Community, with an important contribution of the Department of Engineering and Architecture of the University of Trieste, which is a partner of AtaC together with other Italian University departments, like the Department of Architecture in Florence. The guidelines are structured in four chapters, which correspond to the four types of actions mapped in the section "Practices and Places" of the Atlas – that is, again: *Projects*, *Tools*, *Processes*, and *Training*. The basic assumptions that inform the guidelines can be summarized as follows.

- A city is accessible when it allows the largest number of people with different abilities to move as much as possible autonomously and safely to reach public spaces and facilities for collective use, between the living place and the places of everyday activities. It is therefore necessary to design or redesign urban space and facilities to make them user-friendly, safe, pleasant to the eye, to the hearing, to the touch and to the smell, fun, not redundant or invasive. According to the principle of UD and place-making, urban design should not provide solutions specifically

dedicated to people with disabilities but create an urban environment in which everyone can feel included. Accessibility for-all must be assumed as an essential feature of all urban redevelopment and regeneration projects, according to the meaning of sustainable city delivered by the UN Agenda 2030.

- As far as planning and programming tools are concerned, what is most important is overcome the sectoral nature that still generally connotes accessibility tools and policies. That implies, on the one hand, to use the PEBA as a project instrument for improving public space and the streetscape of the city and, on the other hand, to integrate accessibility as a performance indicator of urban planning, public works and all other procedures related to the transformation and management of the city.
- Targeting the inclusive city, processes are not less important than projects. Accessibility is a cross-cutting theme in public policies, which claims for a permanent dialog among all sectors of public administration dealing with urban and territorial issues, with special regards to those which have implications on the physical space. Moreover, it requires a dialogue with other institutional and non-institutional stakeholders which can provide special expertise or represent the specific demands of different kinds of users. Participation and co-designing should therefore become current practice in the development and management of spatial plans, policies, and projects. Such a multisectoral approach should be applied to the various operational fields and scales: from urban planning and design to the interior architecture of public buildings; from social and health welfare facilities to public space and mobility; from the protection, management and enhancement of the historical heritage to new developments and redevelopments.
- Education and training are essential issues for spreading and consolidating a new culture of accessibility. Targeted projects should be addressed to schools and universities, professionals, and public officers at any level of public administration. The discussion of best practices is an effective way to stimulate emulation and disseminate successful approaches, methodologies, and procedures. Public authorities, universities and civic associations should cooperate in promoting campaigns for inclusive cities and territories.

3.2. Social media channels

Nowadays, being present on social media is essential, especially for private companies: it is a way to communicate, and it goes to integrate a digital marketing strategy in a broader way, which has the goal of increasing sales. The goal of Social Media Marketing is visibility, brand reputation, relationship, and trust with users. However, social media can also be leveraged by organizations, associations, or nonprofits to create interest around a particular issue or campaign [7], as in the case of the AtaC Community.

The first step taken was to take advantage of social media to talk about the project, through the opening of a dedicated Facebook page and the opening of a Youtube channel. The Facebook page has about 1000 followers without any economic resources or sponsorships being invested; it is used to spread the collected projects and ongoing initiatives. The Youtube channel collects about 30 videos, mainly produced by INU, in which the members of the group disseminate the project.

Since there is no funding dedicated specifically to the communication of the project, currently the work of managing social channels is done voluntarily by some members of the community. It is the intention, however, to search for sponsorship to promote specific

campaigns, in order to raise awareness of accessibility for all, expand the network, establish partnerships with both the public and private sectors.

4. Ongoing initiatives

4.1. Accessible-to-all Cities Award

The *Accessible-to-all Cities Award,* established by Inu in 2020, is funded by the Genoa Chamber of Commerce in collaboration with the Ministry of Culture, the National Research Council and Cerpa Italia Onlus. The prize is awarded through a call for proposals for innovative works on accessibility at 360° carried out in Italy or abroad, specifically master's thesis and PhD. The initiative is particularly important in raising awareness on the issue of accessibility for all, because it acts on the place designated for training those who will help to spread the culture of accessibility in the near future.

At the very first edition 20 works participated, in response to the proposed central themes related to accessibility at 360° in different contexts of reference (within urban parts, within larger areas), in which to consider the limitations imposed on the quality of life of people due to the presence of barriers of different types. At the second edition other 20 works attended, both from Italy and from other countries. Currently open the call for the third edition.

4.2. Pact for urban planning, towards Accessible-to-all Cities

The *Pact for urban planning, towards Accessibile-to-all Cities* is the experiment that the INU Community is developing with 8 medium and little-sized cities form North to South Italy: Udine, Mantua, Genoa, Reggio Emilia, Ancona, Leghorn, Spello, and Taranto. Working together and sharing their experiences, the eight cities intend to: define and apply integrated solutions to improve the quality of life; systemize welfare measures, provisions, and services; offer their communities competitive advantages related to accessibility and sustainability in line with the UN Agenda 2030; go beyond the logic of the single intervention to overcome barriers and inequalities; promote a comprehensive approach to urban well-being.

The topics covered by the joint work are:

• strategic planning must be able to provide an overall vision of the city in order to foster coherence and integration in policies, plans and interventions concerning the overcoming of barriers, the reduction of inequalities, and solutions to fragility;

• the drafting of general planning tools must pay particular attention to knowledge of the new living conditions brought about by the pandemic and to solutions for providing welfare with adequate services for the autonomy of all people;

• The realization of urban projects of social redevelopment/regeneration of neighbourhoods must promote active soft mobility, and more inclusive public spaces and urban green spaces.

The experimentation proposed by the Pact, lasting two years, helps to build a system of accessibility that goes beyond the logic of the single intervention to overcome the barriers allows to achieve a broader goal of overall quality and gives shape to the relationships with other welfare networks such as those of soft mobility, living, work, vitality of the public city and environment.

5. Conclusions and future developments

Considering the tendency of organizations to consider themselves bearers of completely original and unique identities, values and operational proposals, an aspect that can be defined as presumption of exclusivity [8], promoting collaboration and networking is not so simple. However, belonging to a network allows the exchange of information, human and even economic resources that otherwise would not be possible.

The hope of the initiatives put in field by the AtaC Community is to reach, through the adhesion to the network, a rationalization of the planning and economic efforts, with an employment of the eventual freed resources in the activation of other services or in the same support of the network. One of the aims of the Atlas is not only to systematize good practices, but also to represent the pivot of a national communication campaign to be promoted to increase awareness of the tested solutions. The call to stakeholders is "forbidden not to copy": we are committed, today as never before, to finding the original idea, the unprecedented solution, the unique strategy, the special product. But the winning action is the result of a process that passes through many minds, many hands. In order to move in this direction, the community is moving to open up to other contexts, including international ones: hence the very real need to commit to making all materials available also in English, necessary condition so that the network can expand and confront a much wider context.

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Universal Design in Exhibit

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Abstract. Universal Design has become more prevalent in the general use of architectural design buT has rarely been applied to exhibits. This paper features two manuals developed for exhibit accessibility that incorporate several principles of Universal Design.

Keywords. Universal Design, exhibits, exhibit planning

1. Introduction

The public has many opportunities to recreate. Some of the most popular places in the world are zoos and aquariums. The AZA reports that over 183 million guest visit zoos and aquariums in the US. That is more than the attendance at professions, football, basketball, hockey, and baseball combined.

While the public enjoys their visits to zoos and aquariums, is everyone able to enjoy them equally? In the US, laws such as the Americans with Disabilities Act (ADA) plus state and local laws address equal access and inclusive opportunities for the public with disabilities that visit zoos and aquariums. The removal of accessibility barriers such as accessible routes, protruding objects for people with low or no vision, assistive listening devices for those who are hard of hearing all address the various accessibility needs of guests with disabilities. However, there is one area that has not been addressed that can severely affect a person's visit.

Although many accessibility issues have been addressed, access to exhibits has not been incorporated into any disability law. Accessibility laws contain accessible routes up to exhibits, including width of routes, surfaces, protrusions, abrupt transitions, and gaps, but they do not address specific features of exhibits, such as signage heights and fonts or interactive reach ranges.

2. Early Accessible Exhibit Guidelines

While the ADA only addresses requirements up to the exhibit, some efforts have been made to provide guidelines to address accessibility of actual exhibits and their features. The original work was done by Jan Majewski of the Smithsonian back in the 1980's. These guidelines provided some initial thoughts and ideas related to enhancement of exhibits to provide a more enriching experience for a person with a disability at a zoo, aquarium, or museum.

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The early work by Ms. Majewski was the bases for more detailed manuals by the National Endowment for the Arts “Everyone’s Welcome” in 1998 and the National Park Services' “Programmatic Accessibility Guidelines for National Park Service Interpretive Media" in 2012. My contributions were to the "Everyone’s Welcome" manual from my experiences at Brookfield Zoo as the Access Coordinator for People with Disabilities over 18 years and working on over half of the Zoos renovation of exhibits. The National Park Service Exhibit manual was modified from the "Everyone’s Welcome" content to fit their outdoor exhibits and updated with new technology information. This paper will focus on the "Everyone’s Welcome" manual and guidelines that still have application today.

One feature of these exhibit guidelines is the incorporation of Universal Design Principles. These Principles go above and beyond the ADA guidelines and state and local codes. The Principles of Universal Design were developed by Ronald Mace, an architect with a physical disability. His goal was to design and develop built environments and ease of use products regardless of the person's age, ability, or status in life. These Principles allow for a more inclusive and accessible design.

2.1 Universal Design Principles

One feature of these exhibit guidelines is the incorporation of Universal Design Principles. These Principles go above and beyond the ADA guidelines and state and local codes. The Principles of Universal Design were developed by Ronald Mace, an architect with a physical disability. His goal was to design and develop built environments and ease of use products regardless of the person's age, ability, or status in life. These Principles allow for a more inclusive and accessible design.

Universal Design has 7 principles to guide in accessibility when building or renovating an area. They include:

Principle One: Equitable Use

- The design is useful and marketable to people with diverse abilities.
- The design does not disadvantage or stigmatize any group of users.
  - Exhibit entrances with an automatic door that has a smooth level entrance.

Principle Two: Flexible in Use

- The design accommodates a wide range of individual preferences and abilities.
  - Exhibit switches that are large rocker switches (easily operated with a closed fist).

Principle Three: Simple and Intuitive Use

- Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.
  - Interactives shaped on how they are used or what direction to push to operate such as an arrow.

Principle Four: Perceptible Information

- The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory ability.
  - Tactile, visual, and audible information at exhibits.

Principle Five: Tolerance for Error

- The design minimizes hazards and the adverse consequences of accidental or unintended fatigue.

- Guidance in exhibit areas showing accessible routes or where touchable exhibits are located.

Principle Six: Low Physical Effort

- The design can be used efficiently and comfortably and with minimum fatigue.
  - Levers, loops, or touchable pads to operate an interactive exhibit.

Principle Seven: Size and Space for Approach and Use

- Appropriate size and space are provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility.
  - Wider walkways and clear floor space at exhibits and especially interactive exhibits.

The use of these principles has been merged into guidelines for enhancing exhibits to allow guests with various disabilities enjoy and understand information more effectively. In the US, all public zoos, aquariums, and museums must meet the minimum requirements of the ADA and/or state and local codes.

These requirements include features such as accessible parking, accessible routes (curb ramps, ramps, widths, surfaces, abrupt transitions, gaps, protruding objects), entrance widths, door force, door hardware, clear floor space at exhibits, have specific requirements that must be followed.

3. Updated Accessible Exhibit Guidelines

While signage at permanent rooms has specific requirements, signage at exhibits had not been addressed. Many people with low vision are still able to read standard signs and lettering depending on their size, contrast of color and location. These and other guidelines are covered.

3.1. Enhanced Signage

Font sizes should be 18 points or larger and provide a contrast of color at least 70% between the lettering and background. The text should go over a solid background and never over a picture. The picture's various coloration and dimensions can make reading the letters very difficult. The background of the sign should be a matte finish to prevent any glare from lighting.

Figure 1-2. Examples of incorrect use of signage

Another important feature in signage legibility is the use of fonts. Some fonts are too unusual and difficult to read. Fonts that are a script type, condensed type, extended type, light type, or ornate italic type are very difficult to read by a person with low vision. The best fonts to use include Sans Serif such as Helvetica, Ariel, Univers, and Futura. Simple Serif include New Century Schoolbook, Times Roman and Palatino.

The location of signage or labels depends on the type of exhibit they are used at. For wall-mounted signage a height between 54 inches and 66 inches provides an optimal height for a person standing, using a wheelchair, shorter adult, or a child to comfortably read. For small labels using 54 inches to the centerline is a good standard to follow. Also, signage that is behind a barrier and prevent a person from getting within 3 inches of the sign. This can make it difficult to read for many people.

Figure 3-4. Examples of incorrect use of labels on a barrier railing

For labels within an exhibit case or on a barrier railing, the optimal heights are between 36 inches to the bottom and 40 inches to the top of the label. This allows a height that is easy to read by a person using a wheelchair, shorter adults, and/or children. It is recommended to provide the labels at a 40-degree to 45-degree angle to allow for guests who are standing to also read the labels easily.

3.2. Display Cases

Besides the use of signage and labels, specific guidance is recommended for viewing into exhibits and display cases. Display cases are recommended to be between 33 inches above finished floor (AFF) to 40 inches AFF for best viewing. Heights above this range can make it more difficult see the objects on display.

For wall mounted displays, the bottom of the case should be mounted at 33 inches AFF to 40 inches AFF and go up from there. Depending on what is displayed in the case, smaller objects should be displayed at the lower part of the display case. Any portion of the display case above 40 inches should have larger objects that can be easily seen especially by a person with low vision.

3.3. Viewing Windows

Outdoor barriers with viewing windows for live animals have a recommend design that includes the lowest part of the window be no higher than 36 inches AFF. A full window would be best for the easiest viewing. One enhancement provided at Brookfield Zoo was the inclusion of heating and cooling coils near the full viewing window to entice the animals to the location. This allowed not only all guests to easily see the animals, but it also allowed guests with low vision to be able to see the animals better since they would lay near the windows.

Figure 5-6. Examples of viewing windows

3.4. Multi-sensory Exhibits

For exhibits with live animal collections or that are very large, viewing by a person with lower vision is nearly impossible and can make the visit less enjoyable. At Brookfield Zoo we conducted a focus group of kids and adults with low or no vision to determine how we could enhance their experience to be more enjoyable and informative. The result was a multi-sensory approach for exhibits. The main focus that was suggested was to provide life size detailed statues of animals that people could see up close and touch. The second option was to provide small statues but with extensive detail. The third option was to provide a two-dimensional cutout of the animal but again life size.

Figure 7-8. Examples of multi-sensory exhibits

The Zoo was able to provide detailed, life-sized statues in various locations. A gorilla statue was provided at the Tropic World, a dolphin and sea turtle statue at the Seven Seas building, a duck, turtle, and frog statue were provided out at Indian Lake Trail. A two-dimensional cutout of a Siberian Tiger was provided at the big cat exhibits.

Figure 9-10. Examples of multi-sensory exhibits

Besides the specific statues additional enhancements were provided to different exhibits. Some examples include animal artifacts such as a rhino horn, elephant molar, porcupine quills, grooming and medical equipment used on different animals and other artifacts. In addition, some exhibits included a recording of animal sounds or even various animal musk that people could smell.

3.5. Use of Smartphones

The National Park Service (NPS) has taken a step further to increase their accessibility of exhibits through the use of smart phones. The NPS has developed an app for over 400 national parks that provides detailed information not only on the parks but the exhibits as well. The information includes additional accessibility features that can enhance the experience for a person with different types of disabilities.

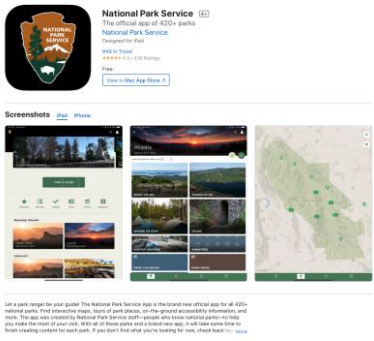

Figure 11. Screenshot of National Park Service app

In particular, the app provides a verbal description of the exhibit and its features. This is very helpful for people with low vision or total sight loss. The description along with the narrative information provides the opportunity for people to enjoy and understand the exhibits better.

4. Conclusion

While the accessibility standards at a national, state, or local level do not provide specific code requirements for exhibit accessibility, there are good resources available to enhance exhibits for accessibility and include various Universal Design principles. The

"Everyone's Welcome" manual and the Programmatic Accessibility Guidelines for National Park Service Interpretive Media both provide detailed information to make exhibits accessibility for people with various types of disabilities and well as the general public. All places that provide some type of exhibits should incorporate the recommended guidelines to make their exhibits accessible to all.

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360-Degree Films for Cognitive Inclusion at Workplaces

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Abstract. Persons with stress-related disorders, mental disorders and neuropsychiatric disabilities are in particular vulnerable to cognitive challenges at the workplace. The barriers faced by persons with communicative, social and cognitive disabilities are most often invisible to persons in the environment. The objective of the study presented in this paper is to develop and test a tool that increases awareness by inviting persons without disabilities to experience how cognitive barriers can look like in the workplace. Three 360-degree films were developed iteratively in close collaboration with users. Each film has one part highlighting difficulties and one part highlighting solutions. The films were evaluated with employers, employment experts, special support persons, HR staff and students. The results show that the films were realistic and useful for both supporting employment and for general awareness and insight.

Keywords. 360-degree films, cognitive inclusion, workplaces, empathy exercises

1. Introduction

Psychological causes are the top reason for prolonged absences from work in Sweden [1]. Studies have suggested that factors impacting the psychological well-being at work involves stress, cognitive load and mental challenges. Persons with stress-related disorders, mental disorders and neuropsychiatric disabilities are in particular vulnerable to cognitive challenges at the workplace [2].

The barriers faced by persons with communicative, social and cognitive disabilities whether permanent or temporary are manifested in internal experiences and therefore most often invisible to persons in the environment. Consequently, it is often difficult for managers and colleagues to identify and understand the needs in terms of cognitive inclusion, and therefore to be able to provide the support needed. In some cases, the lack of knowledge and understanding can lead to stereotyping and exclusion. There are reports that managers avoid hiring persons with cognitive disabilities because they assume that the obstacles are greater than they are in reality [3]. It has also proven difficult for the persons with cognitive disabilities to be the ones to disclose their needs, also for fear of stigmatization [4].

The objective of the study presented in this paper is to develop and test a tool that invites persons without disabilities to experience how cognitive barriers can look like in the workplace. The idea is that making the barriers experienced by persons with cognitive

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disabilities more visible to everyone will increase understanding and pave the way for higher inclusion.

The core methodology builds on the concept of empathy exercises which is a well-established method for gaining insights into how persons with disabilities experience certain situations and the barriers faced by persons with disabilities in the environment. Empathy exercises have been widely used in sensitivity training to create an understanding for the situation of persons with disabilities and induce empathy and a positive attitude with an objective of combating stereotypes, stigma and discrimination. The traditional empathy exercises often involve some type of simulation of a physical disability. However, invisible disabilities related to cognition are difficult to simulate due to two factors. Firstly, the way the disability manifest itself is internal, and thus cannot be shaped by temporary interventions to external senses.

Secondly, and more crucially, while visual and motor disabilities relate to the physical environment of the building, the manifestation of cognitive disabilities are mainly triggered by the social environment such as the organisation of everyday activities at work. Cognition is about processing information and sorting out impressions from the outside. In a calm environment there will be fewer barriers that triggers the cognitive challenges, whereas in a stressful environment the effect of the impairment will be more tangible. Cognitive barriers are thus intrinsically linked to specific situations and scenarios. There have been films aimed at increasing awareness of cognitive challenges that visualise how persons with cognitive disabilities react to a specific situation. However, most of these films or stories are narrated from an outside perspective, thus creating a distance between the viewer and the scene.

The core idea of empathy exercises is that the person doing the exercise should get the experience of having lived through the situation from the inside. The challenge of creating empathy exercises for cognitive disabilities is therefore to find the technical means to visualise realistic scenarios that both take into account the interrelation between inner factors (cognitive needs and challenges) and outer factors (cognitive barriers in the environment), and that also provides a believable simulated experience where the person participating in the exercise has the experience of being in the scenario themselves.

In the past few years, several research projects have used Virtual Reality (VR) techniques to create experiences that allows for perspective-taking and/or developing empathy. There is however still a gap in the literature on how VR exercises can be used to increase awareness of cognitive barriers in the work environment.

The objective of the project was firstly to develop VR 360-degree films that can be used to simulate experience of having an invisible cognitive disability at the workplace, and secondly to test whether these types of empathy exercises can provide insights that are useful in influencing attitudes of employers and employment agency workers to become more empathic and positive towards persons with cognitive disabilities.

The project was set up as a partnership between academic experts, specialists in accessibility, employers in the public sector and experts in supported employment.

2. Framework for co-creation and iterative development

The method for developing and testing the VR exercises was guided by the framework for user-centred design. The method used included five main steps, of which step 1, 2 and 5 are described in this paper: 1) Requirements gathering (chapter 3: a workshop with disability organisations and persons with disabilities, a literature review, and a short

survey to employers) 2) Concept and prototype design (chapter 4: development of scenarios and manuscripts, early feedback and producing a pilot film), 3) Testing the pilot film, 4) Refining the prototype and developing the rest of the films, and 5) Final evaluation of the three films (chapter 5). Each of the steps included the active participation of stakeholders, in accordance with the user-centred design method. In this case it was identified in the beginning that there are two types of users that have a stake in the VR exercises:

1. The intended audience of the films which include employers, employees, rehabilitation actors and other actors in the employment sector
2. Persons with cognitive disabilities who will not be the audience of the exercises but will be benefiting from their dissemination and use. The persons with cognitive disabilities are also the subject experts since their knowledge and experience guides the scenarios at the core of the empathy exercises.

The project methodology was therefore constructed in such a way that the two types of stakeholders were engaged throughout the project, at different levels.

3. Workshop with disability organisations, literature review, and short survey to employers

The consultation conducted in the first phase of the project had the objective of making sure that the scenarios and dialogues in the 360-degree films fully reflected the experiences of a broad variety of persons with different kinds of communicative, social and cognitive disabilities. The aim was both to explore common needs and experiences between groups with different characteristics, and to find specific examples of difficulties and solutions at the workplace that could be used as a basis for constructing the scenarios.

3.1. Method

A workshop was organised with 20 participants including persons with autism, ADHD, brain injury, bipolar disorder, dyslexia and aphasia. The participants were divided into smaller groups to discuss and present situations they experience difficulties at the workplace and proposed solutions for these difficulties out of their own experience.

The list of difficulties and solutions that came out of the workshop with users was compared to and complemented by a short literature review on cognitive accessibility at the workplace. The literature was used to identify topics raised by the user groups that had been subject of research in order to complement the views of the users with possible learnings from scientific studies. Furthermore, a short survey was sent out to employers in the public and private sector in Sweden about policies and practices, and what support they would prefer to see implemented at their workplace.

3.2. Results

As a result of the workshop and the literature review, a consolidated and annotated list of difficulties and solutions was drawn up as input to the work of creating scenarios for

the films. Table 1 shows the difficulties and suggestions for solutions that were implemented in the films.

Table 1. The list of difficulties and suggested solutions resulted from the workshop with disability organisations

Categorisation	Difficulties	Suggested solutions
Structure and clarity	Messy work environment Lack of structure, including in meetings Many things that happen at the same time Multitasking and shared attention Sudden changes Unclear expectations, roles and divisions of responsibilities Lack of access to information Not knowing why to do things Unclear instructions Social expectations and social interaction	Clear meeting structure Be prepared for what is going to happen Clear expectations Clear objectives Clear instructions in text and pictures
Understanding and support	Feeling of exclusion Fear of being perceived as strange Little understanding of the effect of the form of the day.	Leverage strengths and interests Listen to individual needs Conscious employees who can help To have a supervisor Planning aids (Calendar) Aids (such as Hearing Protection and To-Do List)
Peace and quiet	Time pressure Lots of noise, strong smells and impressions	Ample time Have time to decide Be able to plan their time and tasks Quiet and peaceful environment One person talking at a time Opportunity to leave Own fixed place at the workplace
Opportunity to influence	No opportunity to say no	Opportunity to say no

The workshop also resulted in a decision on which scenarios to focus on in the films. The team had originally thought about a meeting situation, and following comments of the participants in the workshop, a social situation and a job introduction situation were added. Participants in the workshop emphasized that well-thought-out workplace introductions are very important to avoid problems and conflicts that lead to the end of probationary employments. The few answers from the survey to employers indicated a need for support on both management and collegial levels, i.e. with and without a hierarchical dimension.

4. Development of scenarios and manuscripts for three 360-degree films, early feedback and producing a pilot film

The input from the workshop was used to develop scenarios and manuscripts for three 360-degree films. Three situations were chosen for the development of the scenarios, to include as many as possible of the difficulties and solutions and to increase the applicability of the films: a workplace meeting, a social situation (birthday party), and a workplace introduction for a new employee at an industrial pipe company. Two versions of each scenario were developed, respectfully highlighting difficulties and solutions.

A pilot film was produced and tested before the two other scenarios were filmed, to be able to try out the format of the films. The meeting situation was chosen for the pilot

film. The first part of the meeting situation included descriptions of difficulties in the structure and organisation of the meeting. There were also environmental distractions such as people talking simultaneously and distracting noise and visual effects.

The second part of the meeting situation included a clear meeting structure and helpful colleagues, and without distracting noise or visual effects.

4.1. Method

The draft manuscript and sketches for the pilot film were sent to the participants from the co-creation workshop, as well as to the employers and employment organisations among the project partners for further comments before the filming. A workshop with four persons from disability organisations was also held to get feedback of the manuscript.

The pilot film of the meeting situation was recorded with a 360-camera attached to a chair at the meeting table, to record the meeting situation from the viewer's perspective. Microphones were placed at the centre of the table and close to the main actors.

When editing the pilot film, some effects were added, including noise from the traffic outside and when a person eats crispbread and a red beating heart with changing frequency, indicating stress level. The film also included thought bubbles to visualise the thoughts of the person at the centre of the scenario.

4.2. Results

The comments to the preliminary manuscript for the meeting situation included reactions on the overall scenario as well as specific suggestions for improvements. For example, it was suggested not to exaggerate the meeting situation too much, so that the employer can say that this situation is not the case with us. Another suggestion was to remove sound to indicate concentration is lost.

5. Final evaluation of the three 360-degree films.

Two versions of each of the three scenarios were recorded: A workplace meeting, a social situation (birthday party), and a workplace introduction for a new employee at an industrial pipe company. One version highlighted difficulties and the other version highlighted solutions. The films can be viewed at https://inlevelsegerinsikt.se/.

5.1. Method

The films have been tested with:

- 20 employment experts and special support persons for introduction and follow-up, to ensure the usefulness of the films in discussions with employers when placing jobseekers with cognitive disabilities.
- 9 people from 7 employers in a wide range of industries from the construction industry to, the Church of Sweden, using simple VR glasses for mobile phones.
- 6 people from 5 employers in the IT, recruitment and real estate industry, in connection with a training where the empathy exercises are part of a larger material focused on communication and treatment. The test took place in a digital meeting where the films were shown together on a regular screen.

- 2 Human Resource people and a manager within a municipality. They used simple VR glasses for mobile phones.
- 42 industrial design and engineering students studying Universal Design and Rehabilitation Engineering. Most of them used their mobile phones or laptops for watching the films. Many of these students get a managerial role in their careers and thus have an opportunity to influence inclusion in working life.

5.2. Results

In all groups, the films were rated highly in terms of usefulness.

Figure 1 shows the result of supported employment experts' evaluation of the usefulness of each film.

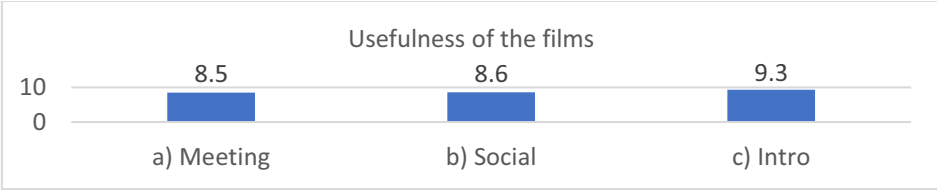

Figure 1. Usefulness of each of the three films according to 20 employment experts (0=Not useful at all, 10=Very useful). The films are a) A workplace meeting, 8.5 of 10 b) A social situation (birthday party), 8.6 of 10, and c) a workplace introduction for a new employee at an industrial pipe company, 9.3 of 10.

Similarly, eight of the nine employers answered the films will facilitate the process of receiving a new employee with an invisible disability. Most of the employers reported that the films had increased their understanding to some degree, see Figure 2.

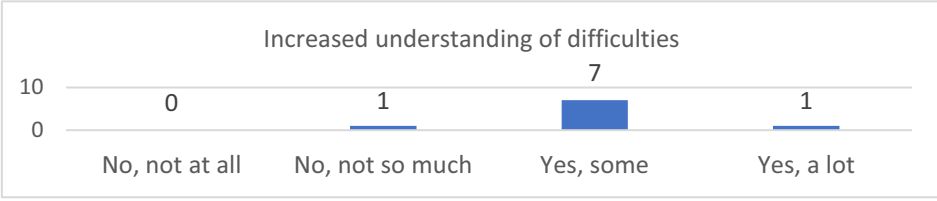

Figure 2. Increased understanding of difficulties people with invisible disabilities can face at a workplace

Regarding in what situations the films could be used, both supported employment specialists and employers reported that the films are useful in recruitment situations and as general awareness-raising. Some comments from the employment specialists:

- A good support to use before a possible employment as you can prepare the applicant and the employer to avoid misunderstandings and irritation.
- They can be used in all contexts in workplaces in general, to draw everyone's attention to how to think and act so that everyone becomes more included.

Some comments from the employers were:

- Good tool. Clear "feeling".
- I think these are very good films as information for many different functions. For example, I will work to ensure that our municipality's management/politicians can watch at least one of these films, to increase the understanding of our employees in the Labour Market Department.

Several of the employers who watched the films together with the connected education material reflected that the situations were realistic and reported that they had not previously thought about some of the concrete things in the meeting situation before, such as that it is disturbing to eat during a meeting.

The two Human Resource people and the manager within a municipality commented that it was good to have exaggerated situations in the films since that is what creates the dialogue after watching the films. But they also thought it needs to be described before that the films are just examples of how situations can look like. They thought that the films can both be used in consultation with the Swedish Public Employment Service when they help a person to get to work with the municipality, and with employees for a greater understanding of colleagues' or residents' possible disabilities.

The employment specialists were also asked about the difference between watching the films using VR glasses and a regular screen. They answered that they got more sense of vulnerability with VR and that the situation is more alive and real with VR glasses, even though the films also work without glasses. Two of the comments were:

- VR made it more real. You were the person who had difficulties. More empathy.
- With VR glasses, I experienced the situation from the inside, as if I were the person. The experience when I looked at the laptop screen became more of an outside perspective. I became an observer.

The industrial design and engineering students commented that the films created a feeling of stress and exclusion, that work introductions they have participated in have most closely resembled the version with difficulties. One student said: "The films made me understand that social codes and indirect communication can be very difficult for people" and "In my future I will ask for what I need to do a good job and ask others what they need".

Other spontaneous comments from the participants in the tests included remarks on the insights gained and the realism of the scenarios:

- As for the meeting situation, I was completely stressed myself./…/. Such a meeting cannot feel good for anyone involved.
- Feels realistic. Amazing how little it takes to make such a big difference.
- Can be an eye-opener – to experience a situation with several senses you otherwise try to explain in just words. It may be easier to have a discussion after this experience.

6. Discussion and conclusions

The tests of the 360-degree films have given very positive results among all test groups regarding usefulness of all three films and the insight they give.

Overall, the vast majority of those who have tested the films have been positively affected, which shows that the films really reach out to those who watch them and create thoughts that can lead to insights. The films were originally planned to be used specifically in connection with the Supported Employment method [5], as connecting a new technological tool to a well-known method for which there are networks and conferences will make the dissemination of the tool easier. However, the feedback from the special support persons for introduction and follow-up is generally that the films provide a good overview of specific difficulties and solutions and that they can

supplement information material in a broader context for increased awareness. Several of the companies have given feedback that specific difficulties/solutions shown in the films are good and provide concrete tips on adjustments that can be made. The students have also given feedback that the films have opened their eyes to how a situation can be perceived in different ways by people with different needs.

The positive results from these empathy exercises are in line with experiences of teachers in design education [6] but in contrast to an article about negative attitudes empathy exercises can create [7]. Possibly, the reason for creating a positive attitude from empathy exercises is dependent on the creative focus on how to design or change the environment, instead of focusing on how it would feel to have the difficulties yourself.

One aspect that was highlighted by the participants is that it can create a strong sense of empathy if the meeting leader gives a comment directly to you, for example: “You should prepare better for the next time. I had these expectations of you, but you did not live up to them.” And positively: "This was a really tough task, which you have done well." Furthermore, it was important not to mention the main person’s name or let the main person speak, as the empathy feeling would be lost for the viewer if the male/female voice of the main person is not compliant with the viewer’s voice or name. Another finding from the tests was that many of the employers and students without disabilities spontaneously remarked that they could identify with the barriers visualised in the films. [8]. It would therefore be interesting to explore further how these types of empathy-building exercises could have a potential to contribute to the design of psychosocial workplaces that are accessible and inclusive for all, regardless of ability.

Acknowledgments

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Mapping Accessibility in Norway – A Tool and Method to Register and Survey the Status of Accessibility in Urban Areas and Recreational Areas

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Abstract. The Norwegian mapping authority has developed a standard method and an easy and flexible tool for mapping accessibility mostly for people with limited or no walking abilities in urban and recreational areas. We choose an object-orientated approach where points, lines and polygons represent objects in the environment. All data are stored in a geospatial database and are presented as web map and can be downloaded and analysed using GIS software. By the end of 2021, more than 250 out of 356 municipalities are mapped using that method. The aim of this project is to establish a national standard for mapping of accessibility and to provide a geodatabase that shows the status of accessibility throughout Norway. The data provide a useful tool for national statistics, local planning authorities and private users. The results show that accessibility is still low and Norway and faces many challenges to meet the goals for Universal Design.

Keywords. Accessibility; Barrier Free; Inclusive Design; Regional Management; Diversity

1. Introduction

In 2009, the Norwegian Government issued "Norway universally designed by 2025", an action plan for universal design and increased accessibility [1]. The plan shows how the government will lay the foundation for achieving this goal through different time stipulated targets and measures.

The Norwegian Mapping Authority's (Kartverket) was commissioned to collect and standardize data about the current situation in municipal centers and recreational areas and make these data accessible for statistics. The mapping project started in 2009 as a tool to establish the status of accessibility in Norway. In the beginning, the data should be used essentially for statistical purposes. However, we soon realized that the data could also be used by the districts in planning processes, for raising funds and awareness and for communicating the topic of accessibility within administration and towards the public. Local and regional administrations as well as organisations can apply for funding for mapping. Kartverket trains the project participants in the methodology, provides support during and after mapping and is responsible for data maintenance and data distribution.

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Regular meetings with our users showed that the field mapping tool still needed a better user-interface, updating and more functions. In 2021, we therefore started to develop a new APP based on a simplified data model. The following paper will introduce the overall project and its results as well as introduce you to our new mapping tool.

2. Methodology

We have set up a project design based on a Finnish study [2]. The requirements were that all objects are saved together with their object features and their geographical information and the validation of accessibility should be based on measurable values.

The object had to be representative for the accessibility of an area. The number had to be high enough to get a relevant picture of the situation but not too high to handle the data amount from a national project. The choice fell on the following elements:

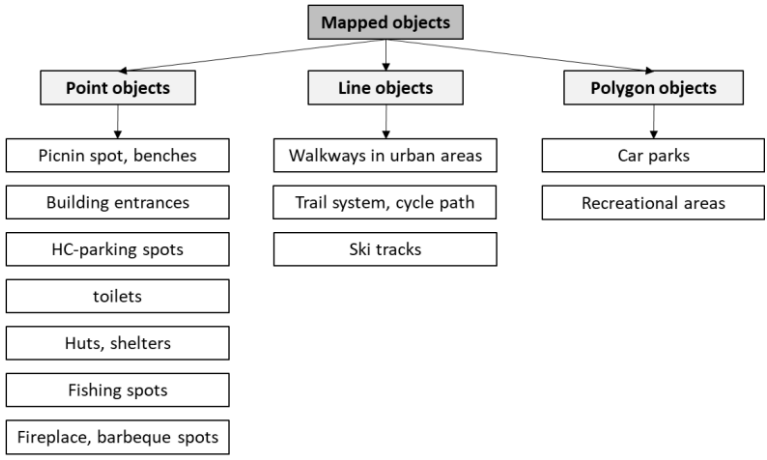

Figure 1. Overview over objects mapped in urban areas and recreational areas.

As main target group, we choose people with limited or no walking abilities. This is the group for which technical standards exist, that contain precise measurable values. We register also characteristics for blind and the partially sighted, but this is not our main focus. The existing technical standards are difficult to use in a practical survey, especially by voluntary field workers.

As a next step, we had to develop guidelines for mapping of objects including a classification for the assessment of accessibility following the Norwegian Standard [3] and the Guidance document for structural engineering [4]. Concerning people with impaired mobility these standards focus on manual wheelchairs as the group with the highest requirements and therefore the key group for Universal Design, hence areas accessible to manual wheelchair users are accessible for all people with limited or no walking abilities. We added the category electrical wheelchair, based on a wheelchair type for outdoor use [5], currently the most common wheelchair type in Norway.

Based on these technical standards we developed a classification scheme for the validation of accessibility for each object. The Classification scheme combines several object features into an overall assessment value for that single object, (e.g. features as

inclination of ramp, door width, height of beam, height of door opener etc. define the accessibility the entrance to a building). Each object is assigned to one of the following categories: accessible, partially accessible, not accessible or not assessed.

Mapping in the field is carried out with an APP that sends data directly into a database from where they are distributed via Geonorge.no, Norway's platform for geodata. Here data can be downloaded, access a Web Map Service or Web Feature Service, as well as yearly reports.

Additionally one can get access to the data via our information page https://www.kartverket.no/en/geodataarbeid/tilgjengelegheit-og-universell-utforming and our open map-client "Norgeskart" http://norgeskart.no/tilgjengelighet/

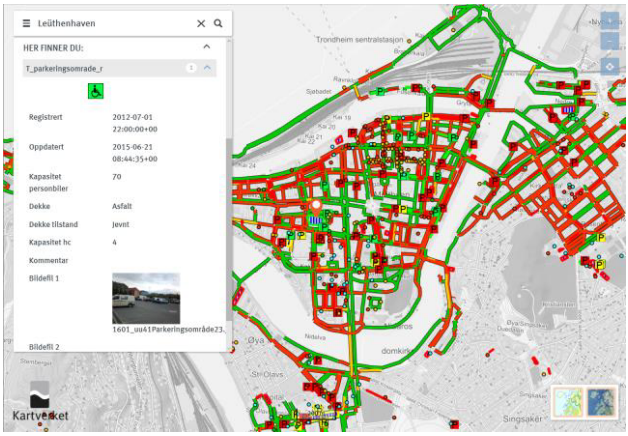

Figure 2. The data are distributed over our map-client "Norgeskart" and are there accessible for the public. (red = not accessible, yellow = partially accessible, green = accessible). By clicking on an object the object features show.

That all data are stored with their spatial information and measured values allows for:

- Spatial analysis, for example availability of accessible accessible-parking-spots in a distance of 50m around the entrances to public health buildings.
- Feature analysis that can determine why certain objects or a group of objects is not accessible.

Additionally storing objects with all their values and geographical information instead of just interpreted or derived information on accessibility has the following advantages:

- Evaluation of accessibility can be adjusted to possible future changes in standards/technology.
- The validation of accessibility can be calculated automatically from the measured values.
- The database can be expanded, for instance with more categories (wheelchairs for outdoor use, walking aid rolator etc.).

The focus on measurable values standardizes the evaluation process and therefore increases the objectivity of the data. That makes it possible to analyze change within a

municipality, sum up data into bigger units like federal or national and compare accessibility status between areas.

3. Results

By the end of 2021 mapping had been completed for urban areas in 172 municipalities and recreational areas in 255 municipalities.

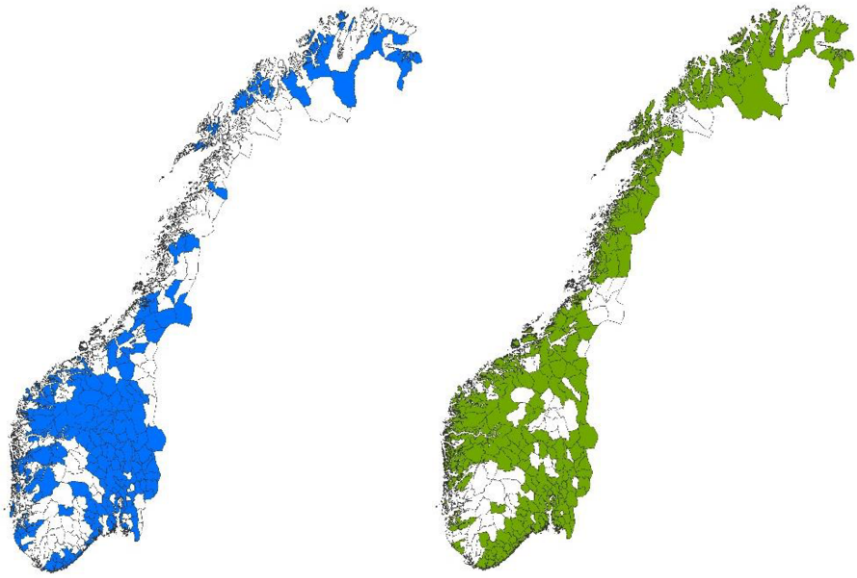

Figure 3. Map of districts with data in the accessibility database from the Norwegian mapping Authority. The map on the left shows data in district centers and towns, the map on the right data in recreational areas.

Analysis of the data shows that the overall accessibility in Norwegian municipalities is rather low. Only 6% of all accessible-parking-spots, 27% of all car parks, 11% of all entrances to public buildings and only 37% of all walkways are accessible for manual wheelchairs.

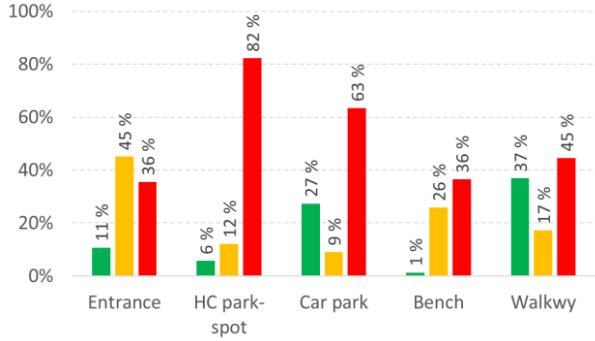

Figure 4. Results for urban areas in Norway (status 2020) for manual wheelchairs. (green = accessible, yellow = partially accessible, red = not accessible)

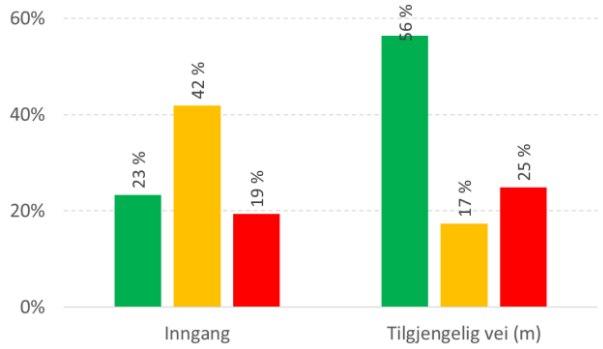

Figure 5. Results for urban areas in Norway (status 2020) for electrical wheelchairs. (green = accessible, yellow = partially accessible, red = not accessible)

The comparison of the results for electrical wheelchair and manual wheelchairs shows a clear difference between both groups for walkways and entrances (Figure 4 and Figure 5). That indicates that gradient and cross-fall of walkways are major problems.

Since all objects are mapped with their features, i.e. length and width for accessible-parking-parking spots gradient and railing for ramps etc. it is possible to precisely evaluate why objects are not accessible. Only 7% of accessible-parking-spots meet the requirements for size and only 29% of car parks have enough designated accessible-parking-spots. Most inaccessible entrances have inaccessible ramps, either manual doors or no accessible door opener or no accessible-parking-spot within 50m. Only few walkways in Norway have tactile or visual guidelines and only a fraction of these have guidelines that are in good condition. The biggest problem with walkways for wheel-chair users is the cross-fall, gradient and width.

Naturally, in recreational areas, some problems are even bigger, as here the surface is often uneven, tracks get washed out after heavy rains and due to Norway's topography the gradient is very rarely below the required value. However, the requirements are also less strict and 44% of all mapped tracks are accessible for electrical wheelchairs but that are often just short sections and not coherent walkways or even round-trips. Of other objects like fishing spots, toilets, huts and accessible-parking-spots less than a quarter is accessible. Here ramps are either lacking, are too steep or lack railing. The threshold of toilets and huts are too high and doors and the inside space is generally too small for wheelchairs. Car parks often have no accessible-parking-spots at all. However, when present accessible-parking-spots are more accessible in recreational area than in urban areas.

4. APP Development

The first generation could be installed on each mobile unit using Android. The APP allows digitizing the objects on a map back-ground, adding object pictures, editing object features and sending data directly to a server. During the years we experienced some problems with the stability of the product and limitations of functionality which necessitated a thorough make-over. The development of the second generation was based

on the user feedback we gather at the debriefings at the end of each mapping season, our experience and technical developments.

The second generation was finished for the summer 2022 mapping season. We went from two separate APPs for urban and recreational areas to one common APP where some objects, e.g. benches are not differentiated after their location. The user is therefore not faced with the decision whether a bench in a park belongs to an urban center or a recreational area and all objects are gathered in a common layer which also makes post-processing and analyses easier.

The APP can now be installed and used on all mobile devices and desktop machines. This allows people to more easily pre- or post-edit their data at the office on a bigger screen and municipal employees in charge of the project can follow the progress in the field easier and in real time. We hope that this change results in more accurate digitalization of objects, a more thorough processing of data and hence a higher data quality. That the App can be used on all operation systems means that users can use their own devices for mapping. This frees funds for actual mapping instead of purchasing extra equipment.

Additionally, we moved many functionalities from the database to the APP. Now the evaluation of accessibility and the assignation of municipality the objects are located in, happens in the APP itself. That gives users more direct feedback whether their accessibility evaluation is according to the technical standards. However, due to upcoming changes in administrative borders and technical standards the same functions have to still be present in the database to allow for massive editing of the whole dataset at once.

The user-interface was stream-lined to be more recognizable for users according to other known map products and we added the opportunity to switch between different colour coding, depending on accessibility or registration status, i.e. mapped this year, older data, error with export etc. (see figure x below). The symbology for the status of accessibility is the same for all data products and therefore easily interpretable for users.

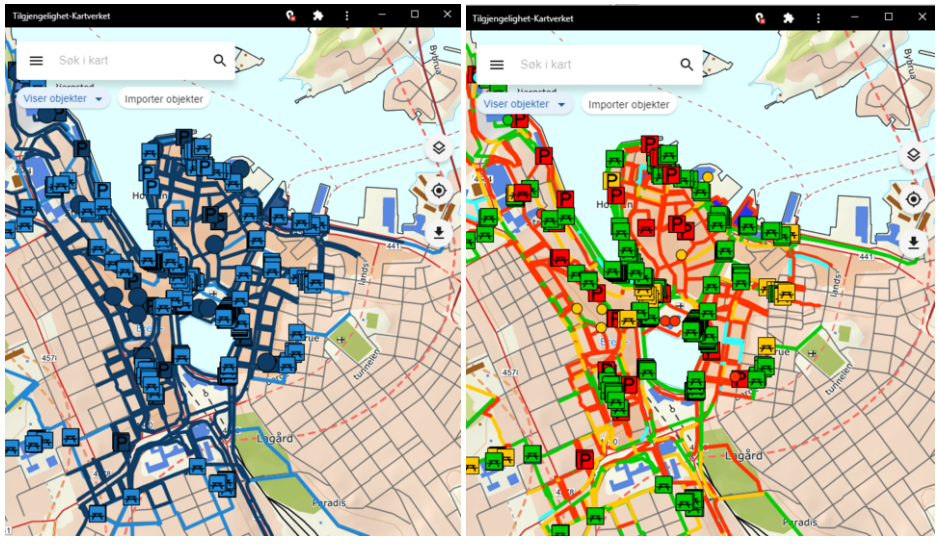

Figure 6. The user surface of the APP during digitizing and editing of objects (left) and during mapping of object features (right).

Another new function is a filter function, where people can use the desktop version to set simple filters, e.g. find all parking spots with no marking, save those filters and share it with other users.

Presently, we are working on adding the possibility to add data that already exist and edit them within the app. That is especially relevant for existing geometry of walkways. In Norway, authorities work towards a unified administration of all geometry for the network of roads, walkways and tracks in order to avoid that the same walkway appears with a different geometry in several databases. Within our project we want to contribute to that effort as well as making mapping easier. Having just one geometry for a walkway additionally allows users to connect the attributes describing accessibility with other attributes like winter service, maintenance status, street lighting of the same walkway.

Another change we are planning to introduce in autumn is the addition of the following objects: information signs, rubbish bins and electrical car loading stations.

5. Conclusion

5.1. Methodology

Even though the method was developed to make the validation as objective and standardized as possible, several factors limit data comparability. The choice of mapped municipalities depended on the municipals interest to take part. Initially, we focused on public buildings and recreational areas in or in the close vicinity of urban centers. However, the final choice of areas and objects is entirely up to the municipalities. That leads to an overrepresentation of interested municipalities in the national statistics.

As the register APP is freely available for administrative users, we have to trust that the method is followed and that all participants feel an obligation towards the data quality and mapping standard requirements of the project. We are also aware of the fact that people perceive and handle technical tools in a very different way and the quality of mapping increases with experience. Under debriefing with field workers we get very different feedback, ranging from rather complicated and difficult to self-explanatory, logical and intuitive. To minimize subjective validation and mapping mistakes we are consistently trying to make the method and the APP as intuitive as possible, require that field workers attend a course before starting to map and offer supplementary training and supervision throughout the whole project. Nevertheless, our experience from several years of fieldwork shows the need to minimize amount of subjective assessments, in order to get reliable results. We therefore calculate validation based on the mapped object features additional to the field workers validation.

5.2. Results

To analyse the results no special skills are required but an understanding of the mapping method is necessary. To be able to interpret the results of data analyses, it is important to have a basic knowledge of the technical standards the accessibility evaluations are based on, i.e. to know which object features are crucial for the assessment of the two target groups and what the critical values are.

When comparing municipalities, it also has to be considered, that some towns are less accessible simply because of old building structure or their topography.

Mapping, keeping the data updated and data use requires a certain continuity in staff responsible for the topic as well as financial support, something municipalities in Norway often do not have.

We are aware that the system is not perfect as it lies in the nature of standardization that complex data are simplified, but we still believe our data will be a valuable contribution to amongst others municipal and recreational planning and development of national statistics.

5.3. Side effects

The mapping project provides a lot of knowledge and awareness about universal design for employees in the municipalities. Often there are several sectors involved in the mapping work. This knowledge and awareness remains in the municipalities even after the survey has been completed. In many municipalities, we see that mapping triggers follow-up projects. The municipalities are not satisfied with the status and work to improve the situation. The information contained in the survey provides good arguments for political discussions and budgeting public and private funds for the future.

These side effects were not planned at project start. However, they show that knowledge and awareness can initiate development. Universal design engages people, and even with very limited resources, it is possible to make progress by working together across sectors and bringing together public and private organizations.

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Personalised Solutions for Universal Goals. A Home Adaptation Project for Disabled People in Italy

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Abstract. Home adaptation is a practice that addresses accessibility issues in the domestic environment of disabled people, introducing modifications to the spatial environment or devices which improve their autonomy and wellbeing, and that of their caregivers.
Protocols developed to define the right adaptations for each home mainly rely on checklists to verify the normative compliance of the physical environment to predefined accessibility standards. However, these protocols fail to address the complexity of the social, cultural, and economic dimensions that structure the person-environment relationship, thus compromising the efficacy of the adaptations. The excessive rigidity of such approach relates to the current debate on the limits of Universal Design when applied to the domestic environment, and especially when directed to people with specific needs.
As an example of a more productive approach, this essay illustrates ADA, a public funded action-research project that proposes home adaptations for severely disabled people. The paper discusses the innovative strategy of ADA, based on a high level of personalization, and its main tactics: interdisciplinarity, relational setting, and centrality of activities, both in the assessment of the users' profiles and spaces, and in the design of the adaptations.
This essay also evaluates the impact of the project, showing how in specific domains, such as those of ADA, personalization is the key to achieve the inclusive and sustainable goals of Universal Design.

Keywords. Disabled people, accessibility, housing adaptations, personalization, interdisciplinarity.

1. Introduction

This paper illustrates the ADA Project, an action-research dealing with design adaptations in homes of severely disabled people. The focus of the project on accessibility in interior spaces and on people with extremely specific needs defines a challenging field of action for the application of Universal Design principles [1]. We believe that the lesson learnt in the implementation of the project can contribute to the debate on Universal Design and its limits, and to its effort to serve collective goals [2].

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2. Home adaptation

Home is the primary space that contains human bodies, where primary needs and many desires are expressed. Its environment both shapes us and is shaped by our attempts to adapt it to our changing needs and requirements [3]. Disabled people's functional limitations, however, compromise this bidirectional process and their capacity to respond to the 'environmental pressure' of their domestic spaces [4]. In addition, the more severe their limitations are, the more they are confined to home, this being their main — if not the exclusive — spatial domain of their existence. This is what makes the home a crucial area of intervention for disability policies.

Home adaptation is a practice to address this unbalanced condition by adapting home's physical environment to improve accessibility [5]. Several studies have investigated home adaptation from different perspectives [6]. Some studies have focused on home adaptation outcomes, such as increasing disabled people's autonomy in their daily activities and well-being, facilitating caregivers' work, reducing injuries and the need for institutionalization, therefore limiting social and healthcare costs [7]. But also on other aspects, such as: the decision-making processes that lead to the implementation of adaptations, the relationship between clients and professionals who design, build or install them; or even on how adaptations can transform the meanings disabled people see in their homes, or on how they can affect family relationships [8].

The assessment aimed at defining home adaptations to be implemented in a home is complex, and several protocols have been developed for this purpose. Two of the most acknowledged examples are the Swedish ENABLER and the American I-HOPE [6].

Some protocols assess domestic spaces by checking to what extent they comply with local or national accessibility regulations. Nonetheless, as these regulations and the standards they are based on often fail to consider the real and diverse needs of disabled people [9], such protocols tend to result in a narrow focus on standardized accessibility and an increase in unnecessary adaptations, compromising their potential. As a result, other needs highly valued by disabled people and that pertain to meaningful domains of human experience are overlooked. Another limit of some home adaptation approaches is to neglect the role of the social, cultural, and economic dimensions that also structure the person-environment relationship.

In contexts where home adaptation policies have been organically implemented — Northern Europe, the United States and Australia — the negative effect of these limits is often mitigated by a favorable context which increases the availability of compensating options, both public and private. In other contexts, such as Italy, these positive systemic factors are often lacking, and disability policies are fragmented and poorly funded. Moreover, the market of accessibility products and services is still inadequately structured and disabled people have restricted access to supplementary resources. These limits can profoundly diminish the positive impact of home adaptation projects.

3. The ADA Project

ADA is an action-research project on home adaptations funded by the Tuscany Regional Government. This project is aimed at people with severe disabilities, with the goal of increasing their autonomy and well-being, and that of their caregivers [5].

Despite having a regional scope, the project falls within the intricate Italian national context of disability policies, affected by "multiple definitions of disability across sectors

and regions, leading to disparity in access to support and services. [...] Disability continues to be defined through a medical perspective, and the revised concept of disability, as proposed by the National Observatory on the Status of Persons with Disabilities, is not aligned to the Convention [on the Rights of Persons with Disabilities] and lacks binding legislation at both the national and regional levels" [10]. This also affects the reliability of statistical data on disability and the quality and funding of accessibility policies, limiting the capacity of such policies to effectively address disabled people's accessibility issues, especially in their domestic environment.

In this context, ADA was one of the first projects in Italy to propose home adaptation in a unified regional framework, introducing a series of methodological and operational innovations, some of which are discussed in this article.

ADA pursues its goals through two actions: 1) providing each participant with a set of Accessibility Recommendations (from now on Recommendations), which are suggested home adaptations to overcome the accessibility issues that hinder the disabled person from carrying out the activities they perform or would like to perform at home; 2) providing access to funding to carry out the home adaptations that the participant decides to implement. Adaptations can include modifications to spaces, furnishings and equipment and the adoption of assistive and home automation technologies.

For this purpose, an interdisciplinary workgroup assesses the conditions of participants, carrying out an approximately 90-minute site survey at the home of each disabled person. The assessment is made using the *Ada Assessment Model* (AdAM; [5]), a multidimensional tool developed by the research team of the University of Florence that coordinated the ADA Project.

The AdAM follows two data gathering strategies. First, during the site survey, the AdAM is used in a relational setting, with an in-depth interview that involves the disabled person, their caregiver, or both, depending on the functional profile of the disabled person. The goal is to outline an in-depth profile of the disabled person which, beyond covering some essential socio-economic aspects, focuses on three areas: 1) the functional autonomy of the disabled person; 2) their social network; 3) their relationship with the domestic physical environment. This last aspect is investigated by visiting and discussing the domestic spaces with the disabled person, or their main caregivers. Second, after the site survey, the AdAM is used to summarise this qualitative analysis in a series of quantitative assessments: these, in turn, are used to compare cases with different conditions and to structure the distribution of public funds.

4. Personalization

Acting in a domain defined by the homes of people with very specific profiles, the main strategy of ADA to achieve the Universal Design goals is to maximise the *personalisation* of its interventions [2]. The tactics implemented to achieve this strategy — as detailed in the two following paragraphs — aim to: a) reliably define participants' profiles and the relationship with their domestic environment; b) suggest Recommendations consistent with these profiles; c) promote equality in access to public funding.

4.1. Interdisciplinarity

A first tactic towards personalisation is interdisciplinarity, an approach that shaped the project from the outset. The university research team that developed the methodological and operative framework of the project was made up of architects with expertise in accessibility and sociologists with expertise in the human-environment relationship. The team consulted with physicians, physiatrists, physiotherapists, social workers, experts in assistive and home automation technologies, administrative personnel, political sponsors at the Regional Government, and representatives of disabled people's associations.

Interdisciplinarity is also a key element of the workgroups involved in the site surveys. Each ADA workgroup, in fact, is made up of three figures: a physician, a social worker, and an architect with expertise in accessibility. The workgroup could include other specialists (child neuropsychiatrist, psychologist, physiotherapist, etc.) depending on the specificity of the assessed case.

The physicians and social workers of the workgroups were already members of the Multidimensional Assessment Units (UVM), the formal bodies that in all Tuscany health districts assess the conditions of disabled people. With ADA the multidimensional units were expanded, including a design member with specific expertise in accessibility and the human-environment relationship. This enriched the analytical, evaluative and design potential of the multidimensional assessment.

The interdisciplinarity of ADA is even more significant in the Italian context, which stands out for the lack of established occupational therapy. Occupational therapists have extensively contributed to the theoretical development of home adaptations. In their practice they connect various disciplines and promote an activity-focused approach similar to that advocated by ADA (as detailed below). In Italy, however, there are less than 4 occupational therapists for every 100,000 citizens, whereas there are 145 in Denmark, 80 in Norway, 70 in Germany and 56 in England [10].

4.2. Relational Setting and Centrality of Activities

ADA suggests home adaptations through an assessment made in a relational setting that directly involves the disabled person and, when needed, their caregivers. What is assessed is how domestic activities are hindered by the spatial environment where the disabled person lives. The assessment also considers the personal, functional, and social conditions of the disabled person, their perspective and needs, and those of their caregivers, also addressing how this multidimensional profile can change in the future. The person-environment relationship, therefore, is not primarily viewed from a standardised perspective but, rather, considering the domestic activities that the person *actually* performs or *would like* to perform if the spaces allowed it.

This assessment posits that activities do not have the same value for all disabled people. On the one hand, only some activities are essential for all disabled people (independently of the assistance of a caregiver). Other activities, instead, are assessed only if they are both compatible with the functional profile of the disabled person, and significant to them. In other words, the ADA framework considers that the assessment cannot be limited to the intrinsic value of activities, which can be extrapolated from the comparison with standards; rather it also investigates their extrinsic value, which instead accounts for the actual needs and desires of each person in their specific context.

A relational setting directly involving participants is crucial for such a granular assessment of disabled people and their homes. Equally necessary are interdisciplinarity

and competence among the workgroup's members, who only have a 90-minute site survey to gather all the information needed for the assessment. These factors form the basis for highly personalised Recommendations, tailored on the specific needs and expectations of the disabled person in her specific context. On the contrary, a general check of regulatory compliance with predefined standards can hardly allow such a high level of personalisation.

5. The impact of ADA

Two experimental phases of ADA have been completed: the pilot phase, covering only two health districts of Tuscany (2015–17); and a second phase, in all its 34 health districts (2016–18). Both phases followed the same methodological and operational principles, albeit with some alterations to address the leap in scale.

In total, all 362 participants of the two experimental phases received the Recommendations, for free. Considering that the cost of such a service on the private market has been estimated in a range that spans from 1,000 to 2,000 euros, the overall economic value of all the Recommendations ranges between 362,000 to 724,000 euros. However, a comparable service in terms of quality and interdisciplinary validation is hardly available on the private market.

Around 75% of all participants (275 medium to low-income disabled people) received public funding to implement some of the suggested adaptations, for a total funding of 900,000 euros. Public funding totally covered the costs of adaptations for participants with low income, while for the others the funding partially covered the adaptations' costs.

5.1. The impact on people with disabilities

A qualitative ex-post evaluation of the effects of the pilot phase of the ADA Project was conducted by a sociologist with expertise in the human-environment relationship, one year after the introduction of the adaptations [10]. The in-depth interviews of 36 participant that received the Recommendations and the visits of their adapted homes illustrated the wide range of effects of the Project.

First, adaptations produced new opportunities of autonomous appropriation of domestic spaces by the disabled persons (when their functional profile allowed it). That happened both allowing the use of spaces that were not accessible before, or that were only usable with the support of others. The home devices that were introduced also improved both social relations and safety at home.

Adaptations improved the accessibility of the home and autonomy of the disabled persons (according to their functional profiles) by allowing not just essential activities (such as, for example, taking care of personal hygiene, eating, or moving inside the home) but also other activities that participants described as particularly relevant for their personal fulfillment. These adaptations also allowed a better use of caregivers' psycho-physical, time and economic resources.

The analysis of the symbolic changes produced by the adaptations revealed that the suggestion in the Recommendations of 'universal' solutions that could not be directly attributed to the world of devices for disabilities was strongly appreciated by participants, as it reduced the perception of stigma associated with disability. This increased the implementation rate of the suggested solutions, given that participants were free to

choose among the adaptations proposed in the Recommendation. This perception promoted the disabled persons' appropriation and territorialization of the adapted spaces, but also — when their cognitive conditions allowed that — the recognition, strengthening and expression of their identity as persons, and not just as disabled persons.

The participation to the project, in fact, triggered in participants a new capacity to observe and conceive their domestic spaces, pushing them to fine tune the adaptations after the project or find other minor issues, sometimes coming up with new solutions to overcome them. This revived agency promoted in participants the perception of themselves as active and intentional producers of their domestic space, a condition usually diminished by the fragilities directly or indirectly connected to disability. This is highly significant for people who must spend most, if not all, of their daily life confined in such space.

In the interviews the ADA project was often described as a turning point in participants' relationship with public institutions dealing with disability. Participants appreciated the on-site visits at their homes and the workgroup listening attitude, both interpreted as signs of attention and care by the institutions to the participants specific conditions. This is particularly relevant considering the Italian context of general mistrusts towards public institutions and disability policies. As a result, some participants even offered availability to share their positive experience to future participants, especially to help them in the implementation stage. The implementation of the adaptations, in fact, is often a difficult step to undertake, especially for people affected by the typical social and cultural fragilities that are associated with disability. And, unfortunately, ADA did not have enough resources to follow participants in such stage.

5.2. The impact on the culture of accessibility

The social, cultural, and economic impact of the Project goes beyond the effects of the adaptations on the disabled persons and their proximate social network (family members, caregivers, friends, etc.). ADA, in fact, promoted the diffusion of the multidimensional approach to accessibility in the wide community of actors directly or indirectly involved in the project.

Opening the interdisciplinary assessment to architects with expertise in accessibility allowed a cultural and professional growth in all the workgroups members. This affected around 100 professionals, considering both the group of physicians, social workers and architects directly involved in the workgroups, but also the neuropsychologists, rehabilitators and experts in assistive and automation technologies that were consulted to address the most complex cases. This improved the spectrum and the accuracy of the assessment of the functional, social, and environmental profile of the participants. But it also affected the process of definition of the personalized adaptations suggested in the Recommendations. On the one hand, the impact of the adaptations was higher than expected by the workgroups social and health members, improving their awareness about the effects of the physical environment on the wellbeing of disabled persons. On the other hand, the architects had the chance to improve their understanding of the functional, health, or social conditions of participants, and to consider the effects of their design solutions on such conditions, often in unexpected ways. Discussing design solution in the interdisciplinary workgroups, in fact, allowed to avoid some unintended consequences of the adaptations. For example, suggesting motion-activated wall switches in the home of a person with a limited capacity to control their fingers could end up reducing the chances to train that residual capacity, thus accelerating its further

reduction. Such unintended consequences are more common than expected and avoiding them requires a case-by-case multidimensional assessment of the supposed efficacy of the solutions for the specific person they are designed for.

It was also estimated that the participants contacted about 1,000 professionals to implement the adaptations. This group includes a wide spectrum of professional figures, such as designers, artisans, builders, installers, and retailers of building material, furniture, and devices. This group also was exposed to the contents, the interdisciplinary approach, and the language of the Recommendations. For the relatively unstructured sector of services for accessibility, the project meant a chance for both a cultural and an economic growth, given that this sector was the final receiver of the money spent to implement the adaptations. Considering both the public and the private funds spent by the participants who had to co-finance the adaptation, the total funds that this sector received are estimated around 2,000,000 euros.

The positive outcomes of the two experimental phases of the Project led to the recent introduction of ADA as a structural action of the Tuscany Regional Government's disability policies. This decision built on the explicit recognition of the innovative approach of the ADA Project and, specifically, of its effort to implement the principles of the UN Convention on the Rights of Persons with Disabilities and of the International Classification of Functioning (ICF), promoting a framework of evaluation of disability in terms of integration between the people and the physical environment they live in. Therefore, accessibility experts are now taking part to the works of the Multidimensional Assessments Units, and the AdAM is the official assessing protocol.

In 2017 the ADA Project was awarded with the title of "Good practice" by the International Design for All Foundation. Then, in 2018, the project won the International Design for All Foundation Award.

6. Conclusions: ADA and the Universal Design approach

The ADA Project is an attempt to introduce an innovative strategy to improve home adaptations protocols. Albeit some limits of the Project related to the implementation phase, we believe that this strategy has a positive impact on the effectiveness of adaptations; specifically, on how they improve the relationship that severe disabled people have with their domestic spaces, increasing their autonomy and wellbeing, and that of their caregivers.

The project strategy and tactics also aim at overcoming some of the limits of Universal Design and of other design approaches promoting inclusion and social sustainability, as illustrated by Arenghi et al. [2]. When such approaches are applied both to private domestic spaces and to address very specific needs, their success lays on their capacity to maximize personalization of their actions. As seen, in the ADA Project such personalization strategy implies an articulated multidimensional assessment method, that is applied prior to any design choice. The assessment does not just focus on the relationship between the disabled person, with their functional limitations, and the space they live in. This relationship, in fact, is analyzed considering an articulated network of other factors, such as social, cultural, and economic ones. Therefore, the design solutions that are proposed consider a wide variety of conditions of their final users, not just addressing their basic needs, but also their subjective desire and aspirations.

Defining and applying such strategy required a great interdisciplinary effort, a principle often much more stated than adopted. Such effort was based on the competence

of the workgroup members involved both in the assessment and in the definition of the Recommendations, a result of the training stages activated during the project. These stages prepared the workgroup members to take a much greater responsibility than the one needed to check the compliance of physical spaces with regulations or standards, an approach that, although useful, in the end is often only apparently objective. We believe that the availability of the workgroup members to get involved and not hide behind the shield of a formal assessment is another example of the cultural outcomes of the project.

These results complement those produced by the relational setting adopted in the assessment of the functional, social, and environmental profiles of the disabled persons. This approach promoted the direct involvement of the disabled persons (or their caregivers) in the assessment. As seen, this produced effects that go beyond the primary expected outcomes of the adaptations, namely improving physical accessibility: it fostered empowering processes, with a re-activation of participants' agency, and an improvement of their trust in the public institutions. Such effects are strongly connected to the realization of social sustainability, one of the main goals of Universal Design.

In conclusion, we believe that the ADA Project is an example to clarify how, when acting in the private and domestic sphere, the 'universal' attribute stated in the Universal Design label should not be intended as a quality of the field of application of the specific proposed design solutions, as it happens when operating in the public or collective space. Rather, in domestic spaces the tension towards universality is played in the effort to create the conditions to design solutions that answer to extremely specific conditions, often made of the unique mix of personal, functional, social, cultural, economic, and spatial conditions each person lives in. Adopting this posture requires an articulated strategy aiming at personalization. But, in turn, this only allows effective solutions if it is informed by inclusive and universal principles and goals.

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Universal Design in Housing in Australia: An Example of People Power

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Abstract. This paper follows three previous ones which have reflected on the grass-roots campaign in Australia to mandate a basic access standard in all new housing. The original negotiations with government and the housing industry for this reform were at first disingenuous then reluctant despite human rights obligations. A tenacious campaign over two decades by user stakeholders, researchers, and principled housing providers finally convinced political leaders to mandate national access provisions for all new housing in the National Construction Code. The paper discusses what assisted and hampered this campaign. It then discusses why politicians eventually favoured the interests of ordinary people over the self-interests of the housing industry.

Keywords. access, standards housing, Australia, politics.

1. Introduction

Australia has recently mandated a minimum access standard for housing in its National Construction Code. Three previous papers have reflected on the campaign that led to this building reform and this paper gives the final chapter. The paper provides the background to the decision to regulate and outlines the process which left a legacy the advocates for regulation wanted to avoid. Regardless, the majority decision by Australia's state and territory Building Ministers was to amend the National Construction Code to include access provisions for all housing construction.

The paper then discusses the insights and lessons for the advocates who campaigned for this reform. It emphasises the value of tenacity, independent research, and the importance of unlikely alliances to influence the political process, regardless of the rightness of the message.

2. Background

Australia has recently mandated basic accessibility provisions for all new housing through its National Construction Code. This reform is the outcome of twenty years of advocacy from people negatively impacted by poor housing design; that is, people with mobility difficulties, and their allies. For twenty years, the Australian Network for

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Universal Housing Design (ANUHD) provided a coordinating function to organize the work of advocates. Without funding or formal organizational structure, ANUHD was sponsored by People with Disability Australia, a national disability rights and advocacy organisation.

Although initiated in 2002, the campaign began in in earnest in 2010 when the Australian Government, as a signatory to the United Nations Convention on the Rights of Persons with Disabilities, identified the need to improve accessibility in residential environments. Industry, community and human rights leaders agreed to an industry-led transformation strategy with an aspirational target for all new housing to provide specified minimum access features by 2020. The agreement included a guideline called Livable Housing Design, with Silver (visitable), Gold (accessible) and Platinum (fully wheelchair accessible) performance levels and a 10-year plan with interim measurable targets of achievement.

Within three years, it became evident to ANUHD that, without government intervention, less than 5% of the 2020 target would be met. The first paper [1] identified the disjuncture between policy rhetoric and outcome was attributed to the force of housing industry lobbyists, an assumption that the private market can address issues of inequality, and the current government antipathy to regulatory enforcement. In short, the agreement was set to fail.

What surprised the advocates over the next decade was the unwillingness by the Australian Government to take responsibility for the agreement failure, let alone report it to the United Nations Committee on the Rights of Persons with Disabilities (UN Committee). After all, all levels of government had committed to support the targets as part of the 2010-2020 National Disability Strategy. Despite the misleading government reports, the UN Committee noted the failure of the Livable Housing Design agreement and recommended that Australia mandate an access standard for housing in the National Construction Code. The second paper noted a systemic disregard for Australia's obligations under the Convention and an apparent willingness by the Australian Government to misrepresent the facts to United Nations officials [2].

This experience raised for advocates the question who should and who would take responsibility for Australia's human rights obligations to make housing accessible. When it comes to social responsibility and who is likely to take action, ANUHD used Arendt's [3] theory on guilt and social responsibility to focus their action. Arendt argues that people fall into four groups: people who are in positions of power and do nothing (in this case, government and industry leaders); people who are unaware that their decisions and actions contribute to social injustice (the many designers and builders who omit to make homes accessible); those who are aware and take individual responsibility for their actions in their daily lives (individuals who make their homes accessible or educate and raise awareness about accessible housing design); and lastly, those who take political and collective action to intervene and to call to account those who have the power to make positive change (this was the natural role for ANUHD) [4]. ANUHD took political action over raising awareness about universal design within housing. They focused their efforts on a single goal: mandated access provisions for housing in the National Construction Code.

A decision by Australia's Federal, State and Territory Building Ministers shaped the next chapter. The Building Ministers meet regularly to oversee policy and regulatory issues affecting Australia's building and construction industries. Their operational arm, the Australian Building Codes Board (ABCB), consists of government representative

officers and construction industry appointees, which oversees the National Construction Code.

The National Construction Code has no legal standing. Rather, the Building Ministers have agreed to reference the NCC in their State and Territory building legislation with minimal variation to provide national consistency [5].

In 2017, the Building Ministers' Meeting directed their operative arm, the ABCB, to perform a cost-benefit analysis, called a Regulatory Impact Statement (RIS), on access provisions for housing in the National Construction Code. The decision to investigate the possibility of regulation was in part a response to the housing industry's failure to follow through with the Livable Housing Design agreement and in part to appease the growing pressure from social advocates. The RIS was to examine both voluntary and mandated options, including the Livable Housing Design Silver and Gold levels of accessibility as a minimum standard.

The paper now describes the RIS process and how it favoured the voice of the housing industry over user-stakeholders' interests. The RIS process took five years from October 2017 to September 2022 in four stages:

1. An options paper developed by the ABCB and released for public comment
2. A summary by the ABCB of the comments, also released to the public
3. Development of a Consultation (or draft) RIS by external consultants and released for consultation
4. Decision (or final) RIS sent to Building Ministers to inform their decision.

3. The process of the Regulatory Impact Statement

3.1. Options Paper released for public comment

The ABCB released an Options Paper [6] in 2018, which provided a menu of options and notional costings on the possible inclusion of a minimum accessibility standard for housing in the NCC. The ABCB ran face-to-face consultations across Australia, which were instrumental in bringing the issue to the attention of the building industry and the broader community. It allowed for debate at a policy level, and a wide range of user-stakeholders participated. The industry stakeholders contributed little at this stage, preferring to wait for more tangible information on how an access standard might affect their individual building practice.

3.2. Consultation Outcomes Report

The ABCB's summary of the consultation, the Consultation Outcomes report [7], in 2019 identified considerations for the RIS. Three points, which became important later in the process, were:

1. Qualitative, or intangible, benefits should be identified and given due consideration as well as ensuring that it goes beyond consideration of people with a disability
2. It is important that costs are accurately quantified and the distribution of costs and regulatory burdens between industry and consumers is clearly identified.

3. There is a need to consider aligning the project objectives to the concepts of equity and independence (pp. 8,9).

3.3. Consultation (or draft) RIS

External consultants developed a Consultation (or draft) RIS [8] and concluded that a mandated standard in the NCC would impose a net-cost on the community. The consultation that followed attracted over 200 responses, with approximately 2:1 challenging the finding and taking a position in favour of a mandated standard in the NCC. ANUHD raised immediate concerns that the Consultation RIS was inaccessible for user-stakeholders who were unlikely to have read such a technical document before.

3.4. Decision (or final) RIS sent to Building Ministers NCC 2022 to inform their decision

The Decision (or final) RIS was not released to the public for further comment. It maintained its original finding; that is, to amend the NCC to mandate an access standard for all new houses and apartments would impose costs that outweigh the benefits to Australian society [9].

Contrary to the Decision RIS's recommendations, the majority of Building Ministers agreed to mandate access provisions for housing in the NCC in September 2022. They further specified that the standard of access would reflect as close as possible the Livable Housing Design Silver performance level. They also agreed publish a voluntary provision based on the Gold performance level. Mindful of the resistance by the housing industry, the Ministers allowed each state and territory to determine whether and how the new provisions would be applied in their jurisdiction. In theory, ANUHD had reached their goal.

4. Implementation of the NCC access provisions for housing in State and Territory legislation

The five supportive States and Territories (Victoria, Queensland, Tasmania, Australian Capital Territory and Northern Territory) have worked together to align their implementation of the new provisions. At the time of writing, the details of this alignment were not available.

South Australia and New South Wales did not support the provisions in the NCC, and Western Australia supported the provisions in the NCC but chose not to implement them in line with the other supportive jurisdictions. In effect, the achievement of including access provisions for housing in the NCC has been tempered by the varied response across Australia.

The next section identifies three lessons for user-stakeholders when making change in the construction industry: the disregard for user-stakeholders within the established authorities governing the built environment; the importance of independent academic research; and government-sanctioned processes are not enough to identify the right outcome.

5. Three lessons

5.1. Disregard for user-stakeholders

The consultants who developed the RIS failed to address the three key points identified by user stakeholders during the initial consultation of the Options Paper [7].

The first key point was that "*qualitative, or intangible, benefits should be identified and given due consideration … , as well as ensuring that it goes beyond consideration of people with a disability*" [7](p. 9). Instead, the RIS focused on individuals with disability, rather than households of a wide range of people with mobility-related issues.

The second key point was that "*costs should be accurately quantified and the distribution of costs and regulatory burdens between industry and consumers is clearly identified"* [7](p. 9). ANUHD raised concerns of perceived bias towards costs over benefits early in the development of the RIS. An independent academic review [10] of the economic analysis in the RIS confirmed ANUHD's concerns. It found that:

- there was a problematic understanding of the principle of symmetry, which requires that benefits and costs are reported in a way that avoids bias;
- the consultants' "willingness to pay approach" undercounted the benefit side;
- the cost-benefit analysis should have reflected the fact that the entire population derives benefit from the improved design and functionality of accessibility; and
- the discount rate used by the consultants (7%) should have been more reflective of the 'present value', say 3%, to be in closer alignment with current practice.

The third key point advised the consultants *"to consider aligning the project objectives to the concepts of equity and independence"* [7](p. 8). The consultants argued instead that issues of social inclusion, equity, and human rights obligations were beyond the purview of the RIS. Although the relation between social and economic participation and suitable housing is well documented, the consultants found no direct quantifiable evidence to support the qualitative evidence. Concepts of equity and independence were not taken into account.

It should be noted here that the government guidelines for best practice in regulation[11, 12] advise that the analysis of benefits should include "*health, environmental and other social benefits, which are often not marketed or are characterized by prices which reflect less than the full value of the benefits*" (p. 26) and "*where quantitative data about such costs are unavailable, a qualitative assessment should be provided*" [11](p. 26).

At the release of the Consultation RIS, ANUHD raised this issue with the Office of Best Practice Regulation (OBPR), whose task is to ensure Government policy and decisions are supported by the best possible evidence and analysis. Their response [13] was to shift the responsibility for the quality of the RIS to the public and ultimately the Building Ministers:

> *The matters [ANUHD] have raised go to the heart of why consultation is undertaken – to test the assumptions and data put forward in the preliminary analysis, and to propose alternative approaches, methodologies, or data, should it be available.*

In summary, the OBPR appeared to disregard ANUHD's concerns that the Consultation RIS was biased, incomplete and inaccessible by most user-stakeholders. Further, the OPBR appeared to rely on the consultation process to identify and rectify these issues.

5.2. The importance of independent academic research

The user-stakeholders realised that the responsibility for rigour and thoroughness in the Consultation RIS was left to the community consultation process, rather than with the consultants themselves. The Melbourne Disability Institute (MDI) at University of Melbourne with the Summer Foundation took leadership by commissioning three independent studies to inform user-stakeholders' response to the RIS.

The first study [10] challenged the economic analysis in the RIS. Using the original data collected for the RIS, an opposing result was found—that an access standard should be mandated because the benefits clearly outweighed the costs, and that the Gold performance level "*has particular merit as the most cost-effective of the options that achieve functionality for those elderly and/or disabled people in wheelchairs*" (p. 10).

The second study [14] aimed to provide the lacking important quantitative (but not monetized) and qualitative (not quantified or monetized) evidence linking social and economic participation and suitable housing. This study found that:

- Existing strategies such as a voluntary building code, reliance on home modifications or provision of accessible social housing have failed to deliver accessible housing for most people with mobility restrictions. Building all new homes to an accessible standard will be the most effective way to address the shortage in accessible housing.
- The impact of inaccessible housing on dignity, freedom, social inclusion, health, and workforce participation is profound, and the report presents robust quantitative and qualitative evidence of these.
- Notwithstanding the above, the data indicated that the RIS underestimated the economic costs of inaccessible housing, by ignoring impacts on workforce participation and productivity of people with mobility restrictions; underestimating the impact on paid and unpaid support needs; underestimating adverse impacts on mental health and wellbeing; and, underestimating the extent to which a shortage in accessible housing limits housing choice and mobility.
- The range of domestic activities for which paid support is provided, and which can be reduced by accessible housing is broader and more significant than estimated in the RIS. The RIS only focused on paid and unpaid assistance with mobility tasks, whereas inaccessible housing also significantly increases need for assistance with self-care and home care.

The third study [15] was an audit of accessible features in 20 new-build, high volume house plans. The study found that many accessibility features are already incorporated into the most popular house designs being built in Australia, but not in a systematic way. It demonstrated that accessible features are now accepted as good house design for the general population; and indicated the cost of the proposed access provisions is likely to be less than estimated in the RIS.

5.3. A government-sanctioned process is not enough

Despite the community feedback on the RIS, the consultants maintained their position that "*that regulatory options to amend the NCC for all new houses and apartments . . . impose costs that outweigh the benefits*" (p. 20). In effect, the assumption by the OPBR that community consultation "*would test the assumptions and data put forward in the preliminary analysis, and to propose alternative approaches, methodologies, or data*" was misplaced. It relied on the consultants respecting user-stakeholder feedback and including it in their final analysis.

ANUHD had no option but to cut across the government-sanctioned process and to take their concerns directly to the Building Ministers. The Summer Foundation through their campaign, Building Better Homes [16], garnered the support of user-stakeholders with a political message of broad community support for regulation. What influenced the majority of Building Ministers to vote for access provisions for housing in the NCC against the express advice of the RIS, we will never know. Their rationale was that, despite the findings of the RIS, "*a regulatory solution will result in significant and lasting benefit to Australians who need access to homes with accessible features*" [17].

6. Conclusion

ANUHD made it clear to the Building Ministers and the ABCB the RIS process was perceived as untrustworthy and lacking in transparency and rigour. In January 2022, an independent review of the RIS process was called by the ABCB "*to establish the lessons that can be applied to similar exercises conducted by the ABCB in the future*". ANUHD's advocacy could be dismissed as the partisan view of social activists, but not so the independent research by prominent academic institutions. The credibility of the ABCB will remain in question until an independent review of both the consultants [9] and the University of Melbourne's [10] cost-benefit analyses is done.

This last paper, with its three predecessors [1, 2, 4], have reflected on different aspects and stages of a complex, lengthy and difficult campaign. Together they revealed undue influence of the housing industry, disregard for the voice of user-stakeholders, and the entrenched flaws in the government processes to improve our built environment. It also has demonstrated the power of ordinary people to call those responsible to account.

With every success, there is more work to do. Now that the Livable Housing Design standard is a provision of the NCC, improvements are likely to favour industry productivity over concerns for social inclusion and equitable access. The advocacy of user-stakeholders will continue to be needed.

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Housing Development for All? Learnings from the Ars Longa Case

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Abstract. This paper discusses the prerequisites of inclusive housing development based on the learnings from Ars Longa, a block of flats for artists, designers and authors in Helsinki, Finland, that was initiated by a group of elderly persons. The study draws from research on co-design and universal design in housing. Post Occupancy Evaluation is used as method of investigation. Interviews with four key actors trace the barriers and enabling factors in the housing development process and assess the final design outcome. The results highlight the role of public institutions in supporting resident-driven projects, the financing of projects as major barrier to laypeople, and the potential of concept design in integrating the needs of stakeholders. Joint design with adjacent plots made extensive shared spaces feasible and clever design moves enabled spatial flexibility, whereas the connection of co-design activities to building design was deemed weak. The study shows that continuous management and community building are needed for negotiating the use of spaces and for fostering agency and belonging among residents. The paper contributes to research on inclusive housing development through an empirical case.

Keywords. Co-Design, Housing Development, Inclusive Design, Post Occupancy Evaluation, Senior Housing

1. Introduction – The Systemic Design Challenge of Inclusive Housing

The ageing of the society, growth of solo living and loneliness, and high cost of housing in cities create demand for more social and affordable forms of urban housing for senior citizens as well as for other resident groups. Within the expert-driven housing system, ageing individuals have traditionally been perceived as a homogeneous group with no capabilities or skills in contributing to the design and development of housing. However, in light of recent examples of innovative housing projects initiated by groups of elderly persons, along with research on participatory design and co-design in housing, it seems evident that elderly persons can have valuable skills and knowledge that could potentially be harnessed for improving the offering of housing also for broader markets [1 p. 427].

Various approaches and methods for realizing resident-driven and communal urban housing have emerged globally, such as group construction and co-housing with extensive community engagement [2, 3]. In Europe, multi-generational housing that connects different age groups and family types is a growing trend [4]. Examples of novel communal housing projects in Helsinki include the Loppukiri (Sprint) senior house with services provided by the residents and Sukupolvienkortteli (Generations Block) multi-generational complex. These projects have had varying degree of resident participation.

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Housing pilots arising from social innovation, diversifying lifestyles and people's everyday needs suggest empowerment and transformative agency of residents in the face of the housing system [5 pp. 57–8, 6 p. 33]. However, as attested by previous research, resident-developers meet considerable systemic barriers when trying to get their ideas realized [7 p. 312]. Supporting user-driven residential development is a multi-faceted challenge to authorities, housing developers, architects, financiers and other professionals, that requires new design competences, tools and shifts in attitude [1, 6 pp. 40–1]. Recognized gaps in resident-driven housing include translation of user needs into actual design features and sharing of knowledge beyond singular projects [7 p. 185, 211].

The framework of universal design opens up further ways for examining resident-driven housing development [8 pp. 177–80]. In this light, truly inclusive housing would not only require physical, cognitive and social inclusivity of housing as artefact, but also the housing development process should be accessible to "all" people. Would such a goal be viable, what would it mean for design and what kind of obstacles are on its way?

This paper discusses the prerequisites of more inclusive and collaborative housing development based on the learnings from one real-life case, the Ars Longa house. The research interest is twofold: to trace the impediments and enabling factors in its development process, and to evaluate the design outcome in use from the perspective of key stakeholders. The study is grounded on research in universal design and co-design. Post Occupancy Evaluation [9] through interviews, observations and analysis of design documents has been utilized as the primary method. The paper seeks to extend the assessment of the inclusivity of housing towards the housing development process.

2. The Ars Longa House and Viehe Block

The Ars Longa house is a communal block of flats for artists, authors and designers who are over 55 years old (https://arslongatalo.fi). The eight-story house, finished in 2020, has 54 rental apartments ranging from 40 m2 studios to three-room apartments with 63 m2. In addition, there are two rentable atelier apartments on the top floor. Situated in the new urban area of Verkkosaari in Helsinki, Ars Longa is part of Viehe block that combines three adjacent plots into one building with extensive shared facilities. The other plots contain affordable housing for young people offered by The Finnish Youth Housing Association NAL, and student housing owned by Setlementtiasunnot, another non-profit housing provider. The whole block was developed as one project.

Ars Longa was initiated in 2012 by a small group of elderly persons with background in design and applied arts. They founded the Ornamo Senior House Association (OSHA) under the auspices of the national association of designers, Ornamo. At the suggestion of city officials, the association partnered up with Finnish Artists' Studio Foundation, a professional owner of studio spaces, to succesfully apply for a building plot from the city. The Ars Longa team soon begun to collaborate with the builders on neighboring plots to develop the Viehe block as one project. Later, due to difficulties in obtaining the required self-financing, The Union of Finnish Writers and copyright society Kuvasto joined as partners in Ars Longa, expanding the target group from designers to authors and artists. The house is owned by a real estate company formed by the four organizations.

The objectives of Ars Longa as defined by the protagonists [1 pp. 421–2] were to build a *senior house for designers* that would combine *communal living* based on shared professional background with *affordability* to comply with the lower-than-average income level of many elderly designers. The building should be physically *accessible*

and offer a functionally and aesthetically *well-designed* environment despite the economic constraints. There was to be *versatile shared spaces* and *flexible dwellings* adapting to different needs and lifestyles. An important goal was to support *artistic and creative practices* even in old age. Ars Longa was envisioned as a testbed for transmitting the cultural impact of the residents to the neighborhood and as a duplicable pilot concept.

Figure 1. Viehe block with Ars Longa house in the front, and view from a co-design workshop where its floor plans were evaluated by the Ars Longa community. Photos by the author, 2020 and 2016.

3. Research Method and Data

This paper is based on a longitudinal follow-up study of the development process of the Ars Longa house. The research material consists of thematic interviews with key persons in the project. Design documents, photos and other materials have also been utilized. In addition, lightweight observation and Post Occupancy Evaluation of the finished building has been conducted to identify how the initial design goals were realized and how the building serves the everyday living practices of the resident community.

Post Occupancy Evaluation (POE) provides a systematic approach for evaluating buildings from the perspective of users and other stakeholders after they have been built and occupied for some time [9 p. 3]. The method can be utilized as a diagnostic tool for identifying problems in buildings, for co-improving buildings based on stakeholder recommendations, for testing new design prototypes, or for developing design guidelines and visions beyond singular buildings. POE typically makes use of observation, interviews and surveys to gather qualitative knowledge about the occupants' experiences, sometimes combined with monitoring of user behavior, usage of spaces or technical performance. [9 p. 5, 57, 70.] Recent research has highlighted the need for more critical and socially oriented POE as means towards responsible and inclusive architecture [10].

Four persons who have been actively involved in the Ars Longa project between 2012 and 2022 were interviewed for this study. The interviewees included an elderly designer-artist who originally started to further the Ars Longa house and now resides there (*The Initiator*), an architect and director of the Artists' Studio Foundation who represented Ars Longa in the building project (*The Developer*), the former managing director of the social housing provider Setlementtiasunnot which was one of the three partners in Viehe (*The Leader*), and the principal architect of the Viehe block (*The Architect*). In addition, the study draws from the personal observations of the author (*The Researcher*), who has been following the project since its infancy.

The role and duration of involvement of the interviewees is reflected in their account of the case (see Figure 2). Only The Initiator had experienced the entire path from the idea to the occupied building (2012–), while The Developer had joined later (2014–) and was living elsewhere. The Leader was only active in the development stage (2014–2018) and The Architect's role was focused in the design and building phase (2016–2019).

The semi-structured interviews were conducted by the author in 2022. They covered the initial goals of the project and the participants' role in it; the project timeline and its key turning points; mapping the network of stakeholders and assessing their contribution; evaluating the finished building; and discussing the case from the perspectives of universal design and the general prerequisites of inclusive housing. The interviews were audio recorded and transcribed. Analysis of the material followed the principles of qualitative content analysis [11 p. 6]. The transcripts were read closely in light of the research question and key insights coded and grouped into broader categories.

4. Tracing the Development Journey and Evaluating the Building in Use

The development process of Ars Longa from idea to occupied building could be divided into four main phases (see Figure 2), three of which relate to the housing development process while the last focuses on the finished and occupied building. In each phase, a *dominant design challenge* was identified, the solving of which would contribute to the inclusivity of resident-driven housing development. The design challenges are opened up in the following through tracing the enablers and challenges in the Ars Longa case.

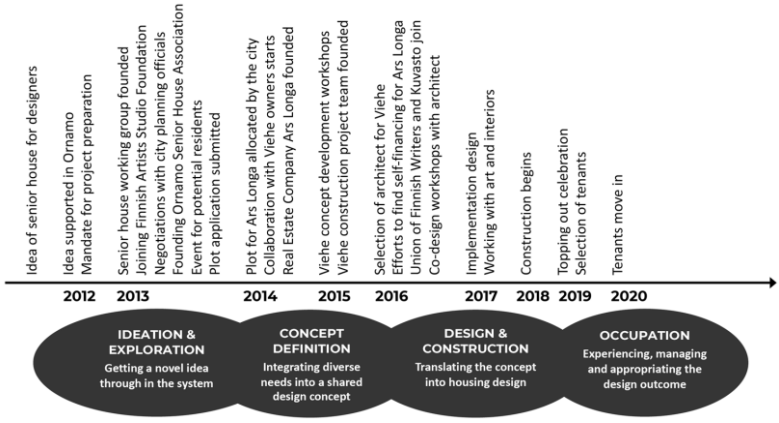

Figure 2. Timeline of Ars Longa and the four main phases with dominant design challenges.

4.1. Ideation and exploration – Getting a novel idea through in the system

The key driving force that made Ars Longa reality was the *persistence* of the resident-developers who voluntarily pursued the complex task of developing housing for seniors in their own field, motivated not only by personal housing needs but a dream of developing affordable and socially supportive housing for colleagues in more vulnerable position. There were hesitations, as recounted by The Initiator: "I said that I can't, but then I thought about it at home and started to think that it might be an exciting thing". Aware of her lack of knowledge, she started to gather information, contact experts and

write a memorandum about the idea. The founding of OSHA brought in more hands and more diverse expertise, and the project started to gain momentum.

An early turning point was the meeting with a city planning official that led to merging of interests with the Artists' Studio Foundation and allocation of a building plot for Ars Longa by the city. Here, personal networks and chance played a part. However, the role of *municipality and state* as enablers of resident-driven projects through city planning, plot allocation, financing and design regulations is important to note. After social rental housing was decided as the tenure model, the governmental Housing Finance and Development Centre in Finland (ARA) became a source of support. The terms of ARA production also created challenges, such as tight economic framework, limitations to the allowed area of shared spaces, and rigid criteria for tenant selection.

Financing of resident-driven projects emerged as a major challenge. "I don't know how we could be so ignorant about the fact that you can't build a rental house without money", exclaimed The Initiator: "Not having [funding] caused terrible anxiety". This not only concerned the construction, but also the early exploration and co-design work. Later on, Ars Longa did not succeed in securing the required 5% share of self-financing, as there were few institutions willing to fund this type of project. The project was only made possible by taking in the more established organizations of authors and artists, meaning that only 10 of the 54 apartments are now allocated for designers.

4.2. Concept definition – Integrating diverse needs into a shared design concept

The development phase of Viehe was characterized by much deeper *collaboration* between stakeholders than is customary in social rental housing. This was instigated by external and internal factors, starting from the city plan and plot allocation terms that designated the block for communal housing. The innovation of voluntarily combining three adjacent projects necessitated yet deeper collaboration, as did the involvement of laypeople via Ars Longa. While also causing complexity and uncertainty to the project, collaboration brought significant mutual value, most notably through the extensive shared facilities and savings made possible by designing the block as one. For Ars Longa, teaming up with experienced developers was crucial in getting the house realized.

Careful contracts and planning of processes and responsibilities were mentioned as requisites of multi-stakeholder collaboration. But professionals' personal motivation and willingness to step out of familiar roles to work with "others" were deemed equally important. The Leader emphasized the role of informal activities such as common meals and general "fooling around" in creating trust, commitment and sense of community among stakeholders. However, other interviewees noted that the enthusiasm somewhat waned after the visionary persons changed and the "hard" construction process took over.

The value of *concept design* in integrating the needs of stakeholders, creating a joint vision and setting specifications for building design was stressed by The Leader. He argued that housing producers are too attuned to building design, while using time for defining the spatial and service concept together with residents and professionals would be beneficial for realizing user value and creating innovative solutions. The concept could also mediate between the users and the architect. However, the architect should be involved early on. In Viehe, the concepting activities included co-design workshops about user needs and the spatial program, facilitated by The Leader and a service designer.

An interesting finding is the *transfer of knowledge* from reference projects and previous experiences of the stakeholders to the development process. The Ars Longa team visited the Färdknäppen communal senior house in Stockholm and studied the

Loppukiri house. They also commissioned a report on international case examples from The Researcher. The Leader relied on German co-operative housing and the Generations Block as references in concept design and The Developer brought in her learnings from a communal group construction project where she was also living.

4.3. Design and construction – Translating the concept into housing design

When the development journey proceeded to building design and execution phase, the stewardship of design was taken over by The Architect and the building project managers. The interests of Ars Longa were now guarded by The Developer, whose experience in housing production was deemed an essential success factor. OSHA members also participated to the design process. Here, translation of the needs of Ars Longa and the joint Viehe concept into the actual housing design solution became a central issue.

The interviewees voiced concerns about the *low impact of participation* to building design. The Ars Longa community felt that the architects were not very responsive to their input and seemed annoyed when someone suggested changes to the design, possibly due to perceived threat of user participation to their professional sovereignty. As put by one interviewee, "Engagement with residents perhaps wasn't so pleasant to them in the end. But it was the right thing to say in the [tendering] interview to get chosen".

From the experts' side, The Architect pointed out that right timing of participation would be essential for it to be effective. Similarly, The Leader opined that focus on truly participatory concept design would be more fruitful than tinkering with architectural details and criticizing building plans. The experts in this phase clearly focused on the production pipeline and valued an effective and *experienced project team* over working with residents in refining their ideas. In Viehe, most of the actual residents were also not known. As means to deepen resident participation, the experts suggested adding clear criteria about participation to ARA regulations and city plot allocation terms. An attitude change among experts would also be necessary to work with "amateurs".

Despite their criticism, the Ars Longa team was able to influence the design of the house to some extent and to bring in their *expertise in art and design*. They determined the spatial program and distribution of apartment types in Ars Longa, informed by a survey to the target group, commented the floor plans, and commissioned an accessibility evaluation. Early on, the team got the idea of open plan apartments to serve combination of living and working. There is now one two-room apartment per floor where the divisive wall is replaced by a curtain rail. The elderly designers also suggested improvements to colors, lighting and materials, and selected some furnishings to shared spaces. There were working groups in art and gardening, and an artwork was realized to the facade.

As an interesting example of the architect's skills in solving user needs in a creative way, *clever design moves* enabling flexible (mis)use of space and overcoming the strict ARA regulations on shared spaces were introduced in the building design. The Ars Longa developers wanted to have a gallery space in the street level for exhibiting their work, organizing events and communicating the identity of the house. This was made possible by adding large windows and other details to a space officially designated as bicycle storage. It is now run as a gallery and forms the heart of the community.

4.4. Occupation – Experiencing, managing and appropriating the design outcome

Assessing the finished building and its design features (see Figure 3), the interviewees were satisfied with the final outcome and getting the building realized. *Positive features*

included the efficient overall concept of the block, the array of shared spaces resulting from the joint project, and the functionality and accessibility of the building. The top floor with terrace and the interior circulation routes were also considered successful. As for *negative features*, the quality of interiors, lighting and furnishings in the common spaces was deemed poor. This could have been avoided by using an interior architect. Another mishap was the closed parapet around the roof terrace obstructing the view from some apartments. Electronic locks and heating regulation had also caused problems.

The *sense of community in Ars Longa*, social activities and gallery space were praised by the interviewees. The residents were running the art gallery with the help of interns and volunteers and it made the artistic identity of the house visible even in the neighborhood. Also, the top-floor clubroom was in active use and the residents had taken over a storage space on the ground floor that they were using as crafts workshop. This shows active agency in appropriating the spatial resources to community needs.

By contrast, the relationship between the Ars Longa people and tenants in the other two houses in Viehe, mostly students and young people in their twenties, was distant. Some elderly residents had met rude behavior or felt unwelcomed when using the common spaces and would have preferred to have some spaces only for Ars Longa. Evidently, *forced multi-generational living* doesn't provide the same social value than voluntary multi-generational communities, and can even be a source of friction.

Another impediment met by active residents trying to adapt and improve the spaces was the *hierarchic joint management* of the block led by property managers. Introducing any changes was slow or easily overruled. The study indicates that shared facilities are important enablers of communal living, but continuous management, negotiation and community building are needed for the housing community to thrive. Resident control and ability to appropriate the building over time can support inclusivity and belonging.

Figure 3. Features of the Viehe block. Communal kitchen and art gallery at street level, clubroom and green roof terrace on the top floor. Photos by the author, 2020–2022.

5. Conclusion – Housing Development for All?

Following the Ars Longa case revealed factors in the Finnish housing system that impact the success of resident-driven housing development and its accessibility to laypeople innovators. The development journey could be divided into four main phases with dominant design challenges. In the ideation and exploration phase, the main challenge was to get a novel idea arising from social needs to be picked up in the housing system. In the concept definition phase, integrating the needs of diverse stakeholders into a viable spatial and service concept to steer building design emerged as the main challenge. In the building design and construction phase, the concept needed to be translated into

concrete design features. Finally, the occupation phase called attention to experiencing, managing and appropriating the design outcome over time by the residential community.

The study revealed breaks between the phases that disrupt the continuity from user needs to housing solutions. One gap was identified between concept design and building design. Other major barriers were difficulties in obtaining financing to resident-driven projects and systemic resistance to real resident impact in building design. Improving the accessibility of housing development would require support from cities and public institutions in financing of projects, guidance and services for resident-developers, and truly inclusive concept creation and co-design methods in housing. Focus on concept level design in steering building design can help in integrating the goals of stakeholders. Moreover, regulations and design guidelines should have more flexibility to changing uses and residential needs, and set explicit criteria for resident participation.

The main research contribution of the paper is identification of factors that impact the inclusivity of housing development and design. The study suggests that principles of universal design and the POE method could be extended to evaluating the housing development process. Limitations of the study include the small sample and provisory theoretical framework. Further research would be needed to validate the findings.

In the end, the protagonists of Ars Longa succeeded in their endeavor through persistence and collaboration with other actors. The role of city and government was instrumental, as was the teaming up with experienced professional builders. Joint development and concept design of Viehe enabled extensive shared spaces within the tight constraints, and clever design moves induced spatial flexibility. The residents brought in their own expertise in art and design and a strong sense of community.

The context of social rental housing also opens up broader questions about inclusive and socially responsible housing innovation. Here, the actors were not just designing housing for themselves, but serving a wider community. Indeed, non-profit rental housing may offer special advantages for cultivating novel housing solutions. However, as stressed by The Leader: “[P]eople with less resources need builders who are interested in getting to know this particular target group and responding to their needs”.

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Perspectives on Accessibility and Its Users Amongst Practicing Danish Landscape Architects

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Abstract. This paper presents findings from 15 interviews of randomly selected Danish landscape architectural offices focusing on how these work with and understand accessibility. The paper finds that Danish landscape architects mostly understand accessibility and its users in relation to existing building regulations. Moreover, in finding that the informants possessed a limited professional vocabulary for understanding accessibility, the paper discusses the type of knowledge requested and by, and necessary for, Danish landscape architects to gain a more reflective understanding of accessibility and its users. Towards such ends, universal design can help the profession. However, with only a few informants mentioning ideas related to universal design, this indicates that more education is needed for universal design to provide a different perspective on accessibility and its users amongst Danish landscape architects.

Keywords. Accessibility, universal design, landscape architecture, Denmark

1. Introduction

The number of issues landscape architecture are expected to help solve, and the texts written about how to solve these issues, come out at an ever-increasing pace. Spurred by the World Health Organization (WHO) and United Nation's (UN) emphasis on socially and environmentally sustainable cities [1, 2] issues such as gender [3], mental and physical health [4], and what could be loosely defined as 'liveability' [5] have gained increased traction. In addition, the UN's Sustainable Development Goal (SDG) 11.7 emphasizes universal access to safe, inclusive, and accessible green spaces by 2030 for women, children, the elderly, and people with disabilities [6]. In other words, for cities to become sustainable we need to think about how we grant access to these new and improved spaces as an inherent aspect of the design process.

Despite this, there has been few attempts in empirical research at granting primacy to practicing landscape architects for whom accessibility or universal design competes with a plurality of other issues which they are expected to act upon [see 7 for an exception related to inclusive design]. Practitioners' framing of such issues can stem from the perceived responsibility and ethical considerations of the profession. In practice

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however, the pragmatic expectations of e.g. the client, the restraints of building regulations, and municipal guidelines greatly influence their decisions [8]. Previous research by Kirkeby [9] has framed this as a choice between context-independent knowledge and context-dependent knowledge, in which practitioners will tend to choose the context-dependent knowledge which is directly applicable to their project.

It is in this intersection, between the daily professional reality of practicing landscape architects and the ethical responsibilities imposed on them externally and internally to their profession, that this article is positioned. Specifically, we wish to explore this by focusing on *how Danish practicing landscape architect's perceive users with disability and solutions designed for this group*. Such solutions being both shaped by practitioner's ethical responsibilities, perception of users and legal requirements.

2. Methodology

The article is based on 15 semi structured qualitative interviews with randomly selected Danish landscape architecture offices conducted during winter and spring 2021. The offices varied in size from one-person offices to offices with several hundred employees and were geographically located throughout all regions of Denmark. All interviews were conducted with trained architects or landscape architects who had experience with project management. All of the informants had taken their education in Denmark and through them all schools that train landscape architects in Denmark were represented. Collectively the interviews represented over two centuries of experience from practice with informants having between 8 and 25 years of experience. Due to COVID-19 all interviews took place online either through Microsoft Teams or Zoom and lasted between 40 and 70 minutes.

We explicitly chose to employ the word 'accessibility' in its Danish translation ('tilgængelighed') in our interview guide and our contact with informants. This choice was made because the word is used throughout the building regulations and is as such well known to landscape architects. All interviews took place in Danish and the quotes are translated by the authors into English.

The interviews were conducted following an interview guide and analyzed according to a grounded theory approach. Following the completion of all 15 interviews several themes were identified as reoccurring and/or interesting. This led to the construction of 30 codes which were subsequently used by the authors to independently of one another code each interview. The outcome of this analysis can be found in [8] – the results presented here are specifically related to the aforementioned focus of this article and all quotes included below have not been published previously. Given the methodology employed in collecting and analyzing the data we emphasize that the results section should be read with the intend to understand the type and variety of perspectives present amongst Danish practicing landscape architects. This is a limitation inherent to grounded theory, as this methodological approach does not allow us to develop a representative description of the Danish landscape architectural profession at large.

What it does allow, is the development of a broad understanding of the professional nuances in Danish landscape architects' perceptions of users with disabilities [10]. The strength of arguments developed through grounded theory rests upon it achieving data saturation. Data saturation refers to a situation when researchers have either 'heard it all' (i.e. code saturation) or 'understand it all' (i.e. meaning saturation) [11]. In the context of this study, data saturation was achieved around the 13th interview.

3. Results

The results section is structured by first framing the context-independent perspectives of practicing Danish landscape architects' perception of users, followed by an exploration of the definitions of accessibility used by the informants as a bridge to move into more context-dependent quotes about user experiences.

3.1. Framing the perspectives of Danish practitioners

The perspective of the informants is inherently, and often times explicitly, framed around the spatial and architectural qualities of discussing accessibility. In relation to this it is important to emphasize that no matter their personal opinions, or those of the office they are employed at, the informants are primarily interested in making high quality landscape architecture. One example of this is the following quote which articulates a frustration with the disagreements that can occur between architectural concerns on the one hand and accessibility on the other hand:

> *"I often experience that something remains unsaid; why is it not more dialogue based? I can't quite understand it. I'm thinking that it's people, flesh and blood I mean, just like we are people of flesh and blood who are also interested in… Without getting polemic, I think they are also interested in good architecture"*

This hints at the issue that many informants have with how accessibility is sometimes framed and handled as a topic in design processes. Namely that they often find themselves in situations where they feel forced to choose between landscape architectural qualities and accessibility. A frustration which is explicitly stated by some of the informants more experienced within accessibility. In a similar faction, the interviewed landscape architects understand that users with disabilities is a diverse group. However, this diversity is primarily understood through what spatial necessities this diversity translates into:

> *"I think it is a little bit rude to say disabled are all alike like one big homogenous group, which they are absolutely not. It is almost impossible to make something which acknowledges everybody's needs (…). I think we would be better off with a catalogue of examples and how to use these than we would be with strict rules"*

This particular quote relates to a conversation about how building regulations function, and what could replace them. It is none the less interesting because it emphasizes how landscape architects perceive accessibility and its users through the lens of their professional relationship with space. In other words, if practitioners cannot translate the experiences and information they are given into a spatial context it falls outside their professional perspective and is as such lost in the design process [12]. As we will see in the next section this is a reoccurring tendency when we explore how Danish landscape architects define accessibility. Moreover, this helps clarify Kirkeby's argument by suggesting that knowledge which can be made to become context-dependent, i.e. translated into design elements in landscape architectural work, is prioritized. This appears to also be the case when dealing with accessibility.

3.2. Definitions of accessibility

While the word accessibility is well known to Danish landscape architects as it features as a legal requirement in the Danish building regulations, how accessibility is defined and worked with in design processes varies greatly. Of the 15 informants only a few directly mentioned universal design, design for all, or some similar definitions, while most clearly tied accessibility explicitly to the legal demands for level free access, tactile guidelines, and so forth. However, during the interviews as informants continued to answer questions and reflect on the topic, several informants expanded their definition of accessibility as more than just a legalistic framework imposed on design processes:

> *"In our profession we are quick to perceive accessibility as how to enter and exit but what do we do about people with allergies for example? If we expand* [our definition] *we are properly not particularly forward-thinking. Sitting here talking about it, one begins to wonder, but it is properly mostly people with physical disabilities we know how to handle"*

Reflections like this, where it becomes evident that practitioners are aware of the limitations to how accessibility is currently solved in design processes, are common across many of the interviews. What is important to highlight is that these reflections often point to how particular types of disabilities (eg. mobility disabilities and visual impairments) are protected and prioritized by existing building regulations and/or by the design processes of the office. Reflections which engage with defining accessibility as a general topic for the landscape architectural profession, which the next quote shows, are rarer:

> *"*(…) *it is a type of social responsibility we try to adhere to when we make quality outdoor areas. I hadn't thought about this in relation to accessibility* (…). *Which makes me think more about level free access and tactile guide lines. But since you broaden it to include social responsibility I actually think it is a large part of what we are already doing naturally as part of our work as landscape architects"*.

Brought on by the questions in our interview guide, the informant broadens their definition of what accessibility is and relates to. This has two important implications: 1) Accessibility continuous to be defined as a legalistic framework under which Danish landscape architects must operate. We did not see something akin to this in terms of e.g. rainwater management and environmental sustainability, both terms which are also present in Danish building regulations. 2) Perhaps due to the significant experience of our informants, the explicit questions introduced through a single interview was enough to shift, or at the very least reevaluate, the meaning of accessibility. This shows an ability by the interviewed practitioners to actively reflect on the premises for their design processes [13].

This somewhat narrow definition of accessibility in design processes and practitioner's ability to reflectively adapt these definitions based on new questions and ideas, sets the stage for moving into the next central results section of this paper.

3.3. Conceptualizing users with disability, their experiences, and accessibility

While there is a great deal of variance in how informants formulate themselves, almost all informants are focused on accessibility as something which should be seamlessly integrated into the general experience of a space:

> *"(...) accessibility should be seamless enough for users, whether they need special accessibility or not, to not think about it"*

One might be inclined to think that striving for seamlessly integrating accessibility in the spatial design at large is akin to the goals of universal design. However, accessibility is still perceived as something 'special' for a certain user group by most informants. In other words, the theoretical ideal for universal design that accessibility is, and should be, perceived as a benefit to all users, is not present in this quote. On the contrary, perhaps due to the definition of accessibility presented in the previous section, accessibility is often perceived of as a tool for eliminating the disparity in spatial experiences between abled bodied users and users with disabilities through particular design solutions. This context-dependent understanding of accessibility in turn means the user experience of a particular group of individuals (with disabilities) should not 'drown' the intended spatial qualities of the entire project:

> *"When you sit and design and integrate accessibility, you do it from the perspective of the users. Otherwise there is no reason to do so, you could say. You sit and imagine how a user will move back and forth, getting from one spot to the next, in a reasonable manner without it overpowering the entire project, so it is a little bit of a balancing act. Sometimes, if you had to make something fully accessible with all the things listed in the recommendations, it would drown the project so much that some of the quality would be lost"*

While the landscape architect attempts to uphold the ethical and legal responsibility of his profession, he simultaneously perceives this particular type of user's experience as an externality to what parameters define the quality of the project. The spatial experiences of users with disability are as such measured against how much alike it is to that of able-bodied users. For the professional practice of landscape architects, this indicates that a potentially increased quality of spatial experiences by users with disability does not directly translate into a higher quality landscape architectural project, unless it coincides with how quality was previously measured in the project. Nonetheless, as previously stated, some informants refer to universal design or terminology similar to universal design.:

> *"But accessibility that is the question, what is accessibility? Is it the physical aspect that everybody can enter through the door or what type of accessibility are we dealing with. If one were to speak about it at a grander scale then it could also include ethics somehow. I mean, who is it for, this thing? Is it for everybody? (...) This is the kind of thing that fuels the program for these different projects"*

In this instance, and in others like it, the landscape architect attempts to articulate a broader definition of accessibility which asks questions beyond how it can be easily

solved spatially. However, this is done without actually articulating an alternative for practitioners beyond reiterating the ethical questions and dilemmas which Danish landscape architects struggle with in their practices:

> *"Again, I'm thinking that we always attempt to integrate it* [accessibility] *fully so everybody can use the space without getting the impression that certain parts have been created specifically for some. A kind of equality, we think. It's tough because it's always a difficult balance"*

What these two previous quotes have in common is that they struggle with articulating a context-independent approach to conceptualizing users with disability and their spatial experiences. The ideal design, even if this is questioned by the landscape architects themselves and pointed out as a point of contention in their projects, is still to find a 'one size fits all' design, even when universal design is referenced explicitly or implicitly. This indicates a conceptualization of the user with a disability as something other than the average able-bodied individual. Arguably this is because the conceptualizations of users with a disability encountered in the interviews had more to do with the *how* of spatially designing for this 'other' rather than the *what*. This meant answers, and the frustrations which were voiced in interviews regarding accessibility, were primarily centered around integrating these users into the imagined experience of the average or 'normal' user. Even when asked directly, very few landscape architects could explicitly conceptualize users with disabilities beyond this *how*. One example which does divert from this is the following:

> *"For me it's not so much about if you're in a wheelchair. It's about freedom of movement. If you have this way of thinking (...) then there are quite a lot of other people than the ones sitting in a wheelchair which need level free access. For instance, parents with prams, all kinds of other user groups, drivers which need to enter with a pallet jack, sack carts, and all kinds of other stuff. Its suddenly not so hard, once think on it a little"*

Here the landscape architect states that accessibility should be perceived as an advantage for both users with disabilities and able-bodied users. While this might seem like a small deviation from previous quotes, the significant difference with this quote is that it deals with the *what* of accessibility as well as the *how*. What is apparent, though, from our interviews is that Danish landscape architects in their practices are primarily interested in solving *how* to design with accessibility. This resonates with Kirkeby's findings that context-dependent knowledge is prioritized over context-independent knowledge. However, as this last quote also indicates, especially the more senior landscape architects expressed a professional frustration that accessibility as a quite significant topic in their daily practices did not gather more professional attention. This indicates that even though context-dependent knowledge is what is almost exclusively present and sought after in the interviews, there might be a necessity to introduce context-independent knowledge, referring for instance to universal design, for Danish landscape architects to become more aware of and better at dealing with matters of accessibility.

4. Discussion and conclusion

The results show that perceptions of accessibility and its users were often times mediated by a 'normate' understanding of designing for accessibility in practice [14]. We mention this because very few informants implicitly or explicitly referred to the physiological diversity of both human beings with disabilities and able-bodied human beings [15]. Similarly, while continuously referencing the general landscape architectural quality which practitioners sought for in their projects and work in general, no link was made between such context-independent qualities and the shared human dependency of our physical environments – i.e. accessibility [16]. To be exact, it is not that the general sentiment of Danish landscape architects is one of being dismissive of the importance of accessibility– though there are practitioners who are very critical of the way accessibility features in current Danish building regulations. A more precise analysis would indicate that there is a general lack of ability by Danish landscape architects to employ a vocabulary which can adequately describe their conceptualization of accessibility and its users. This is despite some senior informants, as per the last quote, approach an understanding of the quality of e.g. level free access to people in all types of situations.

Simultaneously, what is most often referred to as the guiding principle in practitioners' work is that of landscape architectural 'quality'. This indicates that context-dependent knowledge is what is sought after by Danish landscape architects in matters of accessibility but this is primarily due to the fact that accessibility is not perceived of as an inherent part of what constitutes landscape architectural quality. It is important to emphasize that informants showed a significant ability to quickly adapt and appropriate alternative understanding of accessibility through our interviews. As such it is far from impossible for practitioners to appropriate accessibility as an inherent aspect to the ethical and sustainable dimensions of their practices through education or experience from projects in which accessibility featured as a central goal.

The inability to overcome this divide between the context-independent landscape architectural quality and context-dependent accessibility might explain the frustration of senior practitioners mentioned earlier. In light of this, universal design could allow for practicing landscape architects to obtain a vocabulary about accessibility and its users while simultaneously providing a link between context-dependent accessibility design and the context-independent quality of landscape architectural projects. However, this rests upon the premise that it is possible to convince practitioners that universal design can be adopted as a context-independent measure of quality in landscape architectural projects. While our research indicates that Danish landscape architects are quick to reflect and accept that social sustainability is tied to accessibility we cannot speak on the difficulty of implementing such changes to an office, much less the profession at large. The best solution therefore seems to train future landscape architects to reflect on how they conceptualize users with disabilities and the accessibility these users and human beings at large require to 'seamlessly' exist in our physical environments. For a more immediate solution which does not postpone changes to the next generation of practitioners, it appears that the best way to sway practitioners to take seriously a specific issue is to provide them with a professional vocabulary about issues which resonate with existing professional quality measurements.

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Section 3

Universal Design for Inclusive Communities and Urban Spaces

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Transforming our World through Universal Design for Human Development
I. Garofolo et al. (Eds.)

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Systemic Approach to Universal Design of Urban Spaces - Case Study of Trbovlje, Slovenia

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Abstract. The study consisted of examining universal design principles and applying selected interventions with the goal of solving accessibility issues in the settlement of Trbovlje. As a result of the investigative process and the layered spatial data concerning universal design theory, it was possible to propose the dynamics for the implementation of the design solutions. Deliberate selection of only specific universal design features as a pragmatic decision is what ensures the proposed solution's real-world application value. Subdividing a wholistic design into temporal phases secures a more feasible and pragmatic approach to reach the end goal while still preserving the full functionality of each individual phase immediately and thus its effectiveness. Such a systemic approach is proposed as a way of creating a more focused overview of the settlement, making a better design for the solution of specific issues, assessing these solutions, and implementing them in selected places. This approach and thinking present itself as a good method of granting universal accessibility that could be adopted as a mandatory part of any urban plan.

Keywords. universal design, accessibility, inclusivity, spatial plan, phase design

1. Introduction

The needs for universal design arise from the necessity of travelling and navigating through urban space on the scale of an entire settlement. Each day anyone of us can face situations when and where we have to navigate to a destination where we encounter either physical or navigational obstacles. These obstacles we might encounter can be overcome with varying levels of effort by different people, when commuting to work or school, visiting shops or post offices. A person can set off on foot, by car or by public transport. Every one of these methods of travel can be problematic for someone with visual impairment, hearing impairment or movement difficulties. With that in mind, the goal of universal design is to establish as accessible and as inclusive public space as possible that encompasses all groups of people in a systemic manner.

The goal of our research was to define priority levels of access paths to central functions of the urban space to enable universal access to create a full spatial assessment with the intent of defining a general spatial strategy on universal design and design features of the settlement of Trbovlje. Inclusive planning focuses on the diversity of people and how they alter spatial planning [3][4]. Our systemic approach to universal design aims to encompass as many different users of the space as is sustainable and viable in practice, not necessarily meeting the needs of the entire population.

2. Method

The methodology includes a study of existing universal design principles, including a review of the general standards and practices. This is regarding universal design from the national to the local levels which are followed up by a case study of the settlement of Trbovlje. The objective of this study is to investigate the accessibility of most publicly accessible facilities of the settlement. In our study of different facilities and areas, we try to determine the unique spatial challenges of accessibility and other elements of universal design the residents of Trbovlje people encounter in their daily lives.

The case study was conducted with analysis based on observation of the present state and comparing that to available design standards. The analysis consisted of behavioural spatial mapping, infrastructure spatial mapping, a visual assessment, spatial interpretation, program analysis, and a connection system analysis. These analytical tools served to identify crucial elements of open space and their role within the hierarchy of central functions of the settlement. This overview enabled us to develop and restructure design solutions and guidelines in distinct and clear phases. The authors are aware that the study does not include all the spatial barriers, navigational obstacles and equipment that a public space or a private facility can generate. We have selected only those that we have examined in detail in terms of accessibility specific to the residents of Trbovlje.

3. Understanding inclusivity in universal design

Universal design establishes an inclusive planning theory that focuses on the diversity of people and how this affects spatial planning. The British Standards Institute [2] defines inclusion as the design of products and services that are accessible and usable for as many different users as possible, without the need for such a product or service to require any adaptation, a special intervention or retrofit in their use thereafter. The principles of inclusive design in relation to the Commission for Architecture and the Built Environment [5] instrumented in making the public space safe, accessible with ease and dignity, with the flexibility to adapt considering the changing needs of people. This makes the space accessible for all, regardless of their age, gender, mobility, nationality or any other circumstances, removing barriers that could exclude a particular group of people [7]. Persons with functional impairment can involve a variety of age groups, ranging from young children to the elderly, including also pregnant women, people carrying infants with prams, people moving luggage or grocery trollies, etc. The people, who for various reasons have permanently or temporarily reduced their mobility, making it harder or slower to move. These can be again divided in two categories of persons with sensory impairment and people with reduced mobility.

3.1. Persons with sensory impairment

Although many types of sensory impairment exist, visual impairment is the most difficult to cope with when moving through public spaces. Visual impairments are not conditioned by age, so they can occur at any time in life. Most often low vision or complete blindness can occur in later periods of life. The aging of the population also increases the number of blind and partially sighted. The difference between partial and total visual impairment is important and so the adaptations in the space are different as well. The latter group requires the surfaces on which they move to be as flat as possible

and help themselves with other senses such as hearing and touch [9]. Persons with sensory impairment can be helped with minimal improvements in space, such as making the signs and inscriptions contrasting enough to be able to read them with relative ease. The adaptation for the blind is, therefore, more complex as they need adjustments that rely primarily on hearing such as sound traffic signals, or the sense of touch, making tactile markings and tactile maps necessary. Without any alterations to the space person with these impairments must first learn certain pathways with the help of companions before they can use them on their own [7]. This solution is not a solution at all, because it drastically limits the confidence and freedom of people with sensory impairment.

3.2. Persons with motor impairment

People in wheelchairs are either paraplegics, tetraplegics, dystrophies, or people who live with multiple sclerosis, others include the elderly who face similar illnesses or medical conditions. They might be thought of most often when describing motor impairment, however not all motor disabilities are considered [9]. Many motor disabilities include only temporal injuries and disabilities where people can cope with only crutches or stilts. The adjustments to the space, accessible ramps, for example, are also important for other users of the space, such as parents with prams and people who find traversing stairs difficult for whatever reason. In the case of motor disability, the problem is divided into two sides. The first is when a building or a public program is inaccessible due to obstacles in the open public space. The accessible paths can be built too narrow, are slippery, accompanied by stairs with an unsatisfactory access ramp, or they lack a ramp altogether. The other consideration is the building access on private property, mainly the entrances in parking spaces [7]. These are again made difficult to access due to the constructed obstacles, for example, narrow doors passages or door thresholds being too high, effectively turning them into obstacles.

3.3. Design solutions for universal design

The task of bringing universal design into reality can be tackled on different scales. For example, even land-use policy can make the public space safer and easier to master for those with limited mobility. “To achieve this at the level of planning, one must consider walking distances, levels of incline, and landmark orientation. Short distances are particularly important in residential areas. Long distances to grocery stores, post offices, and public services pose obstacles to the daily life of residents, and these obstacles increase with age.” [6]. To adequately plan a commute, a traveller with limited mobility must know whether a path is clear. Whether it is blocked, whether the sidewalk is too steep or rendered unusable due to poor conditions, whether there is a sidewalk at all and if the street can be crossed [1]. During the research process of the case study of Trbovlje and the analytical work, only a specific set of design solutions presented by universal design theory appeared suitable for direct implementation. The reason for this derives from the specific linear character of the settlement which is highly conditional to the topographic features of the landscape. Hence this study rather focuses on traditional solutions to physical obstacles for those with limited mobility that can be applied directly to the settlement. These are listed as follows: building entrance adaptations, parking spaces for the disabled, access ramps, tactile markings, audible traffic lights, and navigational signage. These aforementioned design solutions are further outlined and discussed in the following chapters.

4. Case study of the settlement of Trbovlje

The municipality of Trbovlje is located in the eastern part of Slovenia in the centre of the Zasavje region. The majority of the population of the municipality lives in the settlement of Trbovlje, which stretches over 5 km in a narrow valley along the banks of the Trboveljščica River [9]. Along the entire length of the settlement lies an important traffic axis that branches off for a short distance in part of the settlement and then shortly reconnects back. Roads and streets that branch off from the main traffic axis lead to predominantly residential parts. They are winding and narrow as they have to bridge higher grounds of the steep-inclined valley. The axial character of the settlement means that new interventions to the public transport network can be easy and inexpensive to implement, making it more than suitable for our study. Understanding the population structure revealed the relevance of our research, with a significant share of individuals with impairments, amounting to 6% of the total population [8]. Many were not included in the census, such as the elderly or people with temporary injuries.

4.1. Analysis of accessibility in Trbovlje

A crucial tool for understanding the complex picture of the accessibility issues within the settlement of Trbovlje was a structured analysis of the various public and private programs that it offers which function in a system of node destinations. This provided us with data segmented in the following topics: the traffic system and public transport connectivity along with public transport stop density, the topography and incline of the valley, the pedestrian sidewalk infrastructure, and the commercial-public program network.

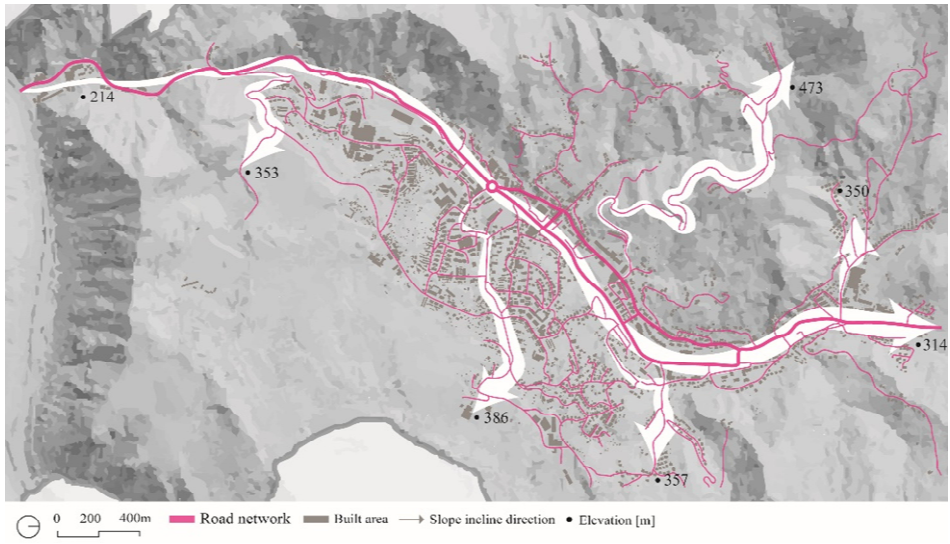

Figure 2. Road network, incline direction and elevation data.

The municipality of Trbovlje is well connected via the road network as shown in Figure 2. Alongside the entire length of the settlement leads the main traffic axis that connects to a regional road in the south. The narrow valley requires the roads to have to bridge considerable height differences, which creates a problem for pedestrians. In the

municipality of Trbovlje, a person with reduced mobility can choose between three modes of travel: moving by car, a bus, or taking the sidewalk and possibly using a wheelchair. Most publicly accessible facilities are equipped with a parking space reserved for the disabled, making them well accessible by car. More limited is travel with the public transport or walking. Only one intercity bus line is needed to ensure access to public transportation for the largest part of the population and the area of the settlement is well covered with bus stops, with only a part of the eastern settlement missing coverage. However, this method is not currently suitable for persons with motor and sensory impairment. This is because the bus stops lack the basic safety features, such as tactile markings, or the sidewalk is not accessible (Figure 3).

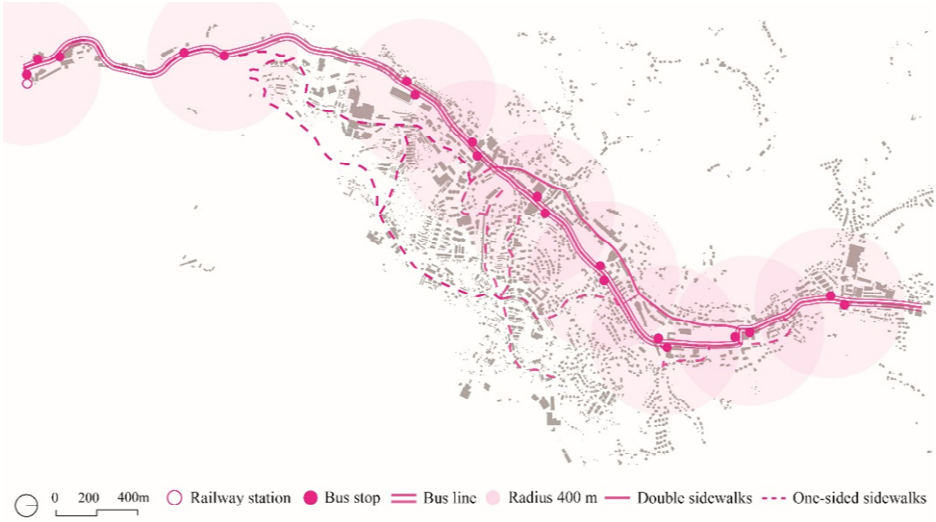

Figure 3. Public transport connectivity in Trbovlje. Each bus station is overlayed with an area of 400 meters in radius.

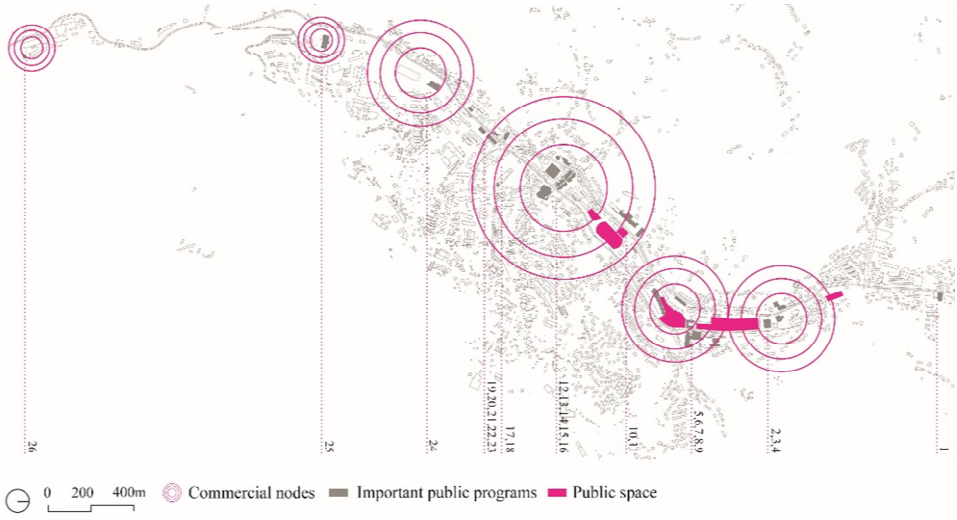

Figure 4. Commercial activities, important buildings of public status and public space in Trbovlje.

The valley topography and steep roads and paths are another problem that is difficult to overcome. Figure 3 is showing that less than half of all road area is equipped with a sidewalk and of those, not all are double-sided. This makes travel more difficult and ideally, any unnecessary crossing of the road to get to a protected sidewalk space should be avoided. The majority of public program in Trbovlje falls under commercial space and is concentrated mainly in the vicinity of the main traffic axis that runs through the entire settlement (Figure 4). They gravitate towards the northern and central part of Trbovlje, surrounding a main square in front of the Delavski dom cultural centre. This allows for an easier implementation of universal design, focused on a single axis. In total, twenty-six buildings with a public status were analysed in regard to their accessibility.

4.2. Synthesis of the spatial evaluation of Trbovlje

We followed the analysis of open public space with an assessment of the 26 individual buildings of public status (Figure 4) and their access. The data was gathered and synthetized in segments (Table 1), giving us a clearer picture of the current state of public programs in Trbovlje. All of them were also assessed on criteria on the basis of (un)equipped space with elements of universal design (as listed in chapter 3.3). Considering the value of any changes to be made in Trbovlje, we proposed that the implementation of universal design is to be accomplished in phases, which could be applied to a municipal strategy.

Table 1. Combined spatial evaluation of accessibility in public spaces of Trbovlje (areas 1 - 26): satisfactory (+) unsatisfactory (o) absent or problematic (-).

The areas of access of buildings with public status	**1 - 9**	**10 - 25**	**26**
Access with a car	o	+	+
Access without a car	+	+	-
Tactile pavement	o	o	o
Contrast pavement marking	-	-	+
Disabled parking access	o	+	+
Tactile pavement on parking ground	o	o	o
Wheelchair ramp access	-	o	o

Trbovlje as a settlement was divided longitudinally in three distinct segments: a northern, central and a southern segment (I.-III.), based on the criteria of functional connectivity, as shown in (Figure 5). These subdivisions are also reflecting the urban built-up density and the spread of central functions and the public spaces that accompany them. The settlement is divided into these three segments and phases which outline not only the spatial priorities but also temporal implementations of design solutions, to offer a pragmatic and systemic urban renewal. From the planned short-term point of view, each of these individual segments and stages can function disjointed as this can be feasibly included in a strategic municipal plan.

5. Universal design for improving mobility in Trbovlje

All elements of proposed spatial solutions are chosen with purpose and specificity, deriving from conclusions made from spatial analysis. The common attribute of all proposed solutions is the possibility of their development in an existing system, tied to existing infrastructure, such as bus stops (Figure 3). As the public transport stops are set up fairly densely the proposed areas of tactile markings that would accompany them and create connections to the outlined public buildings would in turn cover a large area of the settlement as well. The feature of a phasal plan enables the community to implement them whenever opportunities for their realisation occur, given that it can be effortlessly implemented in a municipal strategy and an urban plan. The specificity on the other hand grants a design solution that is intended for the most vulnerable members of the population in mind so that they are treated as a matter of priority through interventions. This is done in such a way as to empower them with equal opportunity to move and use space together with the rest of the population, as envisaged by universal design. The aforementioned design solutions are aggregated in the following four policies: marking territories of tactile marking installation, improving the individual connection between areas of importance, adding new locations of reserved parking spaces, and defining small areas of "micro-interventions" in public space (Figure 5).

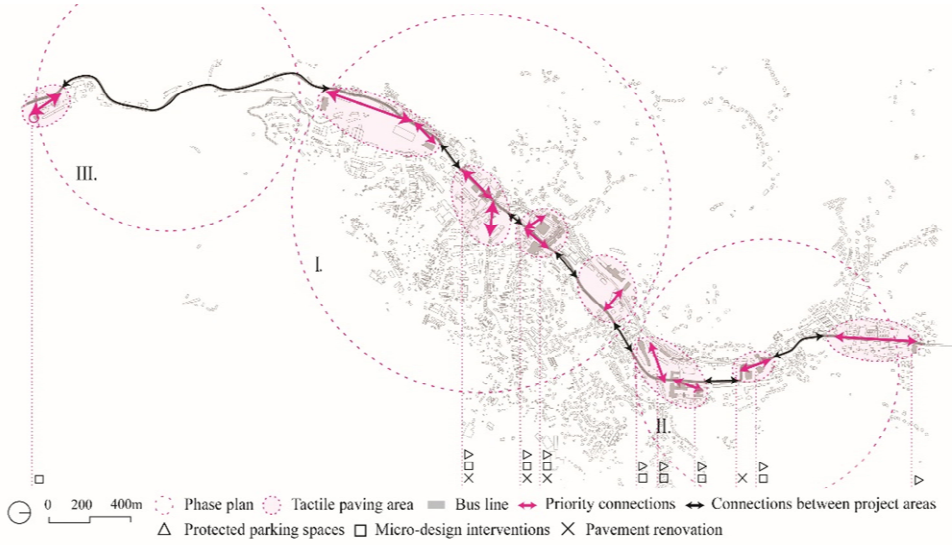

Figure 5. Universal design plan proposal for improving mobility in Trbovlje.

Paving replacement needed to be included in the plan for certain areas in Trbovlje, as it is currently impossible to be accessed by those with limited mobility. In the plan, the vicinity of outlined programs and buildings of public status, were significant planning these connections. Recognizing the importance of certain programs, even small business and shops, were vital for this plan to be considered universal. In certain parts of the city, especially next to publicly accessible facilities, there is a shortage of parking spaces reserved for disabled people, so the plan reinforced these areas. The biggest deficit was recognized in the residential neighbourhoods, which is where most of them are planned. Access ramps were also envisaged to be added to publicly accessible facilities, with most

problems of accessibility occurring in front of older buildings. The tactile system must be designed in its entirety or completed in segments, as it can otherwise confuse. Hence why it will be established in phase one, in the vicinity of the public transportation stop and around the train station. In the following phases, the longer lines of adapted sidewalks would be connected in between and around commercial hubs.

6. Conclusion

What we found out was that a systemic approach should be applied to the design of all networks crucial to connecting the central function of urban space. For example, these solutions should apply to various elements of open urban space, including the crosswalks and crucial elements of roadside proliferation, as well as navigational infrastructure. It is, therefore, necessary to plan the space according to the principle of inclusion so that the urban public space can be adapted and used by everyone. People with disabilities, people with mental disorders, people with visual and hearing impairments, young children, and the elderly should all be considered. This form of spatial planning requires the cooperation of various disciplines. It is especially important to collaborate with people with various impairments because only they can communicate well enough how they will be able to move through the space and what adaptations they would require to be able to access the settlement. This systemic solution provides better made, tested, more effective, and more adaptive solutions. The approach grants immediate and more inclusive space with a better quality of life in the urban space. This design approach to a system solution of urban accessibility should conceivably make for a new all-important or even mandatory layer within an urban plan. Supplementing existing spatial documents and adding another level of missing information.

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SMARTAGING in Venice. Toward a Definition of Age-Friendly Neighbourhood

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Abstract. The growing population over 65 years old and the process of urbanization are two of the major challenges that the contemporary city has to address urgently. These issues require a rethinking of public spaces to ensure health and well-being and stimulate active ageing.
The theme of age-friendly cities emerges in this context; it's about inclusive cities harmonised with the Agenda 2030 goals and the Universal Design principles since they support people's lives regardless of age, gender, and abilities.
In particular, the neighbourhood scale represents the optimal one able to implement experimentations for the sustainable development of the city. Furthermore, the neighbourhood is generally the place of the elderly's everyday life where they are encouraged to go out and maintain their daily habits thanks to the existence of a safe and good public realm.
Starting from the case study of the Santa Marta neighbourhood in Venice, the author has conducted a multi-phase analysis to investigate the quality of outdoor public spaces and which activities are played in these spaces to understand how the urban experience and the quality of life of the elderlies can be improved.
At the same time, both the good practices listed by the WHO for the achievement of age-friendly environments and some of the major neighbourhood sustainability assessment tools were studied, paying attention to the social dimension of sustainability, seen as an "accelerator" of urban well-being and inclusiveness.
This paper aims to present the first results of an ongoing research, whose purpose is to draft a new tool able to measure the age-friendliness – called SMARTAGING protocol – of a selected neighbourhood. Specifically, the methodological framework will be better described.
In this regard, the new protocol shall support administrations in the understanding of the phenomena related to ageing by directing active policies and design choices with an increasing focus on citizens and local and social issues acting complying with the principles of Universal Design.

Keywords. age-friendly cities and communities, healthy and active ageing; neighbourhood; Venice.

1. Introduction

According to the United Nations world is currently undergoing four demographic megatrends: population growth, international migration, urbanization, and population ageing [1]. These trends are differently diffused worldwide but they all affect the sustainable development of the nations.

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Looking at the population ageing as a phenomenon that affects the "physical" qualities of the built environment, it should be noted that the number of people over 65 is increasing exponentially and that about 49% of the population will have reached this age by 2050 [2]. At the same time, it is estimated that about 68% of the world's population will live in urbanized contexts by the same date [1].

Both urbanization and population ageing can impact the Sustainable Development Goals (SDGs) of the *2030 Agenda for Sustainable Development* [3]. Specifically, together they affect the SDG n. 11 *Make cities and human settlements inclusive, safe, resilient and sustainable*, since this goal recognizes the centrality of people in urban transformation processes by providing equal opportunities for all, regardless of age, gender, or abilities.

In this scenario, it is possible to affirm that the concept of "age-friendly cities", introduced officially by the World Health Organization (WHO) in 2007 to focus on elderlies' necessities within cities [4], is in line with the SDG n. 11 and the principles of Universal Design.

The most appropriate urban scale for making considerations in this regard is the neighbourhood one because «as people become older, the neighbourhoods and communities in which they live become more important» [5]. This is the place of the elderly's everyday life and where the idea of ageing in place is consolidated, so it is the better urban scale to implement this concept [6]. Additionally, older people generally identify the neighbourhood with a community and there they are encouraged to go out and maintain their daily habits thanks to the existence of a safe and good public realm.

Studying the relationship between the elderly and the neighbourhood is an issue of growing interest in different areas (sociology, psychology, urban planning) since it is possible to look at the neighbourhood as a "piece" within the wider urban dimension from which to start and then proceed to a larger scale [7].

Starting from research carried out on the Santa Marta neighbourhood in Venice and a literature review about age-friendly movement and neighbourhood sustainability assessment tools, this paper underlines the importance to have a new age-friendliness assessment tool able to contextualize the ageing phenomenon within cities and objectively evaluate physical and social urban spaces at the neighbourhood scale to direct active policies and design choices with an increasing focus on all citizens.

2. About age-friendly cities and communities

The theme of age-friendly cities emerges as a response to the growing phenomenon of "greying of the cities" to encourage active ageing and promote well-being and good quality of life. Among the main factors affecting the birth of the age-friendly idea, there is the increase in the number of people over 65, the desire to create supportive environments to encourage ageing in place as long as possible, as well as awareness of the impacts that urban changes have on the lives of older people [8].

In particular, the impact of ageing populations on cities and vice versa has specific consequences on urban planning, representing one of the greatest challenges of the 21st century [6]. For this reason, age-friendly cities and communities (AFCCs) can address solutions that provide enabling living spaces for older people and beyond.

2.1. Toward a definition of AFCCs

The first and most important document about age-friendly cities is *Global age-friendly cities: a guide*, edited by the WHO in 2007 [4]. It identifies 8 topics that characterize an AFFCs which are (Figure 1): outdoor spaces and buildings; transportation; housing; social participation; respect and social inclusion; civic participation and employment; communication and information; community support and health services.

The first three topics relate more closely to the physical environment and have a strong influence on mobility, accessibility, perception of safety and security. Thereafter, the second three topics concern the social and cultural environment that directly impacts physiological well-being. Finally, the last two topics concern specifically the health and social services offered to the elderly.

AFCCs address these issues, each of them may constitute a "barrier" for the elderly, to create opportunities for active and healthy ageing [9].

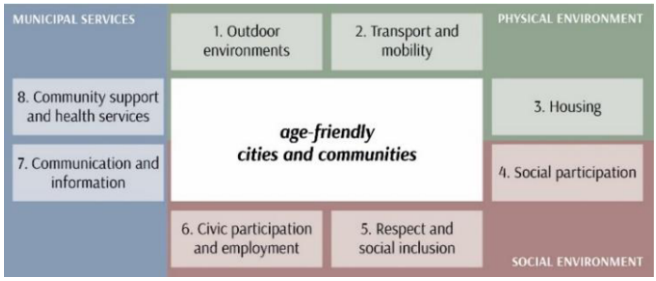

Figure 1. The 8 topics of age-friendly cities presented by the WHO in 2007.

This is the first programme which proposes a comprehensive and multidisciplinary framework concerning a specific demographic cohort which, however, needs global action at the urban level [6]. It was created with elderlies in mind, but it can improve well-being and provide continuous support even to other citizens, regardless of age and abilities [10].

Currently, there is not a unique definition of AFFCs. According to Alley et al. [8], it is «a place where older people are actively involved, valued, and supported with infrastructure and services that effectively accommodate their needs». In addition, for Carpentieri et al. it deals with [11] «a city that manages to compensate for the fragility and physical, cognitive and social changes associated with age, to ensure active ageing, understood as the process of optimising health opportunities, participation and safety to improve the quality of life of ageing people».

In 2018 the WHO [12] states it's about environments that are «free from physical and social barriers, and are supported by policies, systems, services, products, and technologies that: promote health and build and maintain physical and mental capacity across the life-course; and enable people, even when experiencing capacity loss, to continue to do the things they value».

Having a definition of AFFCs can be useful for carrying out an evaluation and a comparison of the interventions in order aim to increase the number (and the quality) of age-friendly environments.

2.2. How to assess the age-friendliness of a city

The 8 topics denote the complexity and multidimensionality of age-friendliness, understood as the ability of communities to encourage and support active ageing through the creation of enabling environments. It is a complex concept, it depends on the context and, for this reason, it is not easy to standardize [13].

Since 2007, the WHO has developed some tools intending to measure the age-friendliness of a city (the checklist in 2007 [14], the core indicators in 2015 [13] and finally the European handbook in 2017 [5]) which, however, present critical, including the lack of a quantitative approach. In fact today, it can be said that an optimal tool for evaluating age-friendly cities and communities has not yet been identified [15].

For example, the *Checklist of essential features of age-friendly cities* [14] is the first attempt aimed to indicate in 84 items the characteristics of an age-friendly city for each of the 8 topics. It is only a qualitative tool because of the lack of regulatory references or benchmarks for the assessment of each item.

Meanwhile, the 23 core indicators are more comprehensive with more accurate definitions. However, it is not a rigorous tool because of its flexibility and adaptability by local administrations. Also in this case there are no benchmarks, which are important for establishing the effectiveness of an action. The WHO declares that the core indicators can be too reductive simplifying complex realities [13].

At last, there is the *Age-friendly environments in Europe* (AFEE) handbook [5] which aims to: get better knowledge and awareness about the topic; sum the phases and the main initiatives to create age-friendly environments; give a rough indication of the indicators to be used for monitoring the projects. There are here 37 action areas and 100 goals. Although it is not a real assessment tool, this handbook represents an important reference for the development of strategies aimed at measuring age-friendliness on the urban scale.

3. Neighbourhood sustainability assessment tools

Together with this study, some of the most used neighbourhood sustainability assessment tools have been analysed to understand how to edit an age-friendliness assessment tool. The neighbourhood scale represents the optimal one able to implement experimentations for the sustainable development of the city [16]. Specifically, attention has been paid to the social dimension of sustainability seen as an “accelerator” for the improvement of urban well-being and inclusiveness, since it is strongly interrelated with accessibility, equity, empowerment, participation, and cultural identity [17].

This analysis was useful to comprehend how they are structured and how social indicators can be applied in the new tool too.

3.1. Social sustainability

Even though not exhaustive, here it is briefly described the meaning of social sustainability (SS). This is one of the three dimensions of sustainability (environmental, economic, social) but it has always been considered less than the other two ones when applied in policies and practices.

There is not a unique definition, however, it is possible to determine the main aspects of SS: social equity, social cohesion and participation, social exclusion, environmental

justice, security, urban livability, and quality of life [18]. As Colantonio says, they could be distinguished in "soft" components (those intangible aspects like social cohesion) from "hard" ones (those tangible ones like the presence of facilities) [18]. These latter components are influenced by urban physical characteristics. This is the reason why SS and urban form are strictly dependent on each other.

Otherwise, the "intangible" nature of the social dimension and the lack of a clear definition make its assessment difficult to achieve [18].

3.2. Social indicators in neighbourhood sustainability assessment tools

Sustainability assessment tools are voluntary systems whose purpose is to certify defined performances of a specific object. They were born at the building scale in the 90s but they were designed even for the neighbourhood scale about a decade later.

Neighbourhood sustainability assessment (NSA) tools are used to evaluate both new constructions and urban renewals. Although globally several tools have been created, they all have a similar structure consisting of general categories, indicators, and benchmarks. They aim to give an objective assessment of the planned interventions through a final score which identifies the overall performance in terms of sustainability [19].

In the research carried out by the author six open-source NSA tools were identified and analysed, above all looking into the social dimension to understand what the new tool can learn from these. The most important results are summarized in Table 1.

Table 1. NSA analysed tools and their main characteristics concerning the theme of social sustainability.

NSA tool	Main country, last version	Weighting of the indicators related to SS	Explicit social category
BREEAM Communities	UK, 2012	17,1%	Yes
EcoDistricts	USA, 2018	n.d.*	Yes
DGNB Districts	Germany, 2020	20%	Yes
Living Community Challenge	USA, 2017	40%**	Yes
GBC Quartieri	Italy, 2015	11%	No
ITACA Scala Urbana	Italy, 2016	21%**	No

* For EcoDistricts it was possible only a partial analysis.
** It is not the weighting based on SS indicators reachable points, but the number of indicators related directly or indirectly to social dimension on the total ones. In particular, LCC has no benchmarks.

From the analysis, it emerges that environmental aspects are generally more considered than economic and social ones.

In particular, many indicators contribute indirectly to SS achievement. Most of them are related to the "hard" components of the social dimension, like urban form or accessibility to public spaces. Therefore, it is possible to affirm that "spatial" criteria – as part of social ones – are more numerous than those concerning "soft" components (such as equity, participation, and so on).

Trying to evaluate SS in its whole complex could help municipalities and citizens to achieve the SDG n.11, and so inclusivity for all in urban areas. To do this, the research was based on a case study.

4. The case of the Santa Marta neighbourhood

For about fifty years, Venice is experiencing two significant processes: depopulation and consequent shrinkage, and ageing population. Today there are just over 50,000 inhabitants (source: venessia.com) in the historic centre and about 30% of them are people over 65. The first phenomenon was also influenced by the so-called "touristification" that has negative consequences on the residential and transportation policies as well as on the presence of services and activities.

Few districts remain "authentic" in Venice, among them, there is that of Santa Marta, located in the Sestiere of Dorsoduro, south-west of the city, between the disused area of the former gasometer (north) and the port area (south) (Figure 2).

Figure 2. Identification of Santa Marta neighbourhood in southwest Venice. Elaboration from Google maps.

This neighbourhood has an old history, but what we see today is dated to the early XX century with the work by Istituto Autonomo Case Popolari (IACP).

The choice fell on Santa Marta because this neighbourhood has some specificities compared to the lagoon city: it is the only one directly connected to the mainland and still outside the tourist routes. Moreover, despite the theme of urban accessibility in Venice [20], the neighbourhood is accessible within the three bridges that "enclose" it and it is connected to the rest of the city by public transport (vaporetto).

Here older people have their habits, even if some aspects can be improved. For this reason, the author has conducted a multi-phase analysis to investigate the quality of outdoor spaces and the available activities to understand how it would be possible to improve the elderly's well-being in this urban context. The analyses are preparatory to the development of the tool together with the previous study of existing instruments (both NSA tools and age-friendliness assessment ones).

4.1. The multi-phase analysis

The analysis is made up of two non-simultaneous phases: a GIS mapping of neighbourhood outdoor spaces and a questionnaire submitted to Santa Marta residents over 65. This represents the preliminary steps preparatory to the drafting of the tool.

Thanks to the GIS mapping, it was possible to identify physical obstacles, presence and quantity of green spaces, seating, services and shops in the urban area ("hard" components of SS). At the same time, the questionnaire was used as a participatory tool to involve the elderlies in this research, even if the outcomes were not a success due to

the pandemic limitations (2020-2021 were the years of the questionnaire dissemination). It was useful to understand even the "level" of social equity, cohesion, participation and so on ("soft" components of SS) in the neighbourhood.

Both the mapping and the questionnaire come out the lack of an adequate number of services. This factor adversely affects the elderly's daily life since they need to move to other parts of the city to buy necessities (e.g.: here there is no pharmacy). Meanwhile, outdoor spaces are perceived as clean and safe, which is the reason why it is pleasant to live in these spaces for them.

4.2. Towards a new tool

On the base of what was said about age-friendliness assessment and NSA tools and the findings that emerged from the multi-phase analysis, the author has delineated some characteristics that the new tool has to respect.

Specifically, it should have a simple but rigorous structure, in which each indicator has the same weight to avoid a subjectification of the evaluation. It will be called SMARTAGING, which is a portmanteau of the sentence "Santa Marta is aging".

Thanks to the different analyses, three key areas that contribute to healthy and active ageing have been first identified. They concern the quality of public space, mobility and transport, services and community (Figure 3).

The first two areas tend to measure spatiality and physical aspects of the environment (excluding the 'housing' topic which is not a subject of the present study), instead, the last one aims to investigate the perceived sense of belonging and the existence of a support network for the elderly.

Each of them can be assessed based on specific criteria, which in turn consist of indicators, with a total number of 13 criteria and 40 indicators.

Figure 3. The three key areas proposed with their respective symbols (edited by the author).

The SMARTAGING protocol is actually under validation, and it will be tested by the author in Santa Marta and in other selected neighbourhoods to understand how it works and act for its eventual improvement.

5. Conclusion

Since urban space enables ageing in place and allows an active social life [21] analysis and actions at this scale are considered fundamental. In this regard, the use of an assessment tool can support administrations in understanding the ageing phenomenon in urban areas and direct them towards age-friendly actions. This paper provides only an overview of the methodological framework to build the new tool.

The SMARTAGING protocol should contribute in this sense by focusing on citizens and heading for good design choices that act in compliance with the principles of Universal Design. It aims to measure quantitatively the age-friendliness of a neighbourhood, understand the existing issues and then identify possible actions to be promoted in the three defined areas so that the neighbourhood can be overall more welcoming and safer for the elderly. To do this further work has to be done, testing the tool and involving administrations and citizens to underline its critical and potential.

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Aging Neighborhood and Social Inclusion - A Case Study

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Abstract. Currently, in Finland approximately one fifth of the population live in the neighborhoods built in the 1960s and 1970s. The built environment is aging, and at the same time the share of the oldest resident cohorts is growing. The neighborhood built environment and social cohesion become important for vulnerable groups, such as older people, who spend a lot of their time at home and in the surroundings. Urban densification and renewal of the old neighborhoods need to take into consideration the local population structure, their needs for the physical and social environment. This paper presents an ongoing case study. The objective was to recognize the meaningful spaces for inclusive social activities in the neighborhood, focusing on aging residents. Qualitative and mixed methods were used to study older people's lived experiences and their relation to the neighborhood. The case study neighborhood is undergoing an important urban development process. A new service hub, with commercial and public services as well as a new metro station, is attracting seniors to move to the area. As most activities are concentrated in the new service hub, access to local services become more difficult for vulnerable groups. The spaces for informal social encounters within the neighborhood are getting fewer and more people of all ages are living in one-person households than previously. To build socially sustainable communities, the integration of all resident groups is important. Successful urban transformation benefits new residents, but also include current residents. The densification and renovation taking into account Universal Design principles can support the vitality, social cohesion, and attractiveness of a neighborhood.

Keywords. Neighborhood design, Inclusion, Older people

1. Introduction

Population ageing is a global trend. According to current population projections, by 2050, all regions in the world will see an increase in the size of the older population. Globally, majority of older population live in the cities. In Europe, the projections show continuation of these trends. UN study shows that Finland has one of the highest economic old-age dependency ratios in Europe. This is defined as the ratio of consumers aged 65 years and older of all people in the working age [1]. Therefore, seniors 65 years old and older, are becoming an important consumer group also in the housing sector. Hasu found, that for seniors, an important housing decision criterion is to have "carefree, safe, and secure everyday life" [2]. In general, older people live in ordinary dwellings, and they have a high degree of residential stability, especially among the oldest age cohorts. However, Andersson et al. found that some housing preferences increase with age [3]. These include for example, location in an area where one feels at home,

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accessible apartment, apartment building with a lift, and dwelling in one floor. Modifications related to the challenges of home environment may improve the autonomy of residents. However, Fernández-Portero et. al argue that to improve the level of residential satisfaction and wellbeing of older people modification to home as well as building, community, and district are needed [4]. Universal Design is one of the tools to make the built environment adaptable for all residents.

Older people may have different responses to cope with housing environment that does not support them. They may accommodate and tolerate unpleasant housing situations, they can try to actively change or modify their home, or relocate [5]. When people choose to relocate, they often try to find a suitable apartment in the familiar neighborhood, if available. The choice of a dwelling depends on the household's preferences and resources as well as the supply within the housing market. According to Hasu the residents adjust their housing preference ratings based on the existing supply [2]. Studies indicate that older people prefer apartments in the city centers or subcenters within walking distance from services [6].

Single-person households are getting common in all age groups. The increasing number of people living longer and alone may imply the likelihood of unwanted social isolation. Easy access, low threshold spaces in the neighborhood that encourage interaction and social activities between residents become important. Mazumdar et al. reported a strong relationship between social capital and the overall built environment as well as the access and walkability to local destinations such as libraries [7]. They point out, that enhancing social capital could be used at various scales when designing and retrofitting neighborhoods. According to Cramm et al. the quality of neighborhood services, neighborhood social capital, and social cohesion are significantly and independently associated with wellbeing of older adults [8]. They observed that neighborhood services, and social cohesion may act as buffer against the negative effects of living alone for low-income older people. The access to affordable apartments, to services that older people value, and to public transport are major factors affecting the quality of life of older residents [9].

2. Background

In Finland, the 1970s were a period of urbanization and suburban housing mass production. It was the peak period for the government subsidize housing construction. The new suburban neighborhoods for young families were realized often on the outskirts of cities [10]. The production was aiming at efficient and low-cost industrial housing production, realized often with three to four level concrete apartment buildings made of prefabricated elements. Currently, approximately one million Finns out of 5.6 million live in these suburban neighborhoods. The urban environment and apartment buildings need deep renovations and adjustment to current living standards. Moreover, the household composition and age profile of the residents have changed. The family-intensive areas have become one to two-person households with increasingly ageing population. Older residents are generally less mobile and more dependent on the immediate living environment. Therefore, they are expected to have a relatively large proportion of their social network living in the surroundings. The safety, walkability, and accessibility of the built environment support this resident group.

Mehta and Bossom identified coffee shops, restaurants, community centers, and local shops as third places [11]. They consider third places as comfortable places outside

home and work environment to meet old friends and make new ones. They observed that the third places were different for different resident groups. This was related e.g. to the duration of stay in the neighborhood, and age. Gardner identified third places (parks, coffees, etc.), threshold spaces (elevators, entrances etc.) as well as transitory zones (bus stops, pedestrian sidewalks) important for older people [12]. These represent *inclusive spaces* where older residents may have the sense of ownership and belonging. The social interaction enhances neighborhood cohesion, mutual respect, and support between residents, which may in return protect against frailty of the older people [8]. This paper presents a qualitative study on older resident's perception of their own living environment in a neighborhood undergoing densification and renewal process. The case study is carried out in Helsinki metropolitan area, Finland.

3. Aim

This study is part of an ongoing larger research project on sustainable suburban renewal. The overall aim is to recognize the identities and qualities in old suburban neighborhoods for the residents. The objective of this paper is to make a descriptive analysis of the meaningful and important spaces for inclusive social activities in the neighborhood. This paper focuses on older residents. The research questions were what spaces in the neighborhood older people value for social activities, and how does the neighborhood development affect the residential satisfaction, access to local services and social activities.

4. Method

Qualitative and mixed methods were used to study the older people's relation to their neighborhood. According to Sousa qualitative research approaches are exploratory and interpretative, aiming at growing understanding and knowledge [13]. Three workshops, one walk-through with residents and an online questionnaire were used to study older residents' experiences of their neighborhood (Table 1.). The study was using purposeful sampling of seniors and older people living in the case study area. They were information-rich sample for the study topic [14]. The workshop participants were volunteers, recruited through local residential association and a non-profit association. Two workshops were held in the local Neighborhood House run by a non-profit association, one was organized outdoors due to Covid 19 restrictions. Some of the participants took part both to workshops and walkthrough. One of the workshops (Workshop 1) was organized together with older people and multicultural residents in working age (4 participants).

Table 1. Participants in the study

	Male	Female	Total
Questionnaire	17	41	58
Workshop 1	7	4	11
Workshop 2	1	7	8
Workshop 3	5	7	12
Walk-through	2	6	8

5. Case study area

5.1. The housing and households

The case study area is located in the Helsinki Metropolitan area. The housing development in the neighborhood had its peak during the 1970s. Within ten years as many as 16 500 new inhabitants moved to the area [15]. Up to 80 % of the apartment buildings from the 1970s have no lifts. Between 1980 and 2000 there has been only a moderate growth. (Figure 1.) Majority of the apartment buildings built before 2000 are low rise apartment buildings with less than four floors without a lift. In the end of year 2018, almost half of the dwellings were one to two room apartments (48.6 %) [16].

In the last decade, a new development phase with a service hub (a shopping and service center, opened in year 2001) and the new metro line (year 2017) have led also to heavy densification of the neighborhood. This has rapidly transformed the area, which remains a residential area with a majority of apartment buildings (75.5 %). New high-rise apartment buildings built after 2010 have lifts and accessible apartments.

Still in 1980, more than half of the households were families with children (average household size 2.6 persons) [17]. Currently, one person households represent 42.5 % of all households and 75 % of households are one to two person households. These include couples and single parent households. The population is ageing and especially the oldest age cohort has been increasing. In 2018, approximately 16.8 % of residents were seniors and older people 65 years old and older. The share of the oldest age cohort is projected to increase in the coming years [16].

6. Results of user participation

6.1. The resident-participants

Majority of participants in this study were seniors and older people living in the case study area. They were recruited through local senior associations. An online survey was published on the local neighborhood association homepage. The respondents to the questionnaire (N=58) were in majority 55 years old and older (63 %) and female (69 %). They reported to have been living in the area in average 20 years (from 6 months to 50 years). The mean housing history of respondents in the area was 15 years. The self-reported reasons for moving to the area were good transport connections, and affordable housing. As one of the respondents expressed to have found "*a suitable apartment at affordable price in a suitable place*". Another explained to have "*downsized and moved closer to services"*. Nine older respondents to the questionnaire, and many workshop participants had been living in the area their whole adulthood, since 1970s. Not all of them were willing to relocate, even if their current apartment did not support their daily coping. As one older person participating in the workshop reported to be living on the fourth floor of an apartment building with accessibility issues and no lift. "*They say I should move, but it is not that easy. I'm so used to live in this neighbourhood… I'm not leaving anywhere, all these places and all people*".

6.2. Housing provision

The views about current housing provision in the neighborhood were mixed. Residents appreciated the low density and greenery of the old part of the neighborhood. However, the low-rise apartment buildings were not accessible due to lack of lifts. The residents' association had made an initiative on age-friendly housing modifications for the municipality. Today, the apartment buildings and the real estate is owned by the Residential condominiums. Therefore, the decisions for the modifications and funding must be done by the owners of the apartment buildings, in this case, the residents themselves. This may be a challenge for many low-income senior residents. Moreover, oldest age cohorts may have less resources of strength than younger age groups to carry out and go through the heavy renovation period. The municipality may, however, facilitate, guide, and encourage accessibility renovations and give information on subsidizes for building retrofitting lifts to apartment buildings.

The new high rise apartment buildings built after year 2010 have been realized with current accessibility standards. However, the new housing stock raised a lot of discussion; many participants considered the new development too dense and deteriorating the quality of the urban environment. Some residents found the new apartments too small, and apartment buildings lacking communal spaces for residents. The again, one of the participants found a small apartment suitable for his lifestyle: "*Me and my partner spend all our spare time together, but we have our own apartments, and it works well for us".* Affordability of the new apartments was also discussed and one of the participants argued that there are little housing choices for seniors: *"A retired person like me, with low pension and no car has little housing choices. We have no other choice than to live in a small apartment close to services.".* The residents reported a considerable rise on rents and real estate values in the area. The new housing developments are not affordable to all.

6.3. Local services

The neighborhood transformation has both positive and negative outcomes for the older residents. Due to the urban transformation the local services, transport network, and spaces for social interaction are changing. In majority, older residents were reporting to be satisfied with the local services and considered that the service hub has led to improved access to services and to a wider selection of services. Further discussions revealed that the new shopping center, metro line and good public transportation had also been attracting seniors to move into the area. However, the residents had observed that small retail shops moved away from the area. They were concerned about the concentration of all local services to the service hub, which has decreased the access to the services and possibilities to social activities for those frail residents living far from it. Moreover, some older residents had negative experience of the premises, considered the shopping center too large and navigation in the premises difficult.

Similarly, older residents had mixed feelings about the construction of the new swimming hall, opened in 2022. Residents were happy of the new premises, but on the other hand, some of them had the fear of losing a small swimming pool at walking distance from their home. Earlier studies show a strong relationship between social capital and the overall built environment as well as the access and walkability to local destinations [7]. One of the workshop participants reported to have been using the

swimming pool for the last 30 years, twice a week. She went there for swimming, sauna, and meeting friends. These local services are spaces for social interaction.

6.4. Social environment

Many of the senior participants had a long housing history in the area. They had friends or family members living in the area. However, 12 respondents out of 58 reported that they had no family, relatives, nor friends in the area. The lack of affordable or free spaces for informal social activities for adults, youth and children were pointed out during the study. Residents were proposing "*a neighborhood house, where adults could meet, chat and play e.g., board games*." The current facilities for social activities are targeted to different user groups. a) The community center managed by the municipality has activities after school hours (from 14.00 to 22.00) mainly targeted for the youth. b) The Neighborhood house is run by a non-profit association. The low-threshold open access meeting place is open at weekdays from 10.00 to 15.00. The activities focus on multicultural and multigenerational integration. Other organizations can rent the premises in the evenings and weekends. c) The playground with an open communal space is targeted to families and children, and it is open at weekdays from 8.00 to 16.00. Extending the opening hours of these places in the evenings and weekends may have a positive impact for social cohesion.

Moreover, developing more spaces for informal social activities across generations could facilitate the building of the neighborhood social cohesion. Currently, there are only few "third places", informal spaces for social activities in the neighborhood. The engagement in social activities of young working age men (20 to 55 years old) in the area is low [18]. The workshop participants were concerned that in the long term, current heavy densification, and lack of third places can lead to social frictions in the area. Therefore, they proposed that the municipality would require private developers and big companies operating in the area to provide for the spaces and means for social activities locally. Moreover, one of the workshop participants made the remark, that the history and stories of neighborhood would increase the residential attachment to place, "*We are lacking the stories; who has lived here, what was there earlier? Losing the history of the place can lead to degradation"*. Similarly, the historical layers in the built environment were appreciated.

6.5. Green environment

Access to green environment is one of the most important aspects of age-friendly communities [19]. There is a lot of evidence that nature promotes physical and social activities as well as general wellbeing. In most of the responses, the proximity of the sea was mentioned as the favorite aspect of the neighborhood. The distance between the neighborhood center and the shoreline was approximately 2 km. The nearest public transport stop to the shoreline was approximately 300 m walking distance, which may be challenging for the frailest. The quality and accessibility of the walking paths were raised up in the discussions, and the resident found that the full potential of the waterfront trial was not used. They wished accessibility improvements and more activities during the summer. The Nordic climate may limit the use of parks and green areas for social activities in the winter. However, in the summer, some organized community events take place in the playground area and other open green area.

Versatile nature, walking paths and parks were considered as the strength of the neighborhood. The areas of development proposed by the residents were nearly all related to the quality and maintenance of the green areas. Moreover, residents wished more sheltered sitting places and activities in them. The densification, however, had affected the green environment. *"The little trees we had are cut down"*. The residents with long housing history in the area described, how the forest, where they had been picking blue berries in the autumn and enjoyed skiing in the winter was replaced by the service hub. In oldest part of the neighborhood, with low density, the large inner court yards were still green with old trees. These court yards were semi-private areas, targeted to the residents only. However, they were places to spend time in and socialize with neighbors. The public green areas and parks were few in the area. Many of the new apartment buildings were lacking the green yards which were considered a potential space for social activities.

7. Discussion

The residential satisfaction is found to be related to the neighborhood characteristics. Hanibuchi et al found that residents who lived in older neighborhoods tended to report higher social capital than those who lived in newly developed neighborhoods [20]. They argue that the old "*neighborhoods, not only the residents with long residency, are embedded within wider historical and geographical contexts, that should be taken into account in the social capital"*. The densification of existing neighborhoods should be carried out with the understanding of local community. Successful regeneration is about making neighborhoods good places to live in for all city residents. To build socially sustainable communities, the integration of all resident groups in planning is important. The older participants in this study pointed out the need for user knowledge and grass-root democracy in neighborhood planning.

In the Helsinki metropolitan area, approximately 93 % of population 75 years old and older live at home. One third of them have challenges in mobility and daily activities. Oswald and Rowles observed that in addition to personal factors, voluntary moves of older people are related mostly to the quality of physical environment [21]. The proximity of services, good public transport connections, green environment and the affordability of housing are among the pull factors of old neighborhoods. The strengths of these neighborhoods should be better understood. The mixed land use, green environment and sustainable transport are pull factors and a great potential for the sustainable development.

The new urban developments should also increase possibilities to access social activities outdoors or indoors. The neighborhood design can increase the possibilities of physical and social activities of the frailest resident groups. A Finnish study show that approximately 30 % of the population 75 years old and older have great difficulties walking 500 m or more [22]. Universal Design of formal and informal meeting places in the neighborhood may enhance social cohesion. Noon and Ayalon argue that older people use urban spaces to spend time in them [23]. They represent the opportunity to extend their social life beyond their home and engage to informal social activity (passive or active). Therefore, the open urban places should be developed accessible and comfortable for the long-term stay of older adults. These spaces are important for people who are not willing to engage in organized activities. For all resident groups, the nature and access to the green areas was important factor for the residential satisfaction. The

extension of local events and services to public outdoor environment may enhance the vitality of the neighborhood and encourage social activities and enhance social activities across generations.

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«Progetto di Vita» and Universal Design for Persons with Disabilities

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Abstract. «Progetto di Vita» ("PdV" Life Project) represents the crucial element to design and build the Quality of Life of persons with disabilities, in coherence with the UN Convention on the Rights of Persons with Disabilities. In Italy, Law no. 112/16 identifies in the PdV the principle around which to build a convergence of intents and interests for the realisation of the «Dopo di Noi» (After Us) that can take place «durante Noi» (during Us) through the construction of empowerment paths towards autonomy in a perspective of prevention, gradualness, emancipation and accompaniment to detachment. In order to experience autonomy «durante Noi», preparing for the «Dopo di Noi», the living space, the surrounding environment and the community of reference represent fundamental functional and/or spatial environments. The aim of this article is to map and analyse the good practices that have emerged from the concrete application of the Law through the activation of housing welfare projects that represent innovative forms of living built around the PdV approach.

Keywords. Disability, "Progetto di Vita" (PdV), Universal Design, Social housing, Housing welfare

1. Introduction

«Progetto di Vita» (Life Project, hereinafter "PdV") represents the crucial element to plan and build the Quality of Life of people with disabilities, applying appropriate tools and supports to ensure the overcoming of inequalities and discrimination, consistently with the UN Convention on the Rights of Persons with Disabilities. The latter "urges society to remove those material, cultural and ideological barriers that, by interacting with a physical, mental or intellectual deficit, create disability" [1]. Writing a PdV implies a complexity of interactions between actors and actions such as to represent a real project based on the idea of a resilient community in which the person is placed at the centre, overcoming the medical or assistance approach: the person is no longer seen as the *object* of care but becomes the *subject* of her or his own life [2].

In Italy, Law no. 112/16 containing «Provisions on assistance for people with severe disabilities without family support» provides for measures enabling parents and caregivers to face the issue of the future of their sons with disabilities in the so-called «Dopo di Noi». In this direction the Law identifies in PdV the principle around which to build a convergence of intents and interests for the realisation of «Dopo di Noi» (After us) that can take place «durante Noi» (during us) through the construction of

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empowerment paths towards autonomy in a perspective of prevention, gradualness, emancipation and accompaniment to detachment. The definition of PdV and the creation of the collaborative network needed to implement it must begin as soon as possible, while at the same time PdV must be able to be modulated across the life span.

The Law refers to severe disability, but PdV is a foundational principle to be universally extended to all types and forms of disability because it represents a key principle for addressing the multidimensional character of disability through the adoption of a holistic approach that allows for a systemic vision with respect to all dimensions of a person's life (health, living, school, work) [3]. In this scenario, housing space, the surrounding environment and the reference community represent fundamental functional and/or spatial environments to experience autonomy «durante Noi» and prepare for «Dopo di Noi» through the human and social experience of "inhabiting a place" that allows to experience collective belonging for the creation of an inclusive welfare [4].

The aim of the paper is to represent the mapping and analysis of best practices emerged from the concrete implementation of the Law through the activation of projects of housing welfare intended in its full dimension of social inclusion that represent innovative housing forms built around the PdV approach.

2. Research objective and methodology

The research project is inserted within a doctorate activated by the ABC Department of Politecnico di Milano in co-financing with Comitato Officina Dopo di Noi (hereinafter "CODDN"). The latter was established in 2017 with the aim of monitoring and supporting the implementation of Law no. 112/16 and disseminating best practices[2].

In this context, the research aims to return a critical picture of the concrete implementation of Law no. 112/16, through a qualitative-quantitative analysis of projects funded by the Law, starting from the monitoring of the state of implementation of the Law promoted and conducted by CODDN. Research methodology adopts a multidisciplinary approach and it is based on Universal Design principles with the specific objective of elaborating a survey grid for the analysis of housing projects activated by the Law that touch various dimensions of PdV in a multidimensional perspective in order to define «Dopo di Noi» housing models that are able to lower each PdV in inclusive environments and spaces.

The research intends to experiment with a survey method that directly involves of Law beneficiaries[3], to make the evaluation of the impact of the projects more reliable because it is able to incorporate into the methodology and evaluation tools final users' point of view (embedded assessment) and/or that of their caregivers. In this way case studies are analysed with respect to their ability to respond concretely to needs expressed by people with disabilities together with their families and caregivers. Involvement is

[2] CODDN, established on the initiative of Senator Annamaria Parente, Rapporteur of Law no. 112/16 to the Senate of the Italian Republic, is the promoter and responsible of «Officina.net – A Platform for dialogue and design», project financed by Cariplo and Compagnia di San Paolo Foundations and realised in partnership with the ABC Dept. of Politecnico di Milano, Istituto per la Ricerca Sociale (IRS), Fondazione FITS! per l'Innovazione del Terzo Settore and BES Cooperativa Sociale, which deals with formation and work integration of people with disabilities. To support Officina.net project a PhD has been activated, through the support of the abovementioned Foundations, in co-financing with the ABC Dept. of Politecnico di Milano.

[3] The UN Convention on the Rights of Persons with Disabilities makes explicit how persons with disabilities should be actively involved in decision-making processes related to policies and programs, including those that directly affect them.

foreseen through specific interviews and questionnaires addressed to a selection of stakeholders involved in various ways in the realisation of «Dopo di Noi».

Research methodology is articulated into the following phases:

- mapping of all housing projects funded by Law no. 112/16 through the analysis and systematisation of data emerged from the monitoring of the implementation of the Law promoted and conducted by CODDN;
- benchmark analysis aimed at identifying a series of case studies (exhaustive sample) considered demonstrative and characteristic with respect to the research objectives;
- construction of a set of indicators functional to the definition of a survey grid for the creation of a taxonomy aimed at the qualitative-quantitative analysis of the sample of case studies selected through the benchmark analysis;
- realisation of targeted interviews and administration of questionnaires through the direct involvement of a selection of stakeholders;
- filing of the selected case studies through the compilation of a specific survey form built with respect to indicators of the previously elaborated survey grid;
- critical analysis of the case studies through the construction of a SWOT Analysis for each of them in order to identify Strengths, Weaknesses, Opportunities and Threats;
- in-depth analysis of two or three case studies emerged from the research process considered to be particularly illustrative and from which to extract characteristics of the implemented model and possible scalability criteria.

3. Results

Results of the research, developed so far in the first three phases, are substantiated in the classification at meta-project level of possible housing typologies able to accommodate different types of disabilities and around which to build the network for the housing project sustainability in the time of «Dopo di Noi».

Results achieved so far by the research are reported below.

3.1. Mapping of housing welfare projects funded by Law no. 112/16

The analysis was based on an examination of 71 regional regulatory documents and 33 public notices from regional sources. In addition, 8 interviews were conducted with regional officials, 5 with regional «Dopo di Noi» project referents and 3 interviews with privileged witnesses. The conducted analysis through the monitoring of the implementation of Law no. 112/16 reveals a strong lack of homogeneity in projects actuation and in implementation processes on national territory, hence the need to "codify" best practices emerged.

To this end, the first research phase took the form of the mapping of all housing projects funded by Law no. 112/16 which led to the development of a database containing about seventy housing projects for «Dopo di Noi» codified in their main features by homogeneous categories.

3.2. Benchmark analysis of housing welfare projects funded by Law no. 112/16

The second research phase took the form of a benchmark analysis aimed at identifying a series of case studies deemed demonstrative and characteristic with respect to new housing models built around PdV. The collection of data for the case files was carried out through research and in-depth analysis with respect to specific keywords, e.g. Inclusive Housing, Possible Autonomies, Social Inclusion, Solidarity Housing, and through interviews with those involved in the experiences. A comprehensive sample of approximately forty case studies was analysed and synthesised into benchmark cards in which each project was analysed with respect to a set of common indicators summarised in six sections: (1) main information of the intervention; (2) project objectives; (3) stakeholders involved; (4) financial resources deployed; (5) project characteristics; (6) services for accompaniment to living. From the benchmark analysis, some significant elements emerge as key points of the analysed projects brought to the attention [2]:

- activation of co-design pathways involving from the beginning in a choral way a complete scenario of actors starting from beneficiaries together with families and caregivers, institutions, Third Sector, through the construction of public/private partnerships;
- construction of accompaniment to living pathways aimed at social inclusion, able to bring people from an individualistic conception to a collective and participatory approach to community life, developing that sense of belonging and "taking charge" of the other ("my neighbour as a resource"), which allows people to feel part of a group and therefore of a community;
- provision of shared spaces for the development of common activities and to promote moments of sharing among inhabitants, the neighborhood and the community with a view to social inclusion, designed with particular attention to usability and accessibility to allow a greater integration with the life of the community;
- possibility of combining different housing typologies for different forms of disability, for both short- and long-term accommodation, within the same project in a hybrid model to progressively experiment different paths for the reception of different types of fragility aimed at designing «Dopo di Noi»;
- design characterised by a particular attention to accessibility issues to overcome physical and sensory barriers to allow people with disabilities to live in a context that promotes housing autonomies of living in a structure appropriately sized and technologically equipped, also through the use of advanced home automation systems;
- design characterised by a high flexibility and transformative capacity of spaces and services to allow a progressive adaptation to inhabitants needs; it is essential that both housing and common spaces can be modified according to the evolution of needs and stories of people;
- accompaniment, supervision and support by operators and qualified staff who, in addition to playing the role of «facilitators» of relationships among inhabitants, work with individuals to build possible housing autonomy pathways and to achieve objectives set for each as part of their PdV;
- specific training pathways aimed at operators who have a significant role in implementing PdV and in the constant monitoring of its development;

- accompanying pathways related to the topic of «Dopo di Noi» (After us) in «durante Noi» (during us), aimed at parents who can face the issue of the future of their sons with disabilities in the so-called «Dopo di Noi»;
- possibility of starting structured experimentations in different phases for pathways of accompaniment to autonomy through a progressive reduction of the presence of operators (where possible) and the gradual reciprocal distancing from families; in this context it is also possible to consider the idea of experimenting with cohabitation with students or young workers (in cases where this project is considered feasible);
- construction of a «generative network» intended as a bond among institutions, Third Sector, volunteering, families and active citizenship, able to intercept and relate transversal skills through a holistic approach, which proves to be the real social infrastructure of compensation of fragility, with a view to generative and community welfare.

The conducted benchmark analysis made clear how the multidimensional character of disability can deeply impact on spaces design and management of processes taking charge and capacitation within the built environment, housing spaces and context.

For this reason, actions in this direction on the physical infrastructure cannot but be integrated to a social infrastructure through a synergy that finds concreteness in the adoption of the PdV holistic approach.

3.3. Housing models for «Dopo di Noi»

Analysis set out in the previous paragraph has led to the identification of projects considered benchmark with respect to the design of new housing forms built through the PdV holistic approach.

Starting from results analysis, a taxonomy has been elaborated to define a classification at a meta-project level of possible housing models for «Dopo di Noi» (see Table 1).

Table 1. Classification of Housing models for «Dopo di Noi» (After us) – Authors elaboration

Housing models for «Dopo di Noi»	Description	Benchmark projects	Types of disability
Accommodation for families coupled with accommodation for daughter/son with disabilities	Pairs of accommodations that can accommodate family in a larger apartment and daughter/son with disabilities in a smaller adjacent and connected apartment to experience a path of accompaniment to independent living for the construction of «Dopo di Noi» (After us) in «durante noi» (during us) [5].	Abitiamo il futuro SON Cascina San Carlo (2020 - in progress) It foresees the realisation of three pairs of apartments next to each other – three two-room apartments for daughter/son and three larger ones for parents – conceived so that the different residents can start a process of housing autonomy from each other [5].	Different types of disability

«Sollievo» accommodation	Apartment intended for short-term accommodation of people with severe disabilities [5].	Abitiamo il futuro SON Cascina San Carlo (2020 - in progress) It foresees the realisation of a «Sollievo» accommodation intended for temporary accommodation of people with severe disabilities [5].	Severe disability
«Palestra autonomia» accommodation	Apartment intended for short-term accommodation designed to experiment temporarily possible housing autonomy pathways [5].	Abitiamo il futuro SON Cascina San Carlo (2020 - in progress) It foresees the realisation of an apartment for autonomy that for 60 days a year will be destined to public use for guests identified by the Social Services of the Municipality of Milan [5].	People with disabilities who want to experience paths of "palestra autonomia"
Group apartment	Accommodation for groups of beneficiaries (from 5 to 10) with different types of disabilities. If more than 5 beneficiaries are accommodated, the structure must be divided into two modules that are part of the same building on the same floor or on two different levels, provided they are contiguous. If the Group apartment hosts people with severe disabilities for whom provision of high-intensity services is envisaged, it is necessary to arrange two housing modules, each with 5 beds [6].	Some benchmark projects: CASA MIA. Una casa accogliente per persone con disabilità (2020 - in progress) Una casa in San Donato Bologna (2020)	Different based on intensity range (from medium/light disability to medium/high severe disability) [6]
«Casa famiglia»	Accommodation characterised by a low intensity of care and low and medium organisational complexity, intended for the reception of beneficiaries with limited personal autonomy, without the necessary family support or for whom staying in the family unit is (temporarily or permanently) not compatible with the individualised care plan [7].	Casa Cenni Milano (2013)	Type of fragility requiring low intensity of care, low and medium organisational complexity [7]
«Support/mutual aid» accommodation	Apartment in which to experience living with other types of target users e.g. students that take care of neighbors with fragility that have already experienced paths of "palestra autonomia".	Residenza attiva Uroburo Monza (2020 - in progress), within the network of TikiTaka project	Mild disability (already experienced paths of "palestra autonomia")
«Peer-to-peer» accommodation	Apartment in which people with disabilities live with people with greater autonomy, guaranteeing in every case the supervision of qualified staff.	Casa Caldera Milano (2016 – 2019)	Severe disability alongside people with greater autonomy

4. Discussion and Conclusions

The multidimensional character of disability can deeply impact on spaces design and management of processes within the built environment, housing spaces and context in perspective of «Dopo di Noi».

The conducted research mapped and codified, in the form of housing models, experiences of co-design that have activated welfare practices «from below» with the aim of disincentivise institutionalisation and foster / train the community to social inclusion processes in implementation of Law. Through the qualitative-quantitative analysis of projects funded by the Law that have seen the implementation of inclusive living projects, research focused on the single project analysing it in its dual connotation of physical and social infrastructure. Research focused on the analysis of how projects were able to lower the PdV in all its dimensions within inclusive environments and spaces, focusing on how some social housing projects were already configured as real platforms of social infrastructure capable of responding to needs in an innovative way, activating paths of community engagement and accompaniment to living [8].

Law no. 112/16 promotes a cultural paradigm shift for the construction of a community welfare, stimulating to redesign the relationship between institutions and citizens for the construction of a welfare "bottom-up" aimed to disincentivise institutionalization and to realise, where possible, pathways of housing autonomy [9].

From the conducted analysis, in addition to a lack of homogeneity in projects actuation and in related implementation processes on national territory, a significant limitation in the number of projects activated emerges. This figure is attributable to several factors, two of which appear particularly critical: the first is the sustainability and the ability to hold over time the designed housing autonomy path; the second is the lack of involvement in co-design processes of subjects who specifically deal with housing welfare. For this reason, in the presented benchmark analysis, a number of significant housing experiences have been outlined, highlighting both the different types of housing that can be achieved, and the processes and actors through which they are realised.

In these experiences some characteristic present in the so-called new forms of "collaborative housing" emerge, in which it is first of all the design approach to change dramatically. In experiences of collaborative housing, in fact, there is a shift from a top-down to a bottom-up design of the housing offer, in which it is the community that pushes institutions and networks from below, forcing a dialogue to find design solutions that can meet needs expressed by the beneficiaries themselves, as well as enhance the skills present in the people who form and make up the reference community. All this reverses the orientation of a "welfarist" type of housing offer to a capacitive and inclusive approach. In this scenario, housing, services to person and service-spaces connected to housing function are strongly interrelated and able to design both functional spaces where people's lives (from house to neighborhood), and the relationships of the community. In the mentioned experiences, housing space, surrounding environment and reference community represent very important functional and/or spatial areas to experience autonomy «durante Noi» (during us) and prepare for «Dopo di Noi» (After us). Types of housing solutions that can be included in wider interventions of social housing are: Accommodation for families coupled with accommodation for daughter/son with disabilities; «Sollievo» accommodation; «Palestra autonomia» accommodation; Group apartment; Casa famiglia; «Support/mutual aid» accommodation; «Peer-to-peer» accommodation [9].

Work done so far opens to subsequent research phases with the aim of constituting an atlas of best practices of housing welfare emerged from Law implementation and to elaborate procedural guidelines according to the performance requirements approach to support spaces design and management of processes for the inclusion of people with disabilities in view of «Dopo di Noi» in the housing sphere.

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Communities, Sport, Inclusion. Strategies for Parish Complexes Social Reactivation Through Sport Practice Promotion

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Abstract. The following contribution presents some findings deriving from the research project "Sport is Society" by Politecnico di Milano. The research reflects on the built heritage and its ability to be accessible and usable for different users with different needs in its structures and offer of services, focusing on sports activities and spaces. The study refers to collective ecclesiastical structures in the contemporary city. The research in this area demonstrates the possible degrees of innovation regarding the increase in the inclusiveness of private facilities with a public vocation, where sport represents a driver of social inclusion for the community. The research proposes advice to guarantee inclusive sports facilities for the community, highlighting the strict relationship between the inclusive city and the ecclesiastical heritage, as an emerging issue to be investigated and solved. Starting from its relevance and the potential of the structures to become a truly "accessible patrimony", the tool suggests strategies for policymakers and ecclesiastical administrations to make them become "open services" - usable and accessible by all - for and inside the urban community.

Keywords. Inclusive Design; Ecclesiastic Heritage; Social Infrastructure; Healthy Communities; Sport Spaces

1. Introduction

The study refers to collective ecclesiastical structures in the contemporary city, with reference to the facilities for grassroots sports linked to the parishes, commonly called "oratorio" [1].

Within the contemporary city's urban and social regeneration processes, the facilities and public spaces combining physical activity, health promotion, and social inclusion acquire a renewed relevance [2].

The research is part of a broader research project funded by Polisocial Award 2019 awarded by Politecnico di Milano, titled "SPèS - Sport è Società" [Sport is Society]. The research activities were addressed by a multidisciplinary working group composed of

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experts in different fields as building hygiene, architectural design, urban planning and management engineering[2].

The research reflects on the built heritage and its ability to be accessible and usable for different users with different needs [3, 4] in its structures and offer services, focusing on sports activities and spaces.

Universal Design has been defined as the "design of environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design*"* [5]. While the minimum standards on accessibility deal with architectural barriers, this strategy aims to satisfy the needs of the widest range of users regardless their abilities or disabilities [6]. For this reason, an inclusive environment represents a place where everyone can access and take part in the community's activities and services with a common and equal experience.

In this regard, parishes facilities constitute a network of spaces already spread in the city, but often scarcely known, or strategically valued [7]. The enhancement and renovation of such structures and the strengthening of their accessibility and openness to all would contribute to promoting social inclusion and health, working with the proximity network of social and public spaces.

The objective of the paper is to provide a method and strategies to support the promotion of inclusive environments in parish facilities, where sports and leisure activities play a fundamental role in the social empowerment of the Community [8].

2. Method

2.1. Architectural scale

The research method consists of the development of an analytic tool, based on qualitative-quantitative parameters, which involves spatial features of the ecclesiastical facility and its surrounding. The tool analyses the physical space of the oratory and the activities carried out, focusing on the sports sector, to define physical and organizational regeneration strategies.

The tool is structured in a framework of three Macro-areas with related criteria: Urban and architectural aspects (I); Technological-functional-spatial aspects (II); organizational-management aspects (III).

The Macro-area *Urban and Architectural aspects* (I) allows the evaluation of visibility and recognizability of the parish and the accesses, the approach to the facility, the accessibility through public transport and active transportation choices for healthy

[2] The research project "SPèS – Sport is Society. Social regeneration, health promotion and urban inclusion, through the reactivation of the sports infrastructure system of the Ambrosian parish complexes" was funded by PoliSocial Award 2019, Politecnico di Milano and developed by researchers from three Departments of Politecnico di Milano (Department of Architecture, Built Environment and Construction Engineering DABC, Department of Architecture and Urban Studies DAStU and Department of Management, Economics and Industrial Engineering DIG). The project has been supported by ICS (Istituto per il Credito Sportivo), and developed in collaboration with CSI (Centro Sportivo Italiano), FOM (Fondazione Oratori Milanesi), Comune di Milano, the Regional Committee of the Italian National Olympic Committee (CONI Lombardia) and the General Welfare Directorate of Regione Lombardia together with Local Health Agency in Milan (ATS Milano Città Metropolitana).

lifestyles promotion and the presence of architectural barriers, separation of paths, and wayfinding [9, 10].

The Macro-area *Technological - Functional - Spatial aspects* (II) investigates the parish centre's functional, spatial, and dimensional organization, identifying unused and/or available spaces and their potential for intervention.

Finally, the Macro-area *Organizational and Management aspects* (III) focuses on the evaluation of the different users' that use the parish facility, analyzing their age, frequency of the sports activities, typology of sports, and voluntary staff involved.

Among the different criteria of the tool, issues such as accessibility and usability of the environment and the users' inclusion are considered, allowing an objective evaluation [11]. In particular, the tool considers the following criteria in the first Macro-area (table 1).

Table 1 Framework of the tool's Macro-area I - Urban and Architectural aspects.

Macro-Areas	Criteria	Indicators
1. Urban and Architectural aspects	***1.1 Recognizability and identity***	Level of recognizability of the parish facility in the neighborhood
		Level of community services offered by the parish facility
		Presence of collaborations with parishes facilities in the surrounding area
		Collaborations with the municipality and/or associations and/or local authorities
		Level of the historical and architectural value of the spaces of the parish facility
	1.2 Context	Level of proximity of green areas to the parish facility
		Presence of playing areas near the parish facility
		Quality level of aggregation spaces within the parish facility
		Presence of outdoor gathering spaces around the parish facility
		Presence of public and private sports facilities in the parish facility
	1.3 Reachability	Level of accessibility to the parish or oratory via bike paths
		Presence of bicycle stops inside and outside the parish
		Presence of dedicated parking spaces near the parish
		Level of accessibility to the parish by public transport
	1.4 Usability and accessibility	Level of accessibility to the parish via bike paths
		Presence of bicycle stops inside and outside the parish facility
		Presence of dedicated parking spaces near the parish facility

Recognizability and identity (1.1) evaluates the recognizability of the parish complex both to support orientation and the community's identity of the neighbourhood.

Context (1.2) analyzes the services for the citizens to understand the relationships between the neighbourhood and the parish facility.

Reachability (1.3) maps the public and private mobility services to allow people to reach the parish facility through active transportation choices for healthy lifestyles promotion.

Usability and accessibility (1.4) analyzes the characteristics of accessibility of the facility both physical usability and wayfinding [Fig.1].

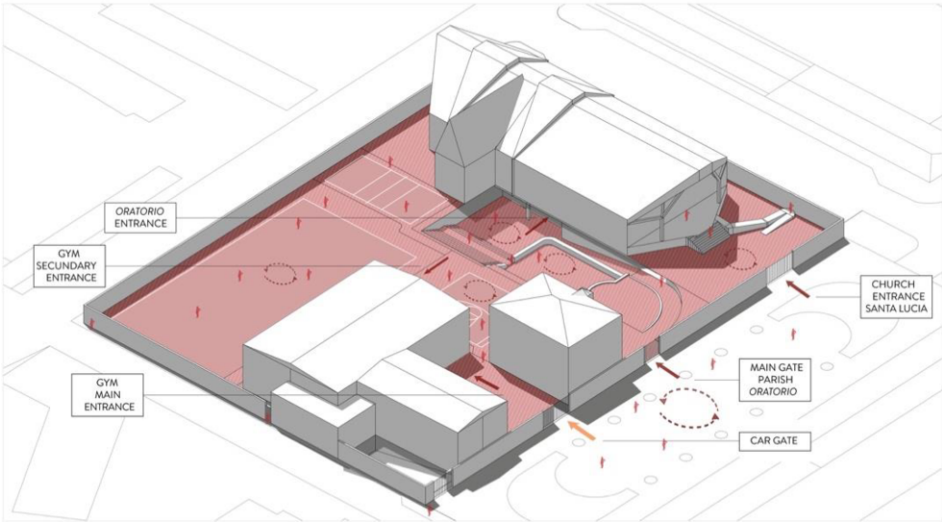

Figure 1. Volumetric representation of the accessibility and fluxes of a parish facility in Milan (Santa Lucia, Quarto Oggiaro). @Project SPèS, 2022.

Overall, the tool developed allows analyzing the current scenario of existing parish facilities also in terms of accessibility and usability to support their renovation in terms of inclusion of different users with various needs.

2.2. Urban scale

Together with the structural analysis, an urban analysis [12] in Milan (Italy) through GIS-based software was addressed to reflect on the level of urban accessibility and the characteristics of the *oratorio* system [Fig.2].

The urban analysis took in consideration: the population health status, demographic and social issues, sports infrastructures availability, and accessibility of the structures. In particular, the accessibility of the parish's facilities at the macro scale was analyzed considering the following aspects about the urban soft mobility [13]:

- accessibility by foot: the mapping of the isochrones of 5, 10 and 15 minutes walking distance from the parish facilities;
- accessibility by Local Surface public transport: the mapping of stops and lines of streetcars, buses and trolleybuses and existing urban green spaces (of all types);
- accessibility by rail public transport: subway lines and stops; railway lines and stops;
- accessibility by soft mobility: existing and planned bicycle routes.

The analysis helped to select 5 Case Studies for the application of the tool in different social and urban contexts [14], to suggest strategies and actions for the improvement of the parish facilities in terms of accessibility and inclusion.

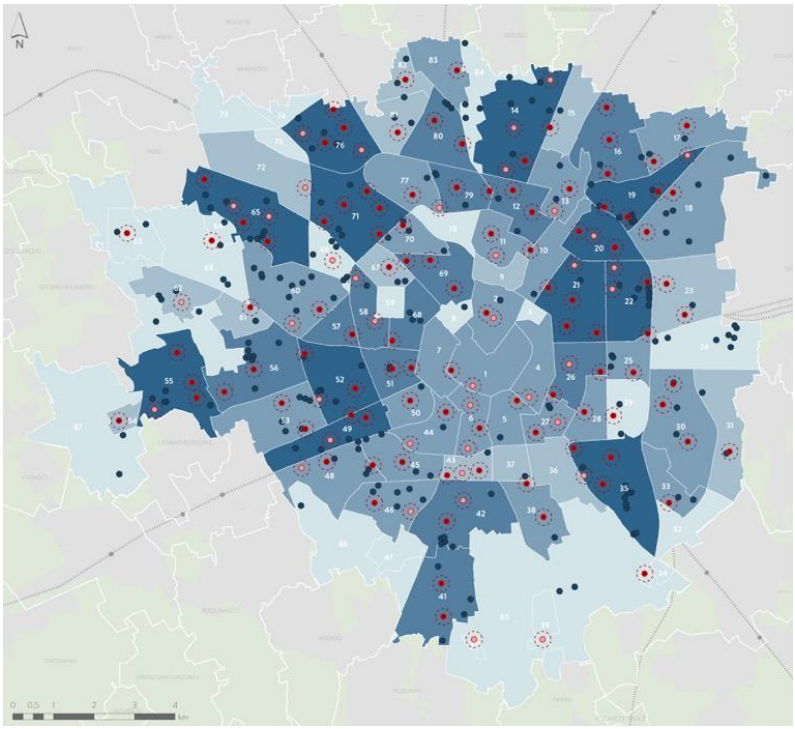

Figure 2. GIS-based Map of the city of Milan showing youth density, parish structures (red dots) and public sport infrastructures (blue dots). @Project SPèS, 2022.

3. Results

The application of the analytic tool highlights the level of usability and accessibility of the structures and the users of the facilities, as well as the possible degrees of innovation and inclusion to strengthen the public and collective vocation of these places [15].

The case studies were selected in different areas of the city, for a heterogeneous reading of urban situations and circumstances, with elements of interest or criticality on the sporting front: for instance, some of the cases had an important sporting activity, with a lack of spaces, and others, on the other hand, had several under-utilized spaces. Also from the social and urban planning point of view, the case studies involved intermediate areas, accessible and well connected, while some suburban areas with a lack of services and transport.

Although at the urban level they are already highly accessible and connected to mobility networks, at the architectonical one most of them present critical aspects related to architectural barriers, routes separation, and wayfinding. Moreover, the fact that they are part of cultural heritage often involves maintenance problems and needs for renovation difficult to solve.

3.1. SWOT Analysis

The application of the tool to the 5 pilot cases – together with some surveys and interviews with the communities involved – highlights some transversal elements that emerged from the experimentation. Overall synthesis of the results has been represented through the SWOT analysis, which makes it possible to examine the strengths, weaknesses, opportunities and threats of a project in order to support decision-making and the achievement of an objective.

The **strengths** that emerged in terms of accessibility and inclusion are:

- parish facilities are often highly connected and accessible by the public transport network;
- most facilities include spaces that can be used for different sports activities (e.g., gym, soccer fields, basketball, volleyball, etc.), both inside and outside the oratories, encouraging the promotion of physical activity for different users;
- parishes offer a variety of educational-aggregational services for youth people (sports services), families and in some cases for the elderly to promote social inclusion;
- the refreshment areas, as well as the sports areas, can be used as places to promote social aggregation for the whole community;
- often, the parishes have important outdoor areas, and are not always exploited to their full potential.

In addition, the **weaknesses** analyzed in terms of accessibility and inclusion are:

- several sport areas in some parishes are poorly visible, accessible or valued, while they could represent a great reference for the community and the promotion of physical activity;
- several parishes have architectural barriers in the main entrances, where becomes necessary the use a secondary entrance for persons that use wheelchairs or parents with strollers;
- the wayfinding system of structures is often poor, especially in indoor environments and in the connection between outdoor and indoor environments, so only people who know the spaces can orient themselves;
- the refreshments areas and support spaces for sports activities are often not adequate to the needs of users since they are not accessible or small compared to real needs;
- the activities for the elderly in many cases should be improved and increased for their needs.

The potential **opportunities** that emerged to promote social inclusion are:

- several parishes desire to offer sports for people with and without disabilities taking advantage of the collaborations already in place with associations, however, this requires adequate facilities;
- parishes could ensure a larger and more varied offering of sport and physical activities for different age groups;
- parish facilities can represent socially attractive centres for all citizens and become health-promoting environments for the community thanks to inclusive sport activities (e.g. different ages and cultures, individuals and associations, etc.).

Finally, the **threats** to care about are to be able to promote social inclusion are:

- the space's management becomes a problem especially during the daily hours, because of the lack of volunteers and/or staff, this can also generate problems in terms of security of spaces;
- unused spaces that are not used daily generate additional maintenance costs, as well as not being a source of revenue;
- poor spaces enhancement can lead to a lower presence of the community users in the parish.

3.2. Strategies

In light of the application of the tool and the general SWOT analysis, it is possible to propose different strategies for the oratorio-system, to give some hints that could be applied to all the facilities.

Accessibility, usability and well-being promotion:

- due to the historical nature of the structures, different entrances need to be used: at least one of them should be fully accessible with ramps and technological solutions suitable for the inclusiveness of the users;
- to facilitate the separation of paths and to increase the accessibility of the oratory and sports spaces through the use of existing secondary accesses;
- to implement wayfinding between indoor and outdoor spaces (wall and/or floor) with maps, graphic indications and tactile guidelines;
- to renovate some existing underused sports facilities such as theatre halls or gyms, transforming them into multifunctional spaces including support spaces (locker rooms, storage, etc.) that can operate at different times of the day [16];
- to integrate covers and/or technological elements to create shaded outdoor areas during the summer season to promote more gathering spaces for users;
- to ensure homogeneous outdoor lighting to promote safety and security of all the areas at different times of the day;
- to maintain the outdoor areas and to integrate them with play areas for children and seating for users to promote community social aggregation.

Community social inclusion improvement:

- to strengthen the synergy with associations in the neighbourhood to implement sports activities;
- to implement the presence of volunteers and/or staff to support the spaces' management;
- to involve the elderly population in the practice of sports with ad hoc activities and/or management of spaces through volunteering;
- to involve the young population in interventions of "participatory" activities of requalification and activation for the management of sports activities;
- to search for synergies with sports organizations in the area for the funding and management of renovated sport spaces.

4. Conclusions

The research demonstrated the possible degrees of innovation regarding the increase in the inclusiveness of private facilities with a public vocation, where sport represents a driver of social inclusion for the community.

Starting from its actual relevance, and the potential of the facilities to become a truly "accessible patrimony" for all, the tool suggests hints and strategies for policymakers and ecclesiastical administrations make them become "open services" - usable and accessible by all - for and inside the urban community. This way, the relevance of the strengthening of the inclusive city or the city of proximity matches with the renovation of existing ecclesiastical heritage, as an emerging issue to be investigated and solved. The optimization of the *oratorio* facilities by applying multi-criteria and scientific tools leads to the increase of knowledge and consciousness about the built heritage and its role in building a city for all.

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Rethinking Play Environments for Social Inclusion in Our Communities

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Abstract. "Make cities and human settlements inclusive, safe, resilient and sustainable" is one of the 17 Sustainable Development Goals of the 2030 Agenda approved by the UN General Assembly. This means that every Country must commit to facing the challenge of increasingly welcoming and barrier-free cities, providing "universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities". The mission of inclusive play is to create accessible and sensory-rich play environments that meet the widest range of users and abilities offering several and stimulating play opportunities in the same setting. In many playgrounds of our cities, for persons with disabilities, accessing, moving and making play experiences is not easy, in some cases it is not possible. The paper presents the results of a study carried out in order to investigate the inclusiveness of outdoor playgrounds and introduces the need of new perspectives towards a new and innovative view of inclusive playgrounds.

The development process of the checklist for assessing the inclusiveness of outdoor playgrounds involved four steps. Step 1: Definition of the main concepts of investigation and generation of the items on the basis of the relevant literature and best practices. Step 2: Scaling and scoring. Step 3: Pilot test to verify the real applicability of the checklist. Step 4: Design of the final checklist. The final checklist was applied to a sample of playgrounds belonging to an Italian urban area selected as a case study in order to make a picture of the state of the art of the playgrounds built in recent years.

After the checklist application, the processing of the collected data shows that there is still much to be done to make urban play areas fully accessible and usable by all. Physical accessibility (not always guaranteed) to the play area and to the play components is not enough. Currently there are few playgrounds that ensure inclusive experiences by offering a wide range of equipment with different game values and levels of challenge and services that can be used by everyone.

Inclusive playgrounds in our communities are still a small percentage compared to all existing play environments, although there is a greater attention to the theme from year to year. The importance of inclusive playgrounds is recognized by everyone at a theoretical level, but in practice it is still necessary to promote, implement and verify the culture of accessibility and inclusive play. If we want inclusive cities, it is necessary to find skills and resources as well as effective operational tools to map the critical issues of existing playgrounds and to implement restyling interventions or new projects of successful and comprehensive inclusive play environments.

Keywords. Playground, inclusive play, accessibility and usability

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1. Introduction

Policies to create inclusive environments have become a movement in several countries in Europe and in the world. Making cities inclusive, sustainable and safe is one of the missions of the UN 2030 Agenda for Sustainable Development. It is therefore clear how important it is to be able to change and improve our cities in order to "provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities". The Italian National Recovery and Resilience Plan, in its fifth mission, supports social inclusion and cohesion in urban areas by promoting the regeneration of public areas such as parks and green spaces in order to promote the social integration of disadvantaged and frail persons. Pursuing these goals means rethinking the cities where we live to find new inclusive solutions for public spaces including the playgrounds.

In our cities the playground is an equipped area that tries to fill the lack of free outdoor play opportunities. It is also an important opportunity for socialising outside school and other regulated activities. In the past, children with physical-motor, visual, hearing, intellectual-relational disabilities did not have the same opportunities for play as other children. There has been a lack of planning and designing of public play spaces inclusive and suitable for all which we absolutely must implement today in order to improve the society and the well-being of all individuals.

The mission of inclusive play is to bring everyone together regardless of abilities and skills, through diversified and stimulating play opportunities. In many existing playgrounds, accessing, moving around and playing is not easy and safe for persons with disabilities; in some cases, it is even impossible. Although there has been increased attention to the issue of inclusion in recent years, inclusive play spaces are still not widely widespread.

The paper aims to present the results of a case study. This analyses playgrounds in terms of inclusivity in order to stimulate a thought on how we can rethink and regenerate them in a new and systemic way to ensure the inclusion and well-being of persons of all abilities.

2. Inclusive Playgrounds: Mission and End Users

Playgrounds are one of the leisure and entertainment opportunities that our communities typically offer to residents and visitors. Social inclusion, which in the contemporary scenario is one of the requirements of public space, thus becomes crucial also for outdoor play areas. These must offer opportunities for play, socialisation and integration to all children.

Playing for children is a unique and irreplaceable activity. Every child needs to play. Every child has the right to play and learn through play in order to develop their potentialities and lay the foundations for a healthy and happy growth. The right to play and recreational activities for all children is a fundamental right enshrined in the Convention on the Rights of the Child (1989) and in the Convention on the Rights of Persons with Disabilities (2006).

In many studies it has been shown that children with disabilities not only "want to play in one way or another" [1], but also "want to enter and be part of the world of children; playing with other children is the way to enter that world" [2].

Nowadays the right to play and sport for children with disabilities is not being fully respected in the playgrounds.

Playgrounds “can create an environment of inclusion or exclusion” [3]. Playgrounds with play equipment for the exclusive use of children with disabilities are not inclusive because they discriminate and marginalise [4]. The playground becomes inclusive when it offers play components that can be used by persons with and without disabilities. The inclusive playground includes everyone in the play experience regardless of age, ability or any other discernible difference.

The inclusive playground is the place where each child becomes protagonist, loses passivity and weakness and can make choices because it provides “all children a rich playground environment for play and quality social participation” [5]. It is also a barrier-free place where children with different abilities can make and share play experiences interacting with each other. Children have different social, play, communication and movement needs according to the age and health status. Inclusive playground equipment should be designed, constructed and installed to provide play opportunities for the majority of children with motor, sensory, intellectual or relational disabilities.

The end users of the inclusive playground are not only children of different ages but also adults. Family members with or without disabilities should be able to enjoy playing with their children, grandchildren, younger brothers or sisters, and have the opportunity to socialize with others [6].

In the inclusive playground everyone, including people with weaknesses and difficulty in their autonomy, must be able to access, move, play with the possibility of choice, rest and see their role and identity recognized. It is the playground without physical, sensory and socio-cultural barriers.

Although for a long time playgrounds were designed neglecting the requirements of accessibility and usability, playgrounds called “inclusive" are beginning to be a reality even in our cities. But are they really accessible and usable by a wide range of end users with different needs?

3. Assessment Tool and Case Study

In order to design effective and innovative solutions for inclusive playgrounds, it is important to know the state of the art of the playgrounds currently existing in our communities. For this purpose, an assessment tool has been developed to investigate weaknesses and strengths of playgrounds in terms of accessibility and usability [7]. The assessment tool was tested on the playgrounds in the city of Trento (Italy). For this case study sixteen playgrounds were selected (Figure 1). These are playgrounds built or renovated in the last fifteen years, looking for those typically promoted as "accessible" or "for all" or "inclusive" in the local press, in web pages or directly reported by citizens.

3.1. Method

The study to investigate the playgrounds of the case study is based on the use of a checklist. The checklist was developed from the analysis of guidelines, articles, and examples of best practices concerning inclusive playgrounds. The checklist contains items related the accessibility and usability of the playground divided into five sections.

Figure 1. Playgrounds of the case study of Trento (Italy).

The first section investigates the access to information that allows everyone, and in particular persons with disabilities, a self-assessment of the access and play opportunities for themselves or their children. In particular, the section examines whether there is adequate and clear signage on site, a dedicated web page or other channel to find information about the accessibility and usability of the playground (*access to information*).

The second section checks whether the users with mobility aids (e.g. manual or power wheelchairs, rollators, walker, crutches, strollers, etc.) are able to arrive by car or bus, enter the playground, move around and reach the play equipment as well as the furniture of the rest areas. In particular, the section focuses on the routes to reach the different play areas and those to reach the rest areas (*physical accessibility*).

The intent of the third section is to recognize the presence of environmental facilitators (e.g. landmarks, devices, etc.) for persons with visual sensory impairment in order to orient themselves, maintain the direction of movement and understand the distinctive features of the place (*sensory accessibility*).

The fourth section explores the presence of equipment that provides play opportunities for children with different abilities for physical, dramatic, sensory, cognitive and creative play. The composite structures were broken down into play components at ground level and play elements located at a higher level (*access to play experience*).

The last section focuses on participation and socialisation opportunities. It verifies the presence of equipment for parallel and group play that can be used by children with different abilities. Regarding the experience of rest, the items concern the usability of outdoor furniture (e.g. benches, tables, etc.) and other elements such as drinking fountains, waste bins, etc. (*participation and socialisation).*

The rating scale used for the answer options is a four-level scale with a score ranging from -1 to +2 points. The sum of the values gives a final overall score in a range from -

26 to +52 points. In order to verify the real applicability of the checklist, a pilot test was carried out to refine the tool.

3.2. Data Collection and Results

The survey activity was carried out by means of on-site visits during which the checklist was compiled, a rich photographic documentation was collected and, when possible, opinions were directly collected from end users. Subsequently an information sheet was compiled for each playground whose information was transposed into a summary matrix in order to attribute the scores of the checklist items. This matrix calculates the partial and total scores achieved by each playground showing weaknesses and strengths of the playgrounds.

From the graph in Figure 2 we can see that no playground earns the maximum total score, a zero score or a completely negative score. The playgrounds with the highest total scores are two: the playground called "Enzo Tortora" (P14, 37 points out of 52; 71%) and the playground called "Area verde Roncafort" (P1, 33 points out of 52; 63%), while the lowest total score was earned by "San Rocco di Villazzano" playground (P16, 10 points out of 52; 19%). The average total score is 21 points (40%).

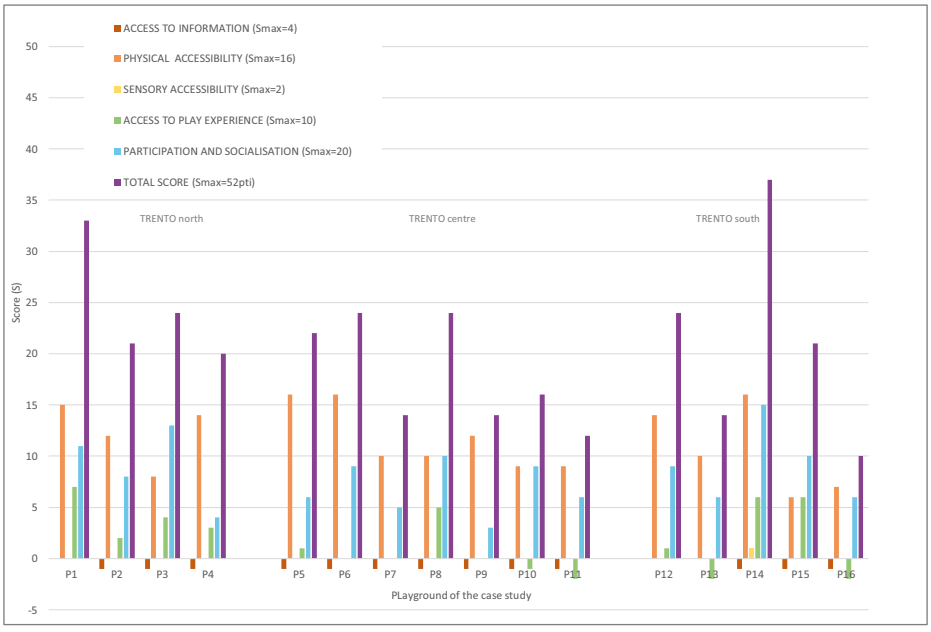

Figure 2. Evaluation scores of the case study.

A negative or zero score was almost always assigned to items on *access to information* included in the first section of the checklist. The reason is the lack of clear and comprehensive information for all on site and/or on web pages.

Another section with an overall score of almost always zero is that of *sensory accessibility*. Only one playground includes paths with contrasting coloured paving and tactile signs on the ground.

The section concerning the *access to play experience* shows low scores, in some cases even negative scores. The offer is limited to a few play experiences for children

with different abilities. It is almost always represented by the following play components for the physical play: basket swings or swings with seats partially-reclined, body-embracing and adjustable safety harness; merry-go-rounds where the base platform is flush with the surrounding pavement, and spring riders with back, foot supports, shelter of the seat sides and handholds. There are no ramps to access the slides, and no opportunities to climb up the embankment, pulling themselves up the rope and using the footholds to get to the top. Similarly, in the play composite structures children in wheelchairs are not able to reach the elevated play components.

In relation to the dramatic play, the thematic structures on the ground (e.g. animals, houses, cars, etc.) are often not usable due to physical barriers or because they are placed on inaccessible surfaces.

There is also a lack of ground-level play components that encourage sensory stimulation. There are no opportunities to explore tactile and olfactory experiences; sound and music play components can only be found in two playgrounds. The lack of sensory play equipment is also accompanied by the lack of educational components that can contribute to develop critical thinking skill, logical and concentration skills. Imaginative and creative play equipment including products with running water and sand are represented only by traditional ground level sandboxes.

The section where the playgrounds of the case study have obtained largely positive evaluations and close to the maximum score is that of *physical accessibility*.

At least one parking space reserved for persons with disabilities is always available in the playground parking lot or in the close proximity. In 75% of cases, there are bus stops wheelchair-accessible for persons with disabilities. Entrances/exits of the playgrounds are barrier-free for those moving with mobility aids.

The routes connecting the entrance/exit of the playground with the play equipment are almost always accessible, but only in 30% of cases the end users find accessible surfaces located in the use zone (ground level area below and immediately adjacent to play equipment). Rarely, are tables suitable to accommodate wheelchair users, and in only one playground are there child-friendly tables and seating. In most cases, litter bins of different shapes and sizes are placed along the routes; they are easily recognizable and usable by children, adults and wheelchair users. Instead drinking water fountains have shapes and mechanisms of action that do not facilitate their use by children and wheelchair users; in some cases, they are equipped with water collection grids at the base that are not coplanar to ground. Often they are not positioned in strategic points and easy to reach. An accessible double-height drinking fountain has been installed in only one playground.

The total scores of the *participation and socialization* section are always positive, but far from the maximum value. The equipment that offers parallel play opportunities to children with different abilities are mainly double swings with diversified and ergonomic seats to give support and safety to the movement. These swings allow interaction between children of different ages and between children and adults, creating an opportunity for communicative exchange and intergenerational sharing. There are no extra wide slides or doubled slides that the children can use when slide together.

The equipment for the group play in the best-performing playgrounds of the case study includes: playhouses and themed structures; basket swings to accommodate multiple children sitting or lying down, and small groups of single spring riders some of which have back and/or side guards. In only two cases there are a two seat spring rider.

In the larger playgrounds it is also possible to find dedicated spaces for playing with the ball or doing gymnastics. Football pitches, volleyball fields, basketball fields, tennis tables and fitness areas can be used by a wide range of people with different abilities if placed on accessible surfaces and properly equipped. Only in the "Area verde Roncafort" (P1) there is a small open-air gym accessible and usable by people with different abilities.

4. Discussion

The culture of inclusion in the design of urban spaces is implemented through the research for the highest degree of accessibility, usability, safety, recognisability, well-being and pleasantness.

Designing an inclusive playground means: guaranteeing and extending a sanctioned right; widening the possibilities of use of spaces and play equipment; making the relationship between end user and environment positive as far as possible.

Children should be brought into playgrounds to play freely in public spaces through contact with and use of both natural and play components, which need not always be a collection of standard play equipment on accessible surfaces.

The playgrounds analysed in the case study seem to be the same with repetitive, common games and often not usable by people with different abilities. Rarely they address a broad spectrum of play needs through opportunities for fantasy and inclusive cooperative play.

Playgrounds can be conceived as works of architecture that are well integrated into the landscape and environmental context [8]. The New European Bauhaus initiative calls on all of us to imagine, design and build together beautiful, sustainable and inclusive built environments [9].

Instead of the traditional play components we are used to seeing in our cities such as swings, slides, spring riders and sandboxes that suggest to users how to play leaving little room for imagination or creativity, the children should find sculptures to play with and play spaces modelled as play sculptures that offer considerable possibilities for play valorising diversity, equality for all, accessibility; playgrounds for all with installations of original and creative play components, in some cases site-specific that dialogue with the place in which they are installed.

Architects, engineers, planners, designers and artists can use the power of innovation and creativity in built environment to shape a better way of living in accordance with the principles of environmental, social, cultural and economic sustainability in order to create more inclusive and resilient communities.

5. Conclusion

The playground is a good indicator of key changes in society: the inclusion and social cohesion, the ideas about education and childhood; the importance of creativity, the role of architecture in public spaces.

Designing and building innovative inclusive playgrounds requires a strong commitment to finding solutions for accessibility, usability, safety and wellbeing of the end users by applying UD principles to create spaces where everyone can have play experiences regardless of age, ability or language, and form new social bonds.

The inclusive playground is the result of a participatory design action using a multidisciplinary approach and technical analysis tools. It is a demanding challenge involving many actors: professionals (i.e. architects, engineers, technicians etc.), artists, therapists, pedagogues, educators, and, of course, the children themselves and their careers.

If we want inclusive cities, we need to find adequate resources and effective operational tools to implement inclusive restyling in existing playgrounds and ensure the requirement of inclusion in all new play areas [10]. In addition, an adequate training for the various stakeholders should be promoted to strengthen the culture of inclusion in order to nurture new forms of creativity for playgrounds.

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A "Best Practice" for Inclusive Art Cities: The Case Study of the I-Access Project

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Abstract. The essay aims to illustrate the results of the I-Access Interreg Italia-Malta 2016-20 project, carried out by a partnership led by the Department of Architecture of the University of Palermo with the scientific coordination of Renata Prescia. The project involved the Vucciria district in Palermo and the Bijcceria district in Valletta. Within the framework of the products created (database, web platform, mobile apps, protocol, etc.), we would like to explain in this paper the measures taken to facilitate physical and cultural accessibility from the integrated point of view of restoration and exhibition design, that is, in particular measures to overcome architectural barriers, measures for cultural dissemination and measures of a museographic-communicative nature, including re-evocations of lost or dislocated monuments and artistic works. The proposal is designed as a method for historic urban areas that have similar problems to the district under study. The Vucciria, for example, despite its high density of monuments, has a low quality of life because many of its monuments, especially churches, are closed and therefore unusable and because there is little motivation for local people to engage with these monuments, partly because it is an evolving community. The proposal, therefore, provides for concrete actions to restore the memory of the inhabitants and to re-establish an identity bond with the context, with concrete implications for attracting widespread tourism to provide opportunities for renewal for the district. Project proposals included the installation of three urban totems, ten tactile maps associated with as many churches, and the design of two new access ramps to two churches. By being realized as smart additions in a contemporary and stimulating way compared to the interventions characterized by a solipsistic *retour au passè* and previously carried out in accordance with the philosophy of the current urban plan, they also become an educational opportunity for a dialoguing community.

Keywords. restoration, physical and cultural accessibility, exhibition design

1. Introduction (A.R.D. Accardi, R. Prescia)

This paper aims to illustrate the results of a project carried out over the last three years under the INTERREG Italy-Malta Programme (Notice 1/16) on the theme of accessibility to historic cities. It was intended to help develop a methodology for areas of historic cities facing similar problems to those of the districts studied: structural and social decay, mutation of inhabitants, and poor quality of life, while at the same time the presence of heritage values is high. It was about the Vucciria district in the historic centre of Palermo and the Bi¢¢erija district in the historic centre of Valletta. The latter,

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consecrated as a tourist site since its approval by UNESCO in 1980, still has dilapidated areas around it, especially near the harbour. In both cases, it was hoped that by solving the problem of accessibility, the restoration of monuments could be stimulated, which in turn could trigger wider urban regeneration processes.

Palermo is an important city (the fifth Italian capital), but there is still much to be done in terms of the physical preservation of pre-existing buildings but also in terms of quality of life. This is partly because a population in transition lacks the grounds for a relationship with the buildings, including affective ones, and partly because many of the monuments that should be the engine of this affection are closed and therefore cannot be used.

Certainly, the UNESCO awards, such as the recent one given to the Arab-Norman itinerary for Palermo (2015), represent an important act for the rehabilitation of the cities, but almost exclusively from a tourist point of view, while the I-Access project was primarily aimed at the inhabitants and envisaged concrete actions for them to recover memory and build an identity bond with the context, but which had a cascading concrete impact on the attraction for "broad" tourism.

2. The I-Access project: intertwining Restoration and Museography (R. Prescia)

The project has matured in the field of architectural culture and restoration principally, understood in the sense of an active activity in the study of cultural heritage, using on the one hand the tools and skills of architecture and on the other hand the dialogue with the communities that use them. The role of the architect today, exercised through thought and concrete action, requires the assumption of responsibility, because we know that with our work we can change places and the people who live there. We are also convinced that today more than ever, monuments have an undisputed educational function, and we think that contributing to the development and communication of this educational power is one of our most current tasks, in a cultural, social, and political climate that needs above all new/old values [1].

It was a challenge to develop this action within the framework of a European project that would transform the widespread opinion that it is just a way to spend money into an outcome that instead considers scientific research as an indispensable prerequisite for real innovation, which is often only announced. An innovation that is not only technological and digital, as the Call required, but is also specifically cultural and expresses a different vision of the current generation. An innovation that must necessarily go hand in hand with conservation, collective memory, and social progress.

The issue of accessibility seems obvious, but, despite the strong commitment of the European Commission, which has already developed a second cycle of the Disability Rights Strategy 2021-2030 (www.ec.europa.eu), it still needs to be assimilated and understood in its deepest values in our southern territories, not as a necessity, but as a social and economic resource to improve the quality of life. Its complexity requires a coherent ethical profile to achieve protection that becomes an integral part of economic and social development policies and urban planning (Washington Charter, Icomos 1987) and guarantees the conservation of heritage as a constitutive resource of the ecosystem urban (Valletta Principles, Icomos 2011).

With reference to the full report on the project [2], we would like to focus in this essay on the interweaving of the disciplines of 'restoration' and 'exhibition design', whose knowledge was applied to the work carried out synergistically in the superintendency

BB.CC. AA., to carry out the two interventions to access the churches, and the design of urban totems and tactile maps, in the historic centre of Palermo, where for the first time we tried to offer solutions within an architectural research, leaving out the recourse to the use of technological products such as stairlifts, ephemeral and reversible elevators or ramps, usually used by the Superintendency because they are considered more convenient, both in terms of cost savings, and project time [3].

The two skills, in the logic of a more democratic dissemination and widespread awareness, are directly confronted with the knowledge of buildings of monumental value, with the aim of experimenting on the necessary opportunity to engage in historicized contexts, manifested in the proposals of innovative signage and, also, in those of the new 'facilitated' accesses to the churches of S. Maria la Nova and S. Maria in Valverde.

The decision to intertwine with Museography [4], for the aforementioned purposes, instead of the Architectural Design *tout court*, was considered the most suitable for its disciplinary and professional characterization, to work on the relational functions between things rather than on things in themselves, and because it allowed us to insert ourselves in the groove traced by Cesare Brandi with the assimilation between Preventive Restoration and Museography which saw, in the 60s and 70s of the twentieth century, exemplary realizations, including the most emblematic, in the context of our reasoning (and above all here in Sicily) are those arising from the historian's meeting with the architect Franco Minissi,

> *per significare che le operazioni museografiche hanno come oggetto la conservazione attiva di testimonianze del passato inalienabili ed irripetibili per le quali il museo si pone come restauro preventivo* [5].

This juxtaposition, however, had also found confirmation in the didactic system with the placement of Museography within the disciplinary field of Restoration from which, unexpectedly, it detached itself in the following years and is today indiscriminately assembled in the context of the Architectural Design.

The progressive clarification of architectural restoration as an operative-design discipline interested in the monument in its unity with the environment, on the one hand, and the current development of the concept of musealisation towards new areas extended and expanded to urban spaces and places of everyday life, on the other [6], has brought the two insights closer together in the sign of a renewed Everyday Aesthetic [7].

Now, if we assume that restoration interventions are intended to preserve not only the physical consistency of buildings and objects, but also the meanings, we can argue that with this variability of different purposes it is not always possible to apply a general rule, but certainly one must expect a wise competence in the relationship with the property to be restored, in the ability to question it and to question oneself about its future.

The opportunity or not to add a new structure to a building of historical-monumental importance characterized by historicized stratifications and the ability to control the intervention cannot be resolved univocally but must be chosen from a range of solutions developed in a real and its own process of "ethical adaptation" of any form of intervention on ancient pre-existing structures [8].

In a European reconnaissance of best practices, it was found that not many permanent architectural interventions have been carried out, because the D.P.R. 24/07/1996, n. 503 has clearly directed towards removable solutions, finding support in the principle of reversibility, recognized by those who work in the restoration [9], but

which today is subject to a process of verification that greatly limits its necessity [10]. The cases of the Cathedral of Grosseto seemed interesting to us, with a concrete and marble ramp integrated into the steps of the parvis, and that of the Ravenna National Museum [Fig. 1].

Figure 1. Grosseto, Ravenna and Palermo compared: on the left group, the Cathedral of Grosseto and the disabled access ramp 'landing' in the churchyard, compared to the Church of S. Maria la Nova in Palermo and the construction of the ramp with the same strategy used in Grosseto; on the right group, the National Museum of Ravenna and the new access with the disabled access ramp, compared to the Church of S. Maria in Valverde and the construction of a new churchyard incorporating the disabled access ramp.

Of course, the decisions taken are the subject of a debate that has its points of friction with the bodies responsible for protection, which still too often prefer to confine themselves in their enclosure of alleged incompatibility, and with a community that has not yet been sufficiently warned against a debate that too often takes place in the academic enclosure alone.

3. Outcomes of the I-Access project, between restoration and musealisation projects in historic centres (A.R.D. Accardi)

In terms of accessibility to cultural heritage, the strategy of "architectural addition" proves to be the most appropriate, as it offers itself as a new design practice and at the same time presents itself as a determined democratic act [11]. The culture of the museographic project, including that of restoration, can thus be understood as a unified approach to pre-existence, aimed at preserving and enhancing the historical-architectural heritage.

Starting from the reflections made so far in Palermo with the project I-Access to overcome architectural barriers and improve accessibility, it was decided to provide answers in terms of "architecture", besides a new architecture to the pre-existing one, as a crucial orientation aimed at eliminating the "transient" character that a ramp (metal or wooden) can express, also due to the fact that "removable" structures reinforce in people with disabilities the feeling of being identified as different and therefore discriminated against.

> *L'idea della reversibilità, soprattutto in questo ambito del progetto, dimostra tutta la sua inconsistenza. Laddove ragionevolmente possibile, si tratterebbe di superare questi logori luoghi comuni e sviluppare invece un'attitudine al progetto di accessibilità che programmaticamente prescinda dal carattere di reversibilità. Del resto, drammaticamente irreversibili sono i motivi che inducono ad adottare questi provvedimenti* [12].

An installation perceived as "temporary" creates a psychological implication of inequality towards different types of users and conveys the message of a continuing separation between healthy and disabled people, which is reinforced by the suggestion of an "alternative" path that generally remains so. When these paths lead to secondary entrances instead of main entrances, this sense of inequality is further reinforced [13].

Therefore, the main objective of the design of the ramps and churchyards of the churches of Santa Maria in Valverde and Santa Maria la Nova was to allow access to every user through a single "shared" entrance without any differentiation [14]. The sense of proposing a new churchyard for Santa Maria in Valverde, in which the ramp for the disabled will be inserted, is also due to the desire to restore the original level of the ground of the "Largo Cavalieri di Malta", where today the secondary façade of the church is located, which in the last decades of the century XIX has undergone a lowering as part of the general urban road rehabilitation works [15]. The obvious signs of this change in height, overcome by the installation of three steps, suggested the creation of the access level of the portal at the exact height that the floor of the "Largo" originally had [Fig. 2]. In the intervention on the church of Santa Maria la Nova, on the other hand, the side door was modified to create a new facilitated entrance, and the new churchyard, connected by the ramps to the two levels of possible pedestrian access, that is, on the sidewalk and on the street, is protected by a railing of successive frames, adapted according to the decorative division of the facade with which it is compared [Fig. 3].

Figure 2. I-Access Project outcomes: Palermo, Church of Santa Maria in Valverde: the ramp for the disabled that engages in the new churchyard, which evokes the original level of the Largo Cavalieri di Malta floor.

Figure 3. I-Access Project outcomes: Palermo, Church of Santa Maria La Nova: the double access ramp to the churchyard, through the side gate modified for this purpose.

We have tried to avoid the concepts of 'physical accessibility' and 'cultural accessibility' appearing as two separate and unrelated areas. Instead, as indicated in the theories of Universal Design [16] and in the statements of ICOM (2014) and ICOMOS (2020), they were part of a single planning consideration aimed at providing a response to overcoming physical and cultural barriers and, in this holistic perspective, leading to the creation of common communication strategies and tools.

The intention to identify an exploratory-cognitive itinerary through the Vucciria area between the spaces of urban life and the monuments highlighted the conditions of accessibility to the different sites, which in most cases are prohibitive and which initially revealed the objective need to intervene with projects to overcome architectural barriers. In a later phase, therefore, the possibility of planning a system of cultural signage and interactive stations that could improve cultural accessibility and favour the overcoming of cognitive barriers was evaluated, so that users with visual impairments or other types of disabilities could also move independently and interact with 'smart objects' located along the itinerary and able to provide all kinds of information and historical-cultural insights about each of the monuments [17].

Two types of aids were thus conceived: 'urban totems' to provide general information, such as identifying the district and the monumental itinerary with its landmarks; 'tactile maps' to provide more detailed information about each monument. As these tools are intended for outdoor use, we have been concerned about the type of materials to be used, potential damage from vandalism and the necessary maintenance of the supports themselves. The need to find a compromise between the means of communication for special needs (visually impaired, blind, dyslexic, etc.) without neglecting the expectations of non-disabled users, the sense of graphic-aesthetic composition, the impact of the supports on the urban decorum and the control of visual interference between the supports and the monuments has led to creative choices aimed at reconciling this infinite number of needs.

In this perspective of social inclusion - with 'tactile maps', through calibrated graphics, with descriptive texts integrated through the Braille code - the visitor is offered not only a brief history of the development of the various sites, but also a reconfiguration (partial or complete) of buildings and monumental sites, sometimes recovering the memory of what has disappeared, or even showing a complete reconstruction of the surrounding context.

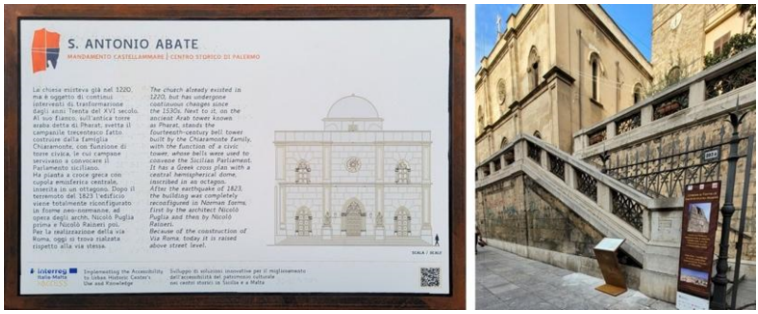

Figure 4. I-Access Project Outcomes: the monumental signage with tactile map installed at the church of Sant'Antonio Abate.

Both the general historical context and the architectural specificities of each monument inevitably 'influenced' the design of the dissemination tools, forcing a work that selected the most appropriate formal and material features of these supports and also met the precise intention of making them recognisable, 'standardised' and perceptible as part of a coherent and coordinated communication system. The bilingual information text of these supports is also translated into Braille and flanked by the relief drawing of the building fronts or the city layout. A human silhouette flanked by the drawing of the monument provides the reference scale, which is useful for all types of users, especially the blind. In addition, a code QR, which refers to the official site of the I-Access project (www.iaccess.eu), provides the opportunity to learn more about the buildings depicted, while a pictogram for motor disabilities indicates that access, if available, is via an inclined ramp [Fig. 4].

In the case of the orientation totems, on the other hand, the structuring of their content was mainly based on offering passers-by information about the urban location of the Vucciria district, the reference to the monumental exploration itinerary, 'Vucciria Walking' and the location of ten monumental buildings and three squares integrated into them. The totem, with its urban scale planimetry, allows the analogy between the city and the district to be grasped and, with the Braille code, offers users a tactile experience essential for blind users, alongside the more traditional bilingual didactic texts [Fig. 5].

The maps and totem boards with contrasting colours, useful for perception by the visually impaired, and showing a text with a legible font, the 'biancoenero' font (www.biancoeneroedizioni.it), to facilitate reading for dyslexics, complete the level of inclusive communication. The use of Cor-Ten steel for the bases of the maps and the supporting structures of the totem is based on the conviction that this material is very versatile in adapting to different contexts, whether ancient or contemporary [18]. The rust effect and the resulting colouration are easy to blend into the environment, especially if it is characterised by stone material, dilapidated walls, earthy contexts and vegetation. However, a decisive factor in choosing Cor-Ten is its very long resistance to weathering, a characteristic that helps to reduce maintenance costs once it has oxidised.

Figure 5. I-Access Project Outcomes: on the left, the totem project; on the right, an example of location in the city (close to church of San Giorgio dei Genovesi).

4. Conclusion (A.R.D. Accardi, R. Prescia)

Most cultural landmarks in Italy and internationally refer to the overcoming of cultural barriers, which takes place mainly indoors, probably because the introduction of the 'contemporary' is perceived as troublesome in direct comparison with buildings of historical-architectural value, mainly because of the 'not easy' proxemic relationship between 'new' and 'pre-existing'. The current need for a more democratic involvement in art cities dampens the traditional caution in interventions in Italian historical centres and welcomes architectural and restoration projects in favour of a more mature sense of responsibility in overcoming the so-called cognitive barriers that significantly affect the visit to cultural sites and the knowledge of the historical-architectural heritage itself. The intervention strategies implemented with the I-Access project are offered to the city of Palermo as the first organic solution to an issue that has not yet been addressed in its complexity and offer themselves as a pilot project for the entire historic city.

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Everyone Inside. Transformation of an Inaccessible Heterotopy. The Case of Buoncammino's Prison

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Abstract. The specific architectural typology of the prison, congenitally inaccessible to the urban morphological and cultural context in which it sets, as heterotopia carries in itself physical and cognitive barriers. The day after their abandonment, as happened for the former prison of Buoncammino in Cagliari, it's interesting to understand what new relationships should be put in place to make it accessible to all of the city users, in both material and immaterial terms.

Keywords. Inaccessible places, multiscalarity, multidisciplinarity, synaesthesia

1. Introduction

There is a subtle relationship between what each of us experiences in relation to our own corporeality, and what society feels in front of an architecture that opposes it without accepting it: "to feel as an insuperable limit or even as a prison our being confined here, in this body [...], our being something limited and unlimited at the same time, locked in the confines of our bodies, but also curious and anxious to go elsewhere" [1].

The investigation originates from this consideration and chooses to explore a specific architectural typology, the prison, which is congenitally inaccessible to the morphological and cultural urban context in which it is included, an other-place, suspended in time and space, in perpetual dispute with the reality outside it.

In order to understand which characters are specific to this category, it is particularly interesting to recall the Foucaultian concept of Heterotopia: "is a determined space that opposes and denies another defined space and inserts a substantial discontinuity in the *continuum* of the space. [...] Heterotopias are not places like any other, from which one enters and leaves, like from this room, this street or this city. They are places that neutralize and contradict all other spaces, because once we go into them, the difference is absolute" [2]. Prisons, in addition, belong to a peculiar typology of heterotopias defined as 'deviant', which includes all places organized by society on its margins, because they are dedicated to individuals whose behaviour is deviant from the norm [3].

The inaccessibility of prison architecture, therefore, is a result of the very nature of the institution, which segregates the society of the guilty, isolating it, clearly and without possibility of reconciliation, from the society of the good, as well as from the presence of physical, perceptive and cognitive barriers that exalt and explain the bi-directional incommunicability between the inside and the outside.

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To this purpose, we consider the project experimentation carried out on the former Buoncammino prison in Cagliari, result of departmental research which, with the help of the competences of different disciplines [4], has brought out the imperative to enhance, and therefore make accessible, the material and immaterial values of the building, listening to the needs that emerged from the continuous comparison with different categories of users [5]. In accordance with the enthusiasm promoted by the Faro Convention, which emphasises the necessary interdependence between cultural heritage and the community, as well as the role that the first one has in the "construction of a peaceful and democratic society" [6], the proposals have been completed with different points of view, further confirming the interest that this kind of architecture moves towards the society that has always been excluded from it.

2. Method

This work is structured according to an analytical-taxonomic approach with the aim of selecting and categorizing, starting from the study of the architectural elements of the typology in discussion, the composition and the heterogeneity of the barriers inherent in it, as well as the relationship that they establish with the users, the latter read in its infinite complexity.

The very meaning of "Barrier" should be understood in the broader sense of "Limit", including all those physical and symbolic elements that have an influence on individual freedoms, and the definition of the restrictions imposed by prison architecture is necessarily understood in terms of accessibility, especially when the use has changed as a result of decommissioning, which also determines a radical change in the community with which it relates.

It is with this aim that the barriers generally linked to prison structures, perceived and recognized differently by the prisoner population and by the city, are listed and discussed below (Figure 1).

Figure 1. Barrier's Taxonomy. Design of the author.

- **Morphological Barriers:** considering the relationship between prison and city on a territorial scale, it is clear that the construction of structures specifically designed for prison use between the nineteenth and twentieth centuries can be identified along the axes of expansion of the consolidated historical city center, in marginal and distant areas. In some cases, such as the Buoncammino prison, the new penitentiaries are housed in elevated and isolated positions, further increasing the invisible but tangible barrier between the city of punishment and the *Urbs*.
- **Typological barriers:** These are all those devices structuring prison architecture which clearly define the space, physically enclosing it. In fact, the prison is characterized by the presence of segregative elements found in the segmentation into bodies or blocks and, on a smaller scale, in the division of the same into cells. The cubicles represent the minimum dimension of confinement, almost to the point of being identified with the prisoner's own body. Even the open *intramuros* space is not freely usable but, on the opposite, is parcelled out by high walls that are inaccessible to the sight, deforming any kind of perception of the outside world and disorientating the prisoner with regard to his position. But certainly the most emblematic element which constitutes a typological barrier is represented by the fence, an absolute limit that, coherently with the concept of heterotopia, is able to manage the inside and the outside: "Heterotopias always have a system of opening and closing which isolates them from the surrounding space. In general, one does not enter a heterotopia at will" [7].
- **Architectural Barriers:** Under this category are identified all the physical and non-physical elements connected to the architectural scale. The movements inside the prison spaces are marked by the exceeding, always controlled and mediated by the guards, of gates that divide different areas, although they allow the intervisibility and transmission of sounds that bounce from one wing to another. Moreover, their metal structure, which is determined by utilitarian reasons, amplifies in a tactile way the perception of a glacial and rigorous atmosphere. If the gates prevent autonomous access to specific spaces, the *blindo* constitutes the individual limit for each prisoner. Completely matt except in correspondence to the spyhole, which allows one to be seen and never to see, the serious door of each cell opens only at fixed times of the day and never at the wish of the prisoner. Inside the cell, when the closure of the *blindo* does not allow anything except introspection, the only element that facilitates a relationship with the outside is the window, generally placed at the top and always partitioned by the presence of a grate. Although considered inhumane and demolished in many penitentiary structures, the "*bocche di lupo*" openings are still visible, characteristic ventilation devices that only allow the view of a blade of blue sky, directing and forcing the eyes upwards. The tiny dimensions of all the cell's constitutive elements can also be seen inside the detention blocks, where corridors, galleries and stairs oblige each prisoner to pass individually and it is almost impossible to change direction.
- **Institutional Barriers:** The fourth type of barrier is closely linked to the as an institution in which prisoners are deprived of their liberty to serve a sentence. As an exclusive and excluding structure, access is allowed only to prisoners and surveillance staff. Overturning the logic and relational dynamics of the city, the wall limits the freedom of those who are not guilty and, at the same time, establishes a new system of rules to which everyone (inside and outside) is forced to respect. Life inside the prison is marked by different rhythms that preclude a synchronic

perception of time in comparison to the other side of the wall, a concept perfectly explained by Foucault himself with the term "heterochrony" [8].

- **Symbolic-psychological barriers:** Finally, there is a category of barriers that dialogues with our interiority and sensitivity. It is that inner perception of limit that leads us to keep a certain distance from these places because of their segregative nature. We are scared even though we have not had any direct experience of it because we have developed an image of prison based on the narratives and representations offered to us by some cultural media. This feeling of fear, however, leads to a fascination with inaccessible and unknowable things. There are also some physical devices placed on the border between the inside and the outside, such as barbed wire, patrol paths and sentry boxes, which contribute to the distressing perception of authority and affirm the asymmetrical relationship between prisoner and guard. The most common and consequential reaction is to isolate and ignore the presence of the prison, as if it were hidden by a veil that makes it transparent.
  "In the case of prison, however, it must be pointed out that this invisibility corresponds to a specific demand of public opinion which "perceives prison - understood as a building deputed to guard criminals - as an isolated place to be isolated from the social fabric" [9].
  Moreover, this specific type of barrier sometimes generates a devaluation of the immediate surrounding context, which is degraded and not very experienced, far from urban dynamics.

At the end of the survey and taxonomic analysis of the types of barrier related to prison architecture, the discussion leads us to ask ourselves if, when the function ends, these characteristics persist or change in intensity and on which ones it is necessary to work on.

2.1. From the Barriers to the Frontiers

After the historical prison establishments were closed down as a result of the 2010 Piano Carceri [10], the Buoncammino prison in the Sardinian regional context, losts its institutional role, suddenly showing all its fragility, which had always been hidden behind the austerity and seriousness of its segregative nature.

The research, carried out on the former penitentiary in Cagliari, has tried to rethink the different barriers related to prison architecture with the aim of making them living matter for the project, elements from which to set the strategies of valorization and cultural accessibility of the heritage. Before any design activity, it is necessary to ask how it is possible to work on barriers to make accessible a place born not to be accessible. The most immediate answer to this question would be the strong decision to break them down, physically and symbolically where possible, but risking the loss of the memory and values embodied in the inaccessible nature of the building.

A first interesting observation can be taken from Augè's distinction between the terms *barrier and frontier*: "A frontier is not a wall that forbids access, but a frontier that invites access. [...] it is only thanks to the idea that it can be crossed in both directions that the frontier does not irrevocably cancel the relationship between one and the other" [11].

Therefore, the project of these architectures can operate on the barriers with the aim of transforming them into frontiers, capable of granting and facilitating access, while continuing to make intelligible the identity memory of heterotopia.

"Our own ideal should not be the world without borders, therefore, but a world in which all borders are recognized, respected and crossable [...]" [12].

2.2. The project as a method: the case of the former Buoncammino prison in Cagliari

With the support of the analyses and discussions expressed until now, we have consequently evaluated the method through the project of the Buoncammino prison, a majestic penitentiary complex decommissioned in 2012 and still waiting to discover its new role in society and in the urban context of Cagliari. (Figure 3).

Abstractly isolating the different types of barrier that can be related to the case, we will try to understand the ways in which we can transform them, aware, however, that there is such an interconnection that the project for one of them is able to generate resonances on the others. In fact, it is clear that when the institutional barrier collapses, the exclusive relationship and the laws that have governed the interaction between inside and outside inevitably change forever. Built at the end of the nineteenth century on the San Lorenzo hill, in an elevated position, far from the historic center, it is now part of the urban texture while maintaining, thanks to its topography, its character of isolation and emergency. The large empty factory now offers an important opportunity for defining and implementing the currently latent relationships between the different polarities in the north-western area of Cagliari, so it is necessary to take a transcalar approach to the project, working on the urban accessibility of the site and, only later, on the interior accessibility.

It was considered efficient to use an opposite strategy to the one adopted for the prison: to the question formulated by the emergency, we responded with the definition of an implosive architecture, which quietly dialogues with the building through underground routes. In this way, the unicity of Buoncammino in the skyline is preserved while establishing numerous physical and visual relationships with its surroundings and maintaining its role as a landmark. In line with this, have been designed new architectures which, like telescopes, are projected from the heart of the hill towards the landscape: the conference room to the west and the reading room to the north. Concealed from a superficial view from above, they conceal underground spaces that find an escape route through their large glass mouths. Gradually and slowly accessible by the presence of ramps, the new rooms pursue a synaesthetic approach, thanks to the composition of the forms, the materials that differently react to light, and the relationship with the natural element, which is included in the design process in a multi-sensorial way. The continuous change of levels, determined by the orography of the site, permits evocative solutions which refer to the different meanings that darkness and light take on in the prison context, playing with visual and acoustic perception and the ever-changing emotivity of the users. (Figure 2).

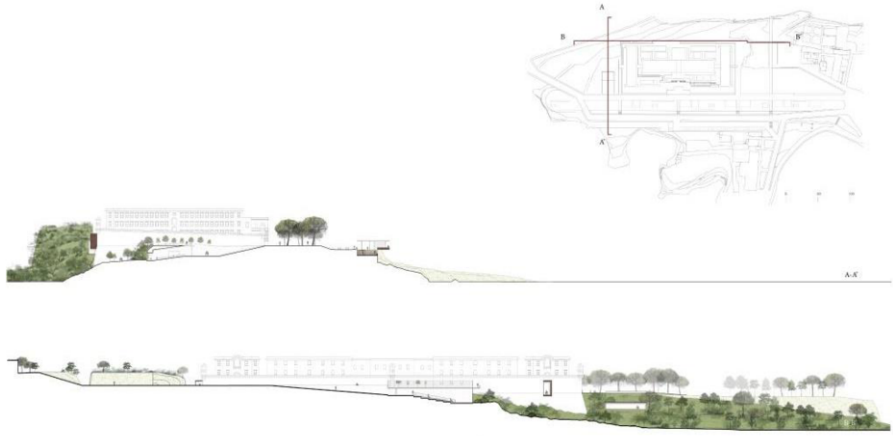

Figure 2. Territorial sections. Project of Buoncammino Prison. Design of the author.

To the west, the prison opens onto Viale Buoncammino, a historic tree-lined boulevard which, until the middle of the 19th century, connected the historic center to the agricultural lands. Designed with the ambition of providing a *locus amoenus* for the inhabitants of Cagliari, it soon came under the influence of the symbolic-psychological barrier of the nearby penitentiary, and is now in a serious state of degradation. The presence of a disconnected pavement, where the emergence of large tree roots alternates with dangerous cracks and gaps, the absence of services and total disaffection make it an inaccessible and inhospitable place. The problems described and the investigations carried out with the participation of physically and sensory disabled users have made it possible to formulate a strategy to revitalize the long ribbon of vegetation, fortifying its historical character by planting new compatible tree species, selected thanks to the expertise of botanists, capable of restoring the linearity of the avenue by orienting and facilitating the walk. New mineral paving is also planned, where large flowerbeds are cut out to contain the root system of the trees, whose design changes at intersections with orthogonal paths or in correspondence with the access to the prison. Along its extension there are also punctual elements, the *folies*, small pavilions hosting services for refreshments, which dialogue with the quadrangular platforms, characterized by different uses such as seating, green areas and play grounds, to respond to the needs of the extended users. Linear *portico* and systems define shaded walking areas which, together with the plant element, cooperate in the creation of a contemporary *promenade* that ends with the historic *rondò*. From this point, it is possible to access through two parallel ramps a renovated space, voted to the sports function. The paved area is characterized by a gentle and continuous slope and hosts a "life path" that finds in the initial pavilion the necessary services for the public. The regeneration of the system also included the infrastructure that currently surrounds the avenue with its lanes, forming a break in the system of relations with the building. Thanks to the skills of specific disciplines, it was decided to expand the avenue as far as the boundary wall, making the entire area accessible to pedestrians, cyclists and, in a differently signalized lane, public transport and emergency vehicles. On the eastern side, a path parallel to the wall crosses and cuts through the rocky bank, reconnecting this area to the historic route down to the public gardens. The reduced size of the path, amplified by the height of the rock surface, invites

and encourages silence and slow walking, increasing the perception of smell and touch, instead of the sense of sight: "The eye is the organ of distance and separation, while touch is the sense of closeness, intimacy and affection. The eye investigates, controls and surveys, while touch approaches and caresses" [13].

At the confluence of the two paths, there is a square for resting, enhanced by a view of the landscape, from which a suspended walkway originates. At the end of it, a lift carries to the level of Viale San Vincenzo, making it easy for everyone to access and climb up, and transforming it into a further emotional experience. After that we worked on the transformation of the typological barriers starting from the border element of the boundary wall. With the aim of modifying the circulation system of the whole prison complex, today accessible only from the avenue and walkable in a circular way, a longitudinal crossing was defined, able to connect, through the perimeter wall and the inner buildings, the external spaces to the east and west. This new direction, together with the transversal one, the symmetry axis of Buoncammino, generates partial interruptions of the perimeter wall. As previously mentioned, it is particularly delicate to work on this element because, after the prison was decommissioned, it became a barrier to new uses, as well as a symbol of inaccessibility, but, if we look at it in terms of a frontier, its punctual demolition makes it possible to understand the heterotopic memory of the prison while still permitting its total usability.

A further movement to the outside can be seen in the internal courtyards, which are now free of the partitions that used to enclose them, to acquire space and extend beyond the boundary wall. The western detention block, unlike the other buildings that make up the complex, has a basement level, currently accessible from the inside, which is made accessible thanks to the connection with the underground square and the demolition of the high internal wall, delimiting the walking courtyards. The levels are therefore reformulated and a system of ramps leads to the ground floor, previously reached only from a monumental staircase. This gives to the basement the possibility of hosting public functions, as well as looking directly onto the courtyard, an element of freedom able to condense in itself a new vitality and inclusion. Symmetrically, other ramps lead to a designed space in which the walls of the walking courtyards delimit a contemporary box, the new cafeteria. In spite of the many transformations described above, a certain introversion persists, while creating large, light-filled collective spaces in which the view can flow freely and the voices of the people can cross the boundary of the wall, animating the former prison with life.

Entering the prison blocks, the rhythmic, serial system of cells maintains its typological configuration but is adapted to new uses through the partial demolition of the walls, permitting expansion and the addition of groups of cells. The construction of accessible platforms with sloping planes makes it possible for each cell to reach the level of the interior windows, which are typically high, and to see what is happening outside. The partial removal of the grates amplifies the feeling of re-conquered freedom, but their preservation in the north wing, chosen as the most suitable for enhancing the prison's memory thanks to the presence of the "*bocche di lupo*", allows visitors to have an immersive and authentic experience of the institution's history. The installation of lifts in carefully selected points inside the buildings completes the project, making the architectural complex almost totally accessible and granting autonomy to everyone. Probably the most interesting and symbolic change in perception takes place along the walls, on the guard route: it is possible to enjoy one of the best views of the city, replicating the same path that was followed by the guards for 150 years. The *garitta*, the corner element of the wall, is declined and reinterpreted by the project through different

forms at certain nodal points, generating views of the landscape and defining visual connections with Cagliari's most important landmarks. These same elements establish a network of links in since they can observe each other. Their position and size also have an influence on the perception of the back side of the Buoncammino prison, which is rarely and hardly caught by the quick gazes of people. On the other hand, it is believed that the "back" is interesting because of the presence of the massive scarp wall, a material element of great importance capable of expressing the roots to the ground and the inexpugnable nature of the entire architectural complex.

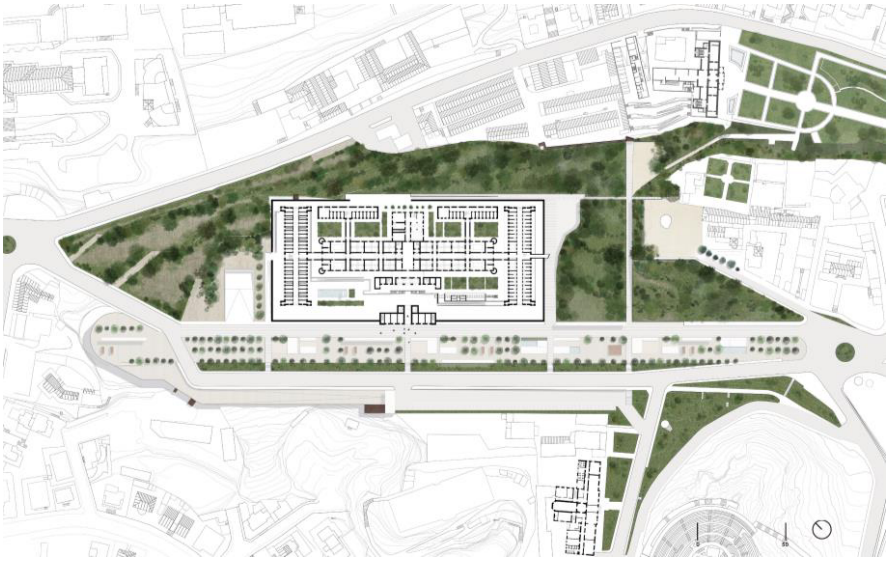

Figure 3. Masterplan. Project of Buoncammino Prison. Design of the author.

3. Results

As experienced with the Buoncammino, there are many forms of inaccessibility in the prison, which a broader approach can reveal and help to overcome, or even emphasize. In this way, the project can work on barriers by taking advantage of the necessary contribution of other perspectives from multidisciplinary dialogue. This experiment also shows that intervening on a pre-existing structure to make it accessible from a physical, perceptive and cognitive point of view does not necessarily mean making strong modifications, but rather understanding how far it is possible to move while maintaining the necessary balance between conservation and use. With this in mind, the design proposal seeks to define solutions of continuity within a fragmented system through punctual and minimally invasive interventions. It also brings out the relativity of barriers, dependent on the relationship between man and place [14] in their changing and dynamic interdependence, which is even more evident in architectures that are congenitally inaccessible, such as the heterotopias of deviation, now abandoned.

4. Conclusions

The study applied to the prison typology shows the complexity of the topic and offers a possible method, certainly improvable and implementable, potentially applicable to many other contexts. It has also shown how extremely necessary and useful it is to involve a wide variety of users in all phases of the design process, which is already necessary for the identification of the different types of barriers related to the architecture and its contexts. The experimentation on the Buoncammino is also revealing of how important it is to consciously select the new uses for the places, since a choice that does not respect the values or is distant from the identity and inner characteristics will result in violent modifications to adapt them to the new needs. Contrary to the conviction that intends accessibility as secondary, additional and disconnected from the issues that govern the project, it is believed that it is capable of directing, suggesting and stimulating an intervention of quality, careful and sensitive "that takes into account the delicate psychological implications of what is proposed" [15].

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[5] We refer in particular to the visit made to the former Buoncammino prison on the occasion of the "FAI Autumn Days", 16-17 October 2021, which was attended by a large number of associations of disabled people. This initial exchange of ideas was followed by others which fed the project to reuse and redevelop the area around the prison with further tools.
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Section 4

Urban Scale, Mobility and Service Planning in a Universal Design Perspective

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Transforming our World through Universal Design for Human Development
I. Garofolo et al. (Eds.)

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Policies and Processes for Accessibility from a UD Perspective: The Integrated Approach Supported by the Friuli Venezia Giulia Region (IT)

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Abstract. With Regional Law no. 10 of 19 March 2018 (General principles and implementing provisions on accessibility), the Autonomous Region of Friuli Venezia Giulia has set itself the objective of improving urban accessibility throughout the regional territory, in order to guarantee equal conditions for everyone to enjoy open spaces and the built environment. The improvement of accessibility is conceived as a long-term objective, to be implemented in stages, according to an incremental development project model. Still today, when work is carried out to eliminate architectural barriers, designers adopt an approach that looks at the "barrier/disability" binomial, identifying "dedicated" solutions and tackling the problem of accessibility in relation to specific targets of users whose ability to access and use spaces and environments is assessed in relation to the capability of a person generically defined as "normally able". In contrast, in a barrier-free approach, designers are called upon to adopt a broader perspective, to look at the variety of people who make up a real community (extended user base), and to consider different physical conditions, ages, abilities and capacities (motor, sensory and cognitive), from the early stages of the project. In order to promote change and to impart this change of approach, the Autonomous Region of Friuli Venezia Giulia has envisaged integrated actions, aimed, as a whole, at accompanying the process that guides the project culture towards a progressive adherence to the methodological criteria of Universal Design, introducing, at the same time, support measures aimed at financing the Municipalities of the Region both for the preparation of barrier elimination plans (PEBAs) and the implementation of the interventions identified in those plans. Among the envisaged actions, the most important is a general accessibility mapping, which includes the adoption of a terminology system (accessibility ontology) integrated in a specific computer application, through which the municipalities will be able to detect architectural barriers, in a homogeneous way, over the entire regional territory.

Keywords: Accessibility, Governance, Inclusive design tools

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1. Introduction

Improving the accessibility of our cities and towns is not just a matter of enforcing regulations, but above all a social achievement: the tangible exercise of those citizenship rights that fulfil the constitutional principles of equality, shared dignity, and inclusion, so often proclaimed on paper, and ignored in practice. Regulatory frameworks are important but, by themselves, not sufficient to obtain widespread positive results; as is often the case (see the Italian example of the Plans for the Elimination of Architectural Barriers), the obligation does not lead to the desired change. Each law must be supported, promoting an effective change in the dominant culture through coherent actions, directed, as a whole, to the achievement of a single, far-reaching objective represented, in this case, by a new culture of planning.

2. Shared governance

The implementation of Regional Law R.L. 10/2018 is based on a programme of well-defined actions and the deployment of significant resources to support them, but it also passes through structured relationships and a constant exchange of shared information between all those involved. For this reason, the Region has decided, from the beginning, to lead the governance of accessibility, employing the expertise and professionalism of subjects able to support every aspect of the planned programme, such as: the Regional Information Centre on Architectural Barriers and Accessibility, the University of Trieste, and the University of Udine. These entities represent a virtuous example of inter-institutional collaboration, providing an interdisciplinary approach, which in itself expresses added value, also thanks to the fact that they belong to networks of reference, in their respective disciplines, at the regional, national, and international levels.

3. The "central regional accessibility reference centre" function

The Region has, among other things, established a central regional reference centre for accessibility with Regional Law 10/18 (art. 5), entrusting its management to the Regional Council of Associations of People with Disabilities and their Families in Friuli Venezia Giulia. The Council fulfils this function through its own specialised office named *Centro Regionale d'Informazione su Barriere architettoniche e Accessibilità* (CRIBA FVG). It provides free advice on architectural barriers and accessibility to all subjects, both public and private, who request it. For many years CRIBA has been a regional the main source of information on the subject. By assigning to the Council the function of a central regional reference centre for accessibility (Regional Law 10/18 art. 5), the Region has therefore guaranteed itself a unique capital of professional skills and experience. The subjects that benefit directly or indirectly from the activities of the office are many: in the last five years alone, the CRIBA has carried out an average - on average by default - of 526 consultations per year. In the current year, the CRIBA has become the main subject upon which the general accessibility mapping project of the Region is based, as well as the core of its action in the field of accessibility *governance.*

4. The Region's measures

Regional Law 10/2018 (General principles and implementing provisions for accessibility[2]), issued by the Autonomous Region of Friuli Venezia Giulia promotes the adoption of Universal Design, as a quality standard for building and urban development design: the basis of this methodology is the assumption of a perspective that focuses on the requirements of use for a wider range of people, starting from the initial stages of the project. Improving accessibility to guarantee equal conditions for the widest number of citizens to fully enjoy the urban environment where they live is a question of civility and responsibility, over and above the quality of the project. In a field in which "dedicated" solutions have always been designed, looking at the reductive and limiting binomial barrier/disability, action must be taken on several fronts to achieve the desired change in the planning culture. The macro-objective of improving the accessibility of open space and the built environment throughout the Region is necessarily a long-term objective, to be pursued in successive phases, according to a project model of incremental development. To achieve such a complex objective, the Region has identified several complementary and integrated measures. The heart of the law is the general accessibility mapping project, which also includes the preparation phase of the Plans for the Elimination of Architectural Barriers (*Piani di Eliminazione delle Barriere Architettoniche* - PEBA).

4.1. The general accessibility mapping project

Article 6 of Regional Law 10/18 states: "*The general mapping project is a long-term macro-objective which accompanies the process of improving accessibility throughout the Region; in order to implement it, the Region has adopted an in-progress orientation, according to an incremental development project model...*". The general accessibility mapping project - the only one of its kind in Italy - represents the Region's most important initiative in the field of accessibility. Through the construction and adoption of a unified ontology of accessibility - the subject of a research project involving the Universities of Trieste and Udine - and by providing the municipalities with a specifically developed application, the aim is to achieve the adoption of a standardised practice for the detection of architectural barriers and critical issues[3] throughout the Region. The collected data will be made available to a central regional accessibility database, which will be made available to all interested stakeholders. The availability of quality data is a key factor in any decision-making process, as it enables meaningful analysis that is likely to lead to better choices. The single accessibility database will be a real Regional asset available to the Region, the municipalities, and any other interested party, which will be appropriately authorised (e.g., construction, tourism, cultural enterprises). The availability of data will also allow an ex-post analysis of public sector policies and related services. It will also constitute the basis for the construction of an accessibility

[2] www.Regione.fvg.it >la Regione >LEGGI, BUR, DELIBERE, DECRETI >Leggi regionali https://lexview-int.regione.fvg.it/FontiNormative/xml/index.aspx

[3] Critical issues include not only the presence of architectural barriers, as defined by Italian Ministerial Decree 236/89, but also the incorrect implementation of structures, the spatial discontinuity of projects, the absence of usable paths and route connections and, in general, the absence of solutions aimed at making the environment usable for everyone autonomously and safely according to the criteria of Universal Design.

classification system aimed, in the long term, at the creation of an application that will allow citizens/users/tourists to query the system from their smartphones, through the geo-referencing of points of interest and to obtain synthetic information on accessible routes to reach them mentioned.

4.1.1. The application for detecting critical issues and overcoming the concept of architectural barriers

Through the use of an application developed for this purpose[4], the operators (municipal technicians and professionals) will be able to perform a survey following the specific methodology integrated into the system. The survey activity will also allow queries to be made and data to be exported to external GIS[5] systems, thus supplying a single regional database on accessibility-related issues. In addition, a function will be developed to allow the insertion, recall, and management of a list of "standard solutions" to accessibility problems, orienting technicians and professionals towards solutions that meet the criteria of Universal Design - without, however, binding them to preconceived solutions - and to determine the relative hypothetical cost.

To date, the application has reached an advanced stage of development. As far as the functionalities pertaining to the survey are concerned, the internal test (executed by the parties involved in the governance of accessibility) has already been completed, and it is about to be tested on the territory of the municipalities that have offered their collaboration (seven pilot municipalities). The testing of the application will be implemented between May and July 2022 in order to proceed with its subsequent release to all regional municipalities as of January 2023.

4.1.2. The ontology of accessibility

The decision to have an "ontology of accessibility" stemmed from the observation that the language used to identify the objects of our particular domain of knowledge was not uniform. In the field of spatial information, in the sphere of urban heritage, these objects belong to different disciplines and fields of application, which implies that conceptually identical objects may be defined in different ways, or that classes of objects may include some and exclude others, depending on the field under consideration. National normative texts, international standards, and research documents on accessibility also present an important variety in the technical vocabulary used to describe components, elements, and attributes of the built environment. Hence the necessity, before proceeding with the development of the application, to acquire a specific ontology, suited to our purposes, in order to conceptually identify, define and describe the classes of objects, the objects, their connections, and requirements in an unambiguous manner, without doubts, with the aim of providing the various parties involved with an unequivocal understanding of the meanings of the reference domain, overcoming the differences in terminology that pertain to the various disciplines involved in the transversal subject of accessibility.

The ontological tree integrated into the application is the result of a research project conducted by the University of Trieste and the University of Udine, with the collaboration of the Region and CRIBA. To create a suitable system to manage the complexity of the different situations, a thorough examination of the existing legislation

[4] The development of the application was entrusted to Insiel SpA, an Inhouse company of the Region.

[5] Geographic Information System.

on accessibility (mainly Italian Ministerial Decree 236/89 and Italian Presidential Decree 503/96) was conducted, identifying the different urban contexts and their subdivisions, analysing, in parallel, the terms most used in the different sector frameworks, including: architecture, construction, urban planning, and environment. Where the term belonged specifically to the field of accessibility, it was preferred over others; whereas, on the other hand, depending on the sector, it was possible to find more than one definition for the same object, the most appropriate and functional one for our specific needs was chosen.

4.1.3. The Elimination of Architectural Barriers Plans (Piani di Eliminazione delle Barriere Architettoniche - PEBA) as a stage of mapping

PEBAs were introduced into Italian law in 1986, with regard to existing public buildings (not yet adapted to the requirements of Presidential Decree 384/1978, now repealed). Subsequently, in 1992, their scope was extended to urban areas. Even though the national law introduced an obligation and provided for a sanctioning measure (the appointment of a commissioner appointed by the Regions in the event of non-compliance), this obligation has been largely disregarded for decades, as has the sanctioning procedure (there have been very few cases of commissioners being appointed). It is also for this reason that the Region of Friuli Venezia Giulia, from the outset, has made a precise choice of field, deciding to support and not sanction non-compliant municipalities. At the same time, through the provision of appropriate tools and measures, it has contributed to the relaunch of PEBAs (integrating national law without overlapping it), but, in line with a broader vision of accessibility, it has brought these tools within the broader scope of the mapping project. Accordingly, the preparation of Plans for the Elimination of Architectural Barriers becomes a phase of the project (art. 2, paragraph 1, letter k) ter) Regional Law 10/18). This was taken into account in the development of the application (point 4.1.1), which, in fact, allows the execution of the survey phases in accordance with the method outlined in the Guidelines (4.2.1) and allows obtaining reports that are part of the documentation of which a PEBA is composed.

4.2. Tools of support and assistance

In order to influence and modify the planning culture and promote change, it is essential to modify the environment in which we work, make it accessible, to prepare it to receive the seeds of the change we wish to promote. This is a cultural challenge, even more than a project-based one, which can be achieved in successive steps and with the aid of suitable tools. In this sense, on June 30, 2020, the Region adopted the Methodological Guidelines for the preparation of PEBAs[6], which have been widely distributed to all the municipalities in the Region, and launched two funding streams: the first to support the costs for the preparation of PEBAs, the second for the design and implementation of the projects identified in the PEBAs themselves.

[6] www.regione.fvg.it >aree tematiche > lavori pubblici, edilizia > edilizia > contributi ai Comuni per la predisposizione dei PEBA > Piani di Eliminazione delle Barriere Architettoniche

4.2.1. Methodological guidelines for the preparation of PEBAs

Since 1986, the national legislator has introduced the obligation for the relevant authorities "to adopt a PEBA", but at the same time has never provided instructions for its drafting. Based on this observation, it was understood that this absence of instructions could be the real reason for non-compliance. A law, even the best one, will not have the desired impact if the cultural environment in which it is intended to have an effect is unprepared for it. From this standpoint, the forecasting of an instrument such as a PEBA was destined to remain unfulfilled in the absence of training, and therefore specific preparation of technicians and professionals on accessibility issues. The Region has, therefore, taken steps to adopt and provide municipalities with methodological guidelines to accompany the process of preparation of PEBAs. The Guidelines - the result of the work of the entire working group involved in governance - are structured in such a way as to identify a set of activities grouped by the consistency of content and timing. These activities, taken as a whole, indicate a general and quality pathway which, however, each municipality is called upon to apply in relation to the specificities of its territorial context: in this sense, the Guidelines offer effective support to the municipality in planning interventions conceived "tailor-made" to the contexts and their actual and specific requirements. The aim is also to prevent municipalities from adopting measures for the elimination of architectural barriers that do not involve participation, planning, and coordination. The precise methodology set out in the Guidelines represents a sort of "toolbox" for internal and external planners, useful for developing the PEBA as a strategic plan to coordinate and systemise the various interventions foreseen in the territory, strengthening the municipality's action also in collaboration with other external parties participating in the project.

4.2.2. Funding

In order to relaunch PEBAs and encourage the process that has been initiated, in addition to the essential operational tool represented by the methodological guidelines, the Region has also introduced two funding measures: contributions for the preparation of PEBAs (art. 8 bis), and funding for the design and implementation of projects to overcome and remove architectural barriers (art. 8). The first is a contribution to partially cover the costs incurred for the preparation of a PEBA, such as the fee due to the third parties (professionals, professional firms, etc.) for the partial or total execution of the activity (study, technical, etc.) related to the preparation of a PEBA, the costs incurred and documented to carry out initiatives/events related to the phase of participation of citizens and stakeholders. The contribution is proportional to the number of inhabitants of the municipality and cannot exceed fifty per cent of the total expense. The second type of funding relates to the co-participation in the expenses incurred for interventions that must have been identified in the PEBA, the adoption of which, therefore, also, in this case, becomes an essential condition for access to the grant.

4.3. Promotion and dissemination of the Universal Design methodology

The Region promotes and supports initiatives to raise awareness and training on accessibility issues, also with the collaboration of other entities. In particular, it is considered that training for professionals and municipal technicians is of paramount importance to implement a real change, towards a gradual adoption of the methodological criteria of Universal Design, so that they become, to all intents and

purposes, an integral part of the skills of the planner and, in general, of all "insiders". Contextually to the release of the application, foreseen for January 2023, a cycle of training initiatives will be launched, aimed at both municipal technicians and professionals (surveyors, architects, engineers, and others), as well as a series of start-up days for the use of the new application.

4.3.1. The FVG Accessibile Portal

The *FVG Accessibile* portal (currently under construction), will host all the information related to the world of accessibility, acting as a "showcase" of the territory on the subject. A space will be dedicated to the municipalities that can directly contribute to it, in order to inform citizens of their achievements in the area of accessibility (contributions requested, interventions implemented, spaces and buildings rendered accessible, etc.)

5. Building an Accessibility Network

The general accessibility mapping project is directed at all subjects, both public and private, however, from the outset, the focus has been on the municipalities of the Region chosen in the Regional Law as privileged stakeholders for developing and consolidating the general accessibility mapping project. Until recently, despite the obligation imposed by national legislation (an imposition that was introduced in 1986 and concerns all public administrations), the municipalities that had a PEBA in Friuli Venezia Giulia were less than twenty, out of a total of two hundred and fifteen. Since the adoption of the Guidelines and the introduction of the support measure for the preparation of the PEBA (2020), to date, more than eighty Municipalities have applied for a contribution; more than one-third of the Municipalities in the Region, therefore, have already adopted or are in the process of developing a PEBA, demonstrating, from the outset, great interest in the Region's proposals and the measures that have been introduced. With the collaboration of the municipalities, the Region has therefore laid the foundations for the growth and consolidation of knowledge and skills inspired by the criteria of Universal Design, in a virtuous circle, inaugurating a new season, a paradigm shift in building and urban design and, consequently, in the approach towards inclusion. No longer an inclusion that considers the needs of some as the object of services confined to specific spaces and dedicated services, but as the concrete implementation of the principle of equality and equal dignity that is also achieved through the transformation of the urban space, into a place enjoyed by all: a site designed with a view to a 'real' community of people, each with varying capacities and abilities, to allow everyone to use the environment safely and autonomously they live in.

6. Future development

Once field testing, verification, and validation of the application's dedicated survey functionalities have been completed, the development of additional functionalities will be implemented, in particular, the one related to the "Solution Library": the surveyor/planner, by querying the system through the new functionality provided on the application, will be able to obtain suggestions, i.e., design schemes and examples of interventions (*best practices*) aimed at providing the most suitable solution for any

architectural barriers and criticalities that have been detected, without, however, becoming restricted to the proposed solutions. Based on a new agreement with Universities - which is being defined - further research will be conducted to examine and extrapolate the best solution proposals that have already been adopted in contexts similar to those analysed, to meet the space and environment utilisation requirements of the most fragile users [7], with the awareness that where a solution satisfies the needs of the weakest beneficiary it also fulfils the requirements for autonomous usability of the majority of people. The release of the application to municipalities, including all the integrated features, is scheduled for January 2023.

Thanks to the aforementioned agreement, an Observatory will also be established to analyse and monitor the quality of Architectural Barrier Removal Plans. The research and study activity includes a thorough benchmarking analysis of PEBAs that have been adopted and are in the process of implementation, leading to the construction of a structured method of verifying their compliance with the recommendations contained in the Region's Guidelines, in adherence to the principles of Universal Design: the activity is directed to highlight and identify the qualifying aspects and elements considered essential for a quality PEBA, according to the interventions for the elimination of architectural barriers/criticalities identified in them. Furthermore, a link to the regional price list is also provided with cost items related to individual activities/work, as well as "packages" of activities/work (regarding works for which it is more economical to solve more critical issues with a single overall intervention).

Also planned for the end of the year is the activation of the FVG ACCESSIBILE portal (under construction), which will host all information related to the world of accessibility, acting as a "showcase" of the regional territory on the subject. A space dedicated to municipalities is planned, allowing them to provide their own pages to inform citizens of what has been achieved on their territory in terms of accessibility (such as requested funding, interventions in progress, building routes rendered accessible…)
By the end of 2024, an additional research activity focusing on the conceptual development of an accessibility classification system, diversified according to the user requirements of the weakest individuals, is planned (please refer to footnote 6). The system is expected to provide a conceptual framework conducive to the subsequent development of an application aimed at providing the end user - who will be able to query the application system via georeferencing - with concise information on the level of accessibility of public places of interest in the form of simplified graphical and/or textual displays.

In the 2022-2024 three-year period, extensive emphasis will also be placed on informative and educational activities concerning the methodological principles of Universal Design through the organization of initiatives and events aimed, in particular, at municipal technicians and professionals to support the complete development of the project and the actions undertaken by the Region.

[7] UN Convention on the Rights of Persons with Disabilities, Article 1 comma 2.

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Beyond the Norm, the PEBA to Live in Udine

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Abstract. The virtuous objectives of the United Nations 2030 Agenda look to inclusion and accessibility as matrices for an autonomous and independent life through the regeneration of urban agglomerations. The paper presents the case of the city of Udine which tried to take the opportunity of the PEBA and the consequent programming, to start a process of reviewing the contents, procedures, and interactions between the various administrative offices in a more general framework for the management of goods, spaces, and services. Following the agreement between the University and the Municipality of Udine, the dalt Laboratory has oriented its studies towards research aimed at a structural intervention solution at the beginning of the experimentation on the urban routes of Udine. At the same time, the SWOT survey on the national offices in charge of accessibility and environmental well-being has given rise to research aimed at identifying how many and which offices are dedicated to inclusion as personal services and those committed to environmental accessibility to understand the connection between the bodies supervised by the responsible technical managers. Crossing the norm of accessibility, the paper aims to highlight how the Udine experimentation can shift attention to the expansion of the degree of usability of a place and service by focusing on the promotion of an additive and adaptive process that does not look at the simple removal of barriers but also to a guaranteed awareness of a sharing culture for fair, healthy and safe use of collective goods[2].

Keywords. Accessibility, Social Inclusion, SWOT Survey, Awareness, Regenerative mapping

1. Introduction

The virtuous goal of the UN 2030 Agenda looks to inclusion and accessibility as matrices for an autonomous and independent life through the regeneration and transformation of

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[2] This contribution reports some of the results of a research conducted under the responsibility of Christina Conti as part of a broader scientific program and in response to a research agreement between the University of Udine and the Municipality of Udine and an agreement between the FVG Region, the University of Trieste and the University of Udine. The recognition of the single contribution of the authors and the authoritativeness of the texts is attributable to the different roles covered and in particular: Christina Conti of the addresses and the summary of the results, defined the structure of the contents of this contribution supervising the overall drafting with attention to the part 'Introduction' and 'conclusions' and is co-author with Silvia Cioci and Teresa Sambrotta of the paragraph 'Results'. Silvia Cioci, postdoctoral research fellow for the program with the Municipality of Udine, has defined the contents, the general references as well as having carried out the editorial review of the contribution. The commitment of Teresa Sambrotta, research fellow for the program with the FVG region, is attributable to the results related to the actions between the development of the program with the Municipality and the planning of the FVG Region.

urban agglomerations. The policy document that determines the commitments to sustainable development identifies with objective 11 the set of actions aimed at making human settlements inclusive, safe, resilient, and sustainable, also through integrated and participatory planning.

The current demographic dynamics related to the lengthening of life and the rise in the aging population index, together with the desire to intervene in order not to exclude or leave anyone behind, involve more and more attention towards planning aimed at designing accessibility. In line with the scientific debate [1 – 3], the design of inclusion and accessibility should not be considered as a mere regulatory concept, but as an analytical and planning category. Therefore, to improve the degree of accessibility of a place or a service, today it is essential both the deepen the national legislation on the removal of architectural barriers and the promotion of processes aimed at raising awareness of governance and stakeholders in the project experimentation centered on the person and in the recognition of the intrinsic value of social inclusion.

With the legislative provisions n.41/1986, of the law n.13/1989, and subsequent DM 236/1989 there has been a commitment on the part of the administrations to achieve a higher degree of understanding and preparation of objectives intended for the yield accessible and, therefore, inclusive of urbanized contexts. From here, with the L.R. 10/2018, Friuli Venezia Giulia - FVG, wanted to integrate the national legislation and relaunched the Plans for the Elimination of PEBA Architectural Barriers, introduced with Law 41/1986, updating them with respect to the principles of universal design for higher building quality. This entailed an integrated review process also with instrumental interventions, including the PEBA FVG Guidelines for the preparation and implementation of the PEBAs, to support the implementation of the regional monitoring and financing process as well as the implementation by public and private institutions. for public or private spaces and buildings open to the public. The PEBA FVG guidelines published by the FVG region in 2020 are the result of a targeted collaboration of the same Region with the CRIBA single regional reference center, the University of Udine and the University of Trieste are the result of the will to structure an integrated process through complete and dedicated documentation aimed at addressing the issue of accessibility because of a universal design centered on the person.

This is a reminder that wants to activate dynamic paths that take into consideration: (i) the needs of citizens concerning the use of everyday places; (ii) the measures to perceive public and private places open to the public as qualitatively safe, inclusive, and accessible areas; (iii) the fairness, flexibility, simplicity, perceptibility, and error tolerance of public and private places open to the public comparison to the need of citizens [4,5]. What the FVG Guidelines tend to report, stems from the desire to rethink the project to meet the needs of people of all ages and abilities to the maximum extent possible without the need for adaptation or specialized design typical of Universal design. [6]. A captivating term as an abbreviation to describe the design for all, Universal design becomes for the research in question, an emblematic symbol to signal a milestone in the technical planning dedicated to environmental accessibility and, therefore, social inclusion.

In this regional planning framework, the case of the city of Udine, a provincial capital municipality that has tried to take the opportunity of the PEBA and the consequent programming to start a process of reviewing the contents, procedures, and interactions between the different services to improve the management of public goods, spaces, and services. From the considerations that lead to paying attention to the interaction between space and society and from the vision of urban inclusion as the ability to overlap with

the behavior of society, the administration's choice focused in advance on a cognitive phase of the urban fabric. This first moment allowed accessibility planning that considers the complexity of the development elements as well as the vocation of a city anchored to tradition but with significant potential for the development of the tertiary sector, trade, and tourism in an increasingly amplified interaction with the University both in terms of real estate investments and related derivatives. A preparatory phase for the drafting of the PEBA made it possible to establish the database for strategic planning of the space that guarantees, that is, a direct link between spatial inclusion and social inclusion and to support those choices necessary to make the PEBA an integrated tool for programming not only aimed at the mere removal of architectural barriers.

2. Territory experimentation: the Udine the Udine case experience

2.1. Method

On these premises, the signing of a research agreement between the University of Studies and the Municipality of Udine involved the return of structural intervention solutions at the start of experimentation on urban itineraries identified as fundamental spatial elements for accessibility of citizen services. Identifying the itineraries on which to intervene was the first step of an experiment consistent with the FVG Guidelines. The Guidelines provide for a detailed territorial analysis and a careful identification of the accessibility needs of citizens. The dialogue with stakeholders is very important to identify the needs; through a continuous dialogue, furthermore, it is possible to have a more precise understanding of the spatial identification and the survey of the performances; knowing the performances means being able to create a hierarchy of intervention priorities for coherent planning of the interventions.

The research, from such assumptions, was articulated starting from the analysis of the municipal territory on a regional and municipal database, as well as of territorial importance to proceed with a selection of good practices according to elements of the process, planning, and management of interventions to eliminate architectural barriers and their design (Figure 1.).

The next steps looked at the consideration and identification of places with high priority of interest in terms of the need for accessibility of spaces with greater attractiveness and concentration of users. The next phase involved an analysis aimed at identifying the criticalities contextualized in the framework of the paths with the priority of interest for accessibility planning and was proposed as an opportunity to integrate the detection methodology considering the spatial components and elements of the urban and building system. The invitation to look at the public space as an element that encompasses a broad reality with which users are confronted every day and how each element that composes it manages to interact with one another, creating synergies to ensure continuity, it involved reflections and prescriptions in support of a design based on non-compliant solutions but guaranteeing that accessibility "goal" addressed to people.

The invitation to look at the public space as an element that encompasses a broad reality with which users are confronted every day and how each element that composes it manages to interact with one another, creating synergies to ensure continuity, it involved reflections and prescriptions in support of a design based on non-compliant solutions; accessibility cannot be achieved by adopting compliant solutions (Figure 2.).

In this sense, the relief of the criticalities was set up to be able to identify and map them in a point-like, areal, linear way and, therefore, return them on different graphic platforms. Therefore, the categorization of the different issues was based on their entity, relying on the classification dictated by the law, to list and highlight the recurring ones. The purpose of the work involved the creation of an organized and uniform container capable of storing georeferenced data that are responsible for serving the entire community, including possible web applications for tourism. The accessibility system is therefore represented in a structured way and can be made available to stakeholders to provide information to interested users.

At the same time, a SWOT survey was conducted on a national scale on the offices in charge of accessibility and environmental well-being and made it possible to identify the strengths, weaknesses, opportunities, and threats that arise for some administrative offices in charge of accessibility, usability and/or environmental well-being. The work involved research aimed at identifying how many and which were - at the national level - the offices dedicated to Inclusion as services to the person and those committed to environmental accessibility, to arrive at an understanding of the link between the bodies supervised by municipal technical officers in charge or, at most, regional. The research envisaged the first phase of synthesis of the different organizational models of the administrative offices dedicated to accessibility and environmental well-being present on the national territory, specifying the services offered, the number of employees, and a brief description of the skills, and the reference contacts.

In the second phase, the research aimed to deepen the theme of the establishment of administrative offices dedicated to accessibility and environmental well-being; it also questioned the various possible services, imagining their establishment with the possible drafting of the PEBA. In addition to programming, a PEBA can strengthen relationships with stakeholders concerning the validation of environmental quality results achieved in general, with consequent improvement in the usability of public spaces and buildings.

To answer these questions and deepen the analysis to obtain a matrix that made it possible to compare the strengths, opportunities, and weaknesses of the various offices investigated, we proceeded with cross-interviews with professionals involved in the management of administrative offices dedicated to the removal of architectural barriers, environmental accessibility, and centers for the adaptation of the domestic environment[3].

The experiences, the will, and the ideas that have given life to paths aimed at interacting with the "hidden actors" of marginalized realities as well as with planners, municipal administrators, research bodies, and universities, have allowed an examination of the most effective and suitable to increase the levels of accessibility and usability of the different territorial contexts to be transmitted in the administration of Udine.

[3] To complete the survey, some interviews were also carried out aimed at professionals in the sector including Dr. Mariachiara Guazzieri, head of the Elimination of Architectural Barriers (EBA) office in Venice; dr. Leris Fantini, design consultant in the field of environmental well-being, urban accessibility and construction, member of CERPA Italy; dr. Fausto Bertoncelli, former head of the Environmental Wellbeing Office of the Municipality of Ferrara).

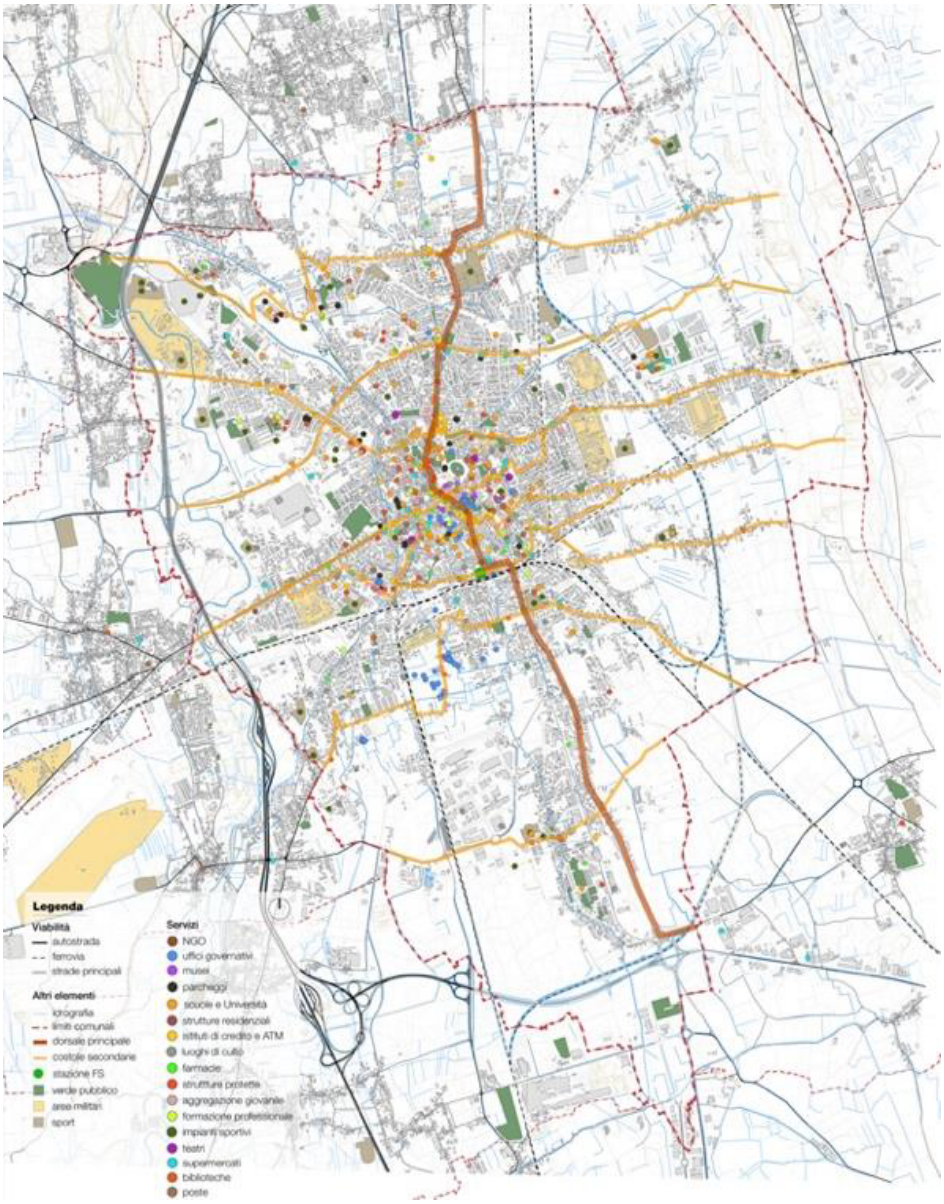

Figure 1. Extract the geo-referenced survey of services to citizens. Full documentation of the Municipality of Udine preliminary to the drafting of the PEBA prepared by the Dalt Laboratory of the DPIA within the framework of the Municipality University agreement.

Figure 2. Extract from the georeferenced analysis of the accessibility of some urban itineraries. Complete documentation of the Municipality of Udine preliminary to the drafting of the PEBA prepared by the Dalt Laboratory of the DPIA UNIUD as part of the Joint University Agreement

2.2. Results

The result of the experimentation process carried out in the Udine area involved an analysis which - through software for the retrieval, analysis, and creation of databases - allows the processing, returns, and transfer of data in the form of maps. georeferenced issues, detailed design, and survey sheets necessary to understand the current situation, recognize recurring criticalities, and imagine possible service actions which, alongside

dedicated planning, combine with conscious planning of the value of people. At the same time, it made it possible to return information and data instrumental to the implementation of the PEBA of Udine in response to the current guidelines of the FVG region. Based on the results of the research, the fundamental guidelines as well as the areas covered by the PEBA, currently being drafted, have been identified[4].

The research as a whole - aimed at giving answers that look at planning the accessibility of pedestrian paths, connections, and crossings according to a reading of the context in which these elements are inserted - aims to stimulate a new sensitivity in dealing with the planning of elimination of architectural barriers. It is in this sense that the added value of studies is conferred by the peculiarities that promote mobility, safety, and social integration, through implementation, planned, and monitored interventions. The path aims to encourage the design of interventions by optimizing their implementation and providing accessibility in close connection with mobility, safety, and integration.

From the close connection between environmental and technological components, and overall organicity emerges that gives the approach experience from the point of view of design resolutions; this knowledge distances the compliant solution to immerse oneself in the specific reference context of the critical issues analyzed. The research, therefore, aims at orienting towards a less sectoral approach, i.e., based on the attention and sharing of problems by designers, stakeholders, and governance, integrating and identifying the due priorities for intervention, planning, and maintenance of the public spaces. The purpose of this strategic planning is precisely to raise the degree of accessibility of the intervention area, tracing hypotheses of solutions capable of both complying with the technical-regulatory requirements of the relevant legislation and fulfilling the tasks of Universal Design. In this sense, the research provides a simplification of actions for a more immediate and broader view of the issues relating to environmental accessibility [7].

At the same time, the SWOT analysis allows for a synthesis of different organizational models present in the national territory, an analysis, and an in-depth proposal on the issue of setting up offices dedicated to accessibility and environmental well-being. The interdisciplinary significance of 'accessibility and environmental well-being' issues leads to attention being paid to the fact that it is not always possible to delegate matters to a single office, but the involvement of different administrative sections becomes relevant[5].

According to what was investigated, the offices dedicated to accessibility tend to become an out-of-current cultural cell concerning the entire mechanism of the administrative machine. Starting to work concretely within the bureaucracy and governance, providing for the spread of opinions and changing opinions, and generating a culture of sharing, means giving life to a process of change that puts human rights,

[4] The municipal administration has just assigned the design task to the Global Project Architettura Inclusiva studio. https://www.architectureinclusiva.it/.

[5] Regarding the involvement of different operational sections at the administrative level, the strong relationship between the EBA office and the Mestre Road network office becomes emblematic, of the interaction that ensures the accessibility of crossings and paths dedicated to pedestrians. The synergy between the two offices is since over the years a relationship of trust has been established which, on the contrary, is still lacking with other services in support of the municipal administration.

For years, Ferrara has also attracted attention to the issue of accessibility by the media and national associations of people with disabilities, offering a constant positive image of the innovative work carried out by the UBA office.

urban regeneration, and social inclusion; this is possible by directing the administration to a careful evaluation of services for inclusion - as social action - and environmental accessibility activities through the services of urban infrastructures, buildings, and the environment.

3. Conclusive considerations

Never, in a climate of global change, has there been a real cultural turning point that pervades all the social and human sciences, enhancing a vision of the world and of culture in general that allows us to understand how people represent themselves and social and political relations [8]. Approaching society and the facts of everyday life to move away from traditional issues and open, therefore, to experiments that deepen space and reality as a social construct, environmental accessibility becomes a matter capable of understanding the life of the community through the careful rethinking of the morphological fabric of the different urbanized contexts, of its temporality and of all the subjects that take part in it.

By crossing the accessibility rule, the Udine experimentation shifts the focus on expanding the degree of usability of a place and service by focusing on promoting an additive and adaptive process that does not look at the mere removal of barriers but also at raising awareness for fair, healthy and safe use of the collective assets.

On the other hand, starting to work concretely within the administration apparatuses, and providing for the dissemination of results in continuous sharing with operators and users, contributes to giving life to that path of change necessary to guarantee the rights of people through strategic urban regeneration processes dedicated to social inclusion.

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The City of Lecce (ITA) Accessibility Plan. The Innovative Experience of the Municipal Accessibility Lab

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Abstract. This article presents the first main outcomes of the innovative experience of the Municipal Accessibility Lab of Lecce, a technical-administrative structure established for guiding the implementation of the Accessibility Plan of the city. In order to make Lecce an accessible, comfortable and safe city, the research activities of the Accessibility Lab focus on interdisciplinarity and citizen participation, thus becomes an opportunity for a generalized improvement of life in the city, an experience of knowledge and socialization to help create a more aware and fair community.

Keywords. Lecce Accessibility Plan, Accessibility, Urban and Architectural Barriers, Community engagement, Inclusion.

1. Introduction[2]

It is now widely understood that the application of rules (albeit insufficient) and some specialized skills are not enough to create inclusive, safe and comfortable habitats; Sensitivity towards "welcoming city" models is also maturing in Italy, which can only be implemented through interdisciplinary planning and design, as an approach that can better respect the multifactorial and dynamic complexity of the intervention. It starts from the principle according to which the elaboration of an Accessibility Plan necessarily implies a social dimension which concerns the experience, habits and perspectives of those representing the main target of urban intervention: the "stakeholders", i.e., disadvantaged people (people with disabilities, the elderly, children, migrants, etc.) and their caregivers. Furthermore, the concept of accessibility [1] [2] [3] implies the principle according to which all the transformation interventions involving the urban fabric must also have a positive impact on all its residents and on the various social categories

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"using" the city: commuters and city users, tourists, freelancers working in construction and urban planning, etc.

The new approach of Accessibility to urban spaces is a consequence of the fact that nowadays the complexity, richness and poverty of urban fabrics are no longer subject to planning for economic purposes, nor are they dependent from slogans such as *smart* and *sustainable*; to adequately understand and conveniently act on the city, the need for a new approach is therefore required, starting from the urban, understood as the lived experience of its inhabitants. Intervening only on the technical and regulatory aspects means believing that the social reality of the city can be transferred through mappings and percentages, without providing any insights into what people experience, think and feel.

The Municipality of Lecce (Italy) has launched a series of actions aimed at drafting an Accessibility Plan, i.e., an innovative programming tool, already tested in other Italian contexts, aimed at enhancing the PEBA conceptual and methodological evolution. The Municipality of Lecce has established a technical-administrative structure[3] for guiding the implementation of a Plan – the "Accessibility Lab" – and entrusted the drafting of the Plan to four researchers through the assignment of research grants by University of Florence and the University of Salento.

Drawing on the new approach to Accessibility, it was deemed necessary to integrate the activities of the Laboratory with a sociological research-intervention, aimed at detecting an exhaustive framework of needs relating to the different social categories that live in the city. The sociological activity envisaged three interconnected phases [4], useful for bringing out the social complexity of urban life in Lecce and for strengthening the link and dialogue between institutions and users. Some preliminary inspections were carried out which allowed the acquisition of information necessary for the elaboration of a general cognitive framework through a comparison between direct observational data and the analysis of socio-demographic and economic data. Two short questionnaires have been prepared for the detection of needs and requirements related to the lifestyle and experience of residents and users of the city, thus creating an important tool for the spontaneous reception of reports from users: the Accessibility Information Desk. For the creation of the requirement framework, the third most important phase involved the team in building a constant network of relationships with the numerous associations committed to improving the quality of life of the most disadvantaged categories in terms of accessibility to spaces, places, goods, and services; the following step resulted in the construction of a Permanent Working Group, made up of associations and cooperatives, foundations, trade unions, trade associations and public institutions.

The Laboratory also developed a detailed Communication Plan which better defines some aspects of the (internal/external) communication and organization of Lecce, and specifies the important link between the organization of the deskwork and user-oriented communication.

[3] Prof. Antonio Lauria, Coordinator of the Accessibility Plan draft and responsible for the Research Activity; Ing. Giovanni Puce, Director of Public Works and Coordinator of the Municipal Laboratory for Accessibility; Sonia Cappello, Sole Responsible for the Procedure.

2. Methodology

The methodology of the Accessibility Plan, intended as "operational program aimed at improving the accessibility rate of venues, collective services and goods through a range of coherent actions and measures planned on the basis of shared priorities" [1]. It is developed, in the middle-term period, according to five phases: Operational framework setting, Knowledge phase, Planning phase, Design phase, Monitoring phase.

The research path has been conceived as inductive learning process that, starting from the specific case of a Pilot Area, aims at define Guidelines, principles, procedures and tools of a methodology progressively applicable to the rest of the municipal territory.

Due to the complexity of the urban and social dynamics, the development of the Accessibility Plan, in order to become fully effective, required precise goals and a well-defined operational structure based on programming tools that are able to direct the entire process and to provide a link with the existing planning procedures. For this reason, in addition to the Communication Plan, the Operational Program and the Management and Monitoring Plan, have been set up.

2.1. The Knowledge Phase: definition of the Pilot Area and general features

The Pilot Area, portion of the city chosen as case-study being representative of all the urban and social scenarios, allows to carry on the research phases in a short time and to define an updated and credible cognitive framework thanks to which it is possible to plan in a informed and efficient way, allocate specific sums to plan and carry out the construction works, to keep track of the Interventions carried out and to monitor the results. The Pilot Area, approved by the City Council, has been defined from the fragmentation of the historical center area in Urban Functional Lots, adjacent portions of territory which can be clustered in a contained size unitary system small tailored to the complexity of the urban tissue, to the social situation, to the amount and the type of the existing polarities. These areas have been further decomposed into Sub-Lots with the purpose of facilitating the organization and the definition of an order of priority of the interventions. Proceeding with a Lynchian approach [5], for each Functional Lots have been identified Dots, Lines and Spaces (Figure 1).

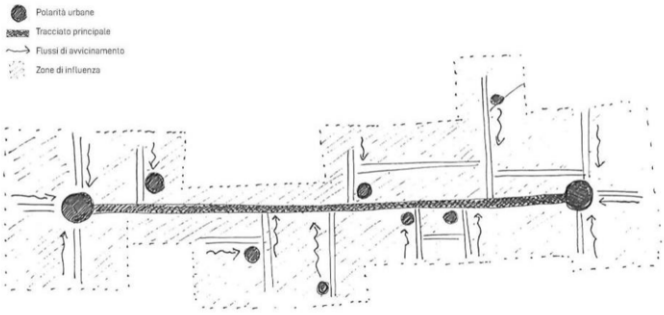

Figure 1. Scheme of the Lecce's urban center perimeter. Dots - Urban Landmark/Polarities seen as spontaneous places of attraction for pedestrian flows). Lines - Links/Main Routes seen as primary or secondary road axis that connect the polarities detected according to a criterion of continuity of the paths. Spaces - Areas of influence as link between polarities and paths.

Lastly, an analytic comparative model has been developed by evaluating the importance that three fundamental criteria (Public Poles and Urban Services; Private social Attractors for public use; Slow mobility and Local Public Transport) have on the social dynamics and on the daily habits and activities of the citizens. It has been provided an extra bonus for the Functional Urban Lots in which have been planned urban development and renovation projects compatible with the strategic guidelines of the Accessibility Plan.

The Pilot Area (Figure 2) plays an important role in the daily activities of the citizens. In its perimeter there are 16 buildings owned by the Town Council and 10 urban spaces such as squares, public gardens, and parking areas. But also from a mobility point of view it represents a strategic hub for the flows and the urban dynamics and takes the form of a complex scenario (pedestrian area, neighborhood street, road of fast sliding) as well as one of the most congested axis in the local road system. In addition, inside the Pilot area there are buildings, owned by companies, entities and other public authorities, that host public functions. It has been therefore necessary to draft the Charter of Properties which is the graphic summary helpful to identify and localize public (or for public use) buildings and spaces, to distinguish them and to define different intervention strategies according to their ownership (property of the Municipality or of public or private entities).

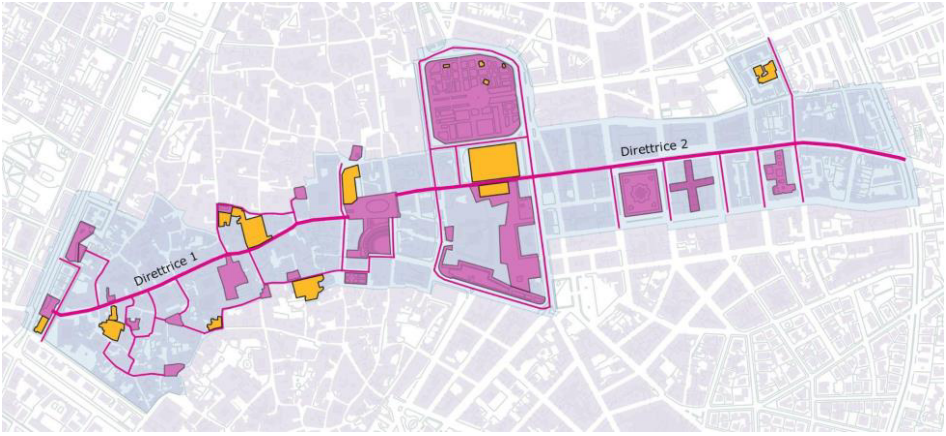

Figure 2. The Pilot Area covers an overall area of 55 ha and extends for about 2 km along two Main Routes: Main Routes 1 (Piazza Sant'Oronzo-Porta Rudiae) touristic axis and seat of a plurality of public and private services and religious buildings. Main Routes 2 (Piazza Sant'Oronzo-Piazza Mazzini) important commercial and leisure axis, place of numerous businesses and activities aimed at ensuring the common good.

3. The survey phase and the creation of digital databases

During the survey phase a preliminary work of organization and planning of the activities has been carried out: the planimetry of the Pilot Area and plans of all the buildings of municipal property have been collected. All road sections, crossroads (i.e. a segment of public road between two road crossings), urban spaces and buildings were given a unique ID code (Figure 3).

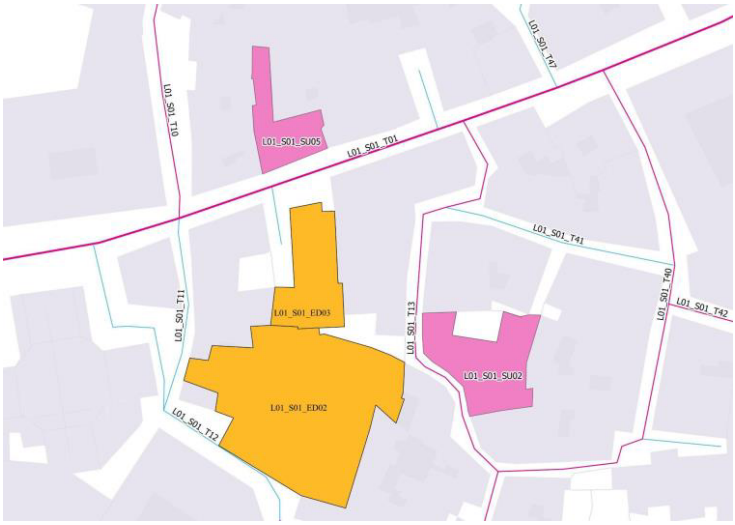

Figure 3. Localization of the road sections, crossroad, buildings and urban spaces of the Pilot Area. Example of ID code: L01_S01_T14. L is for Lotto (Lot) S is for Sub-Lotto (Sub-Lot, T is for Tratto (road section).

For each urban space and road section, taking into account pedestrian flows, the presence of municipal and other public services, commercial activities and places of interest, a degree of priority (priority or non-priority) has been established.

As far as buildings are concerned, on the other hand, a preliminary assessment was made of their attitude for adaptation. Census sheets were compiled in which a judgment was given by sight survey of three indicators: reachability of the entrance, reachability of the places, reachability of at least one accessible toilet.

One of the strengths of the Accessibility Plan is to incorporate the needs of the Administration and the citizens, suggesting management solutions rather than architectural ones. For example, in the case of buildings that are not judged adaptable, it may be more convenient to change the mode of use of the spaces and transfer the services open to the public to other more suitable and accessible places.

3.1. In-depth survey

For all the buildings suitable for adaptation, road sections, crossroads and urban spaces, an in-depth survey of the accessibility problems has been carried out by preparing specific maps and census sheets.

Several digital databases have been created in order to facilitate field survey operations and to collect and to manage data and information in an orderly manner and to make fast their transfer to the GIS platform. Specific sheets have been prepared for each category to be surveyed (building, road section, crossroad, urban space) but characterized by the same main structure that is organized as follows:

- general data: general information that allows to locate the item and the description of its main characteristics. It also contains some boxes in which photos, other multimedia content (audio, video, drawings, etc.) and textual notes can be collected.

- themes: each of these sections concerns a specific theme that must be analyzed in order to verify the conditions of accessibility both in the case of open spaces (pedestrian routes, difference in level, pedestrian crossings, parking, urban facilities and obstacles) and in the case of buildings (accessibility of the entrance, horizontal connections, vertical connections, toilets, furniture and equipment, signage, functions and services)

Within each section relating to a different theme, there are elements, defined as *item*s, which are identified through a unique code; for each one, the position and characteristics are recorded in order to verify the user-friendliness and if they constitute a source of danger, obstacle or distress for users (taking into account regulations but also recommendations not prescribed by law).

Each *item*, then, was localized on plans (in the case of buildings) or geolocated on a map through GPS coordinates (in the case of road sections, crossroads and urban spaces). After a phase of data consolidation (verification and possible updating of the acquired information), these have been subjected to an in-depth analysis with the support of a GIS system (Figure 4), aimed at the realization of thematic maps preparatory to the next phase of planning of the interventions.

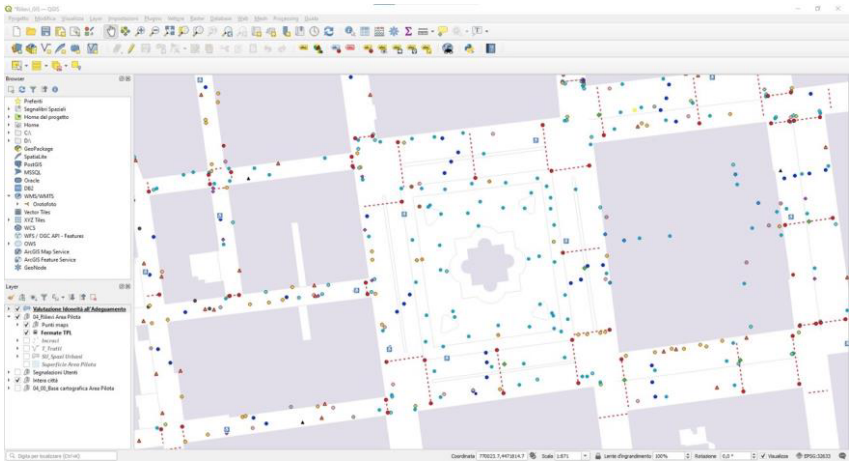

Figure 4. Localization in a GIS system (Qgis) of all the surveyed points. Each color corresponds to a type of item, and the dotted lines represent the existing pedestrian crossings.

4. The Data Analysis and Planning phase

The informations acquired during the survey activities, organized in digital databases and thematic maps, allowed to obtain an overview of the degree of accessibility of the buildings, owned by the Municipality of Lecce, situated inside the Pilot Area.

These general insights allowed to proceed with the planning of maintenance and renovation works and with the reorganization of the confined or open-air venues as well as products and services offered to the citizens.

The measures proposed to improve the degree of accessibility, listed below, have been divided into 4 typologies based on the complexity of the places and on the degree

of detail needed to achieve the results: Strategic Measures (characterized by an integrated and multidisciplinary approach, are intended for large and complex scenarios - streets, plazas and buildings), Ordinary Measures (intended for specific and limited problems e.g. adjustments of the pedestrian ramps, removal of barriers that impede the passage of people moving in a wheelchair), Emergency Works and Maintenance Works.

The measures proposed are also divided into:

- Architectural actions: permanent or temporary projects solutions, in line with the procedures imposed by the current legislation, that transform the space adding quality and performance standards missing by choosing solutions appropriate to the context (retrofit strategy)
- Management actions: Interventions that act on the localization, organization and implementation of spaces and services without changing the physical structure of the places
- Communicative measures: projects solutions aimed at promoting individual autonomy and overcoming sensorial and perceptive accessibility problems by providing digital technologies for the improvement of the wayfinding and the content accessibility.

If, by their very nature, Maintenance Works are cyclical and Emergency Works are unpredictable, in order to planning the Strategic and Ordinary Measures that requires an important economical commitment and long lead time, an order of priority has been defined considering three parameters: Effect (based on functions and services offered in the most significant buildings and urban spaces), Urgency (based on the degree of accessibility of the venues encountered during the survey phase), Financial resources: specific funds provided by the Municipality to achieve the set goals relative to the outcomes that emerged from the survey phase and from the negotiations among the various parties involved.

3.3	**Attraversamenti**				
	La conformazione e la collocazione di Piazzetta delle Giravolte è tale da non prevedere la presenza di attraversamenti pedonali. Tuttavia, si ricorda che la piazza è complanare al tratto L01_S01_T13b (ZTL) ed il passaggio da uno spazio all'altro potrebbe causare disagio e/o pericolo per persone con gravi problemi alla vista se non adeguatamente segnalato.				
	Tipologia intervento	**Descrizione**	**Immagini**	**Riferimenti normativi**	**Priorità**
	G/F	Rendere più efficace la segnalazione delle fasce ad uso promiscuo pedone-veicoli a motore attraverso pavimentazione sufficientemente contrastata in colore e texture e con segnalazione tattile di arresto realizzata con materiali di pavimentazioni della tradizione locale leccese.		art. 4 DPR 503/96	Alta

Figure 5. The interventions form contains sections with context information, a general description, a short evaluation of Accessibility and the proposed actions. This section, as you can see from the excerpt, is divided as follows: actions type, priority type, description of the actions, explicative drawings or images, norms of reference.

To ensure consistency with the information emerged from the survey phase, the planned activities have been organized in digital GIS databases that connect data to a map, integrating location data with all types of descriptive information. For each point, problems emerged and actions proposed to solve it have been provided.

For the significant buildings and public spaces of the Pilot Area, information sheets have been produced to provide the end user with an overall organic vision of the proposed actions. At the end of the Planning phase, it is possible to proceed to the next phases of

designing and monitoring, thereby defining a complete working methodology that can be used to extend the Accessibility Plan to the rest of the municipal territory.

5. Conclusions

Based on the experimentation of the methodology on the Pilot Area, the Guidelines of the Accessibility Plan of Lecce were drawn up. These are intended to illustrate the implementation phases of the Accessibility Plan in the others Urban Functional Lots identified during the preliminary stages of the Research. In particular, the Guidelines describe in detail the process of the various stages of implementation of the Plan and an Intervention Manual that must guide the Administration technicians for the planning of future interventions and that must be taken into consideration by the other municipal planning tools. The Guidelines guide the implementation of the Plan, but are not to be considered as an intangible tool. This document can be refined on the basis of what will emerge in the designing and monitoring phases of the Plan, and also on the basis of the impact it will have on the city and citizens.

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Plans for the Removal of Architectural Barriers (PEBAs) from a UD Perspective. An Interdisciplinary Process in the Italian Region Friuli Venezia Giulia

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Abstract. It is more than thirty years since the Italian Law introduced the Plans for the Removal of Architectural Barriers (PEBAs). However, their implementation by municipalities is still limited, and accessibility is often understood as the result of the elimination of single physical obstacles, rather than the development of interconnected systems of urban spaces and collective equipment that are usable and inclusive according to Universal Design (UD) criteria. Since 2018, the Italian Friuli Venezia Giulia Autonomous Region has started a collaboration with the Universities of Trieste and Udine, in order to bring UD at the core of the implementation of the Regional Law no. 10/2018. This Law introduced significant innovations: the disposal of regional funds to support local administrations when drafting PEBAs; the delivery of a software application to facilitate the drawing of these plans; the establishment of a reference center in charge of training, information and consultancy activities on accessibility at a regional level (CRIBA); the delivery of a regional observatory for mapping and continuous monitoring of accessibility conditions and the implementation of PEBAs. The paper presents: i) an overview of the interdisciplinary work carried out by the Universities with the Region and CRIBA; ii) a focus on Universities' research activities and the current state of the collaboration process; iii) reflections on further research and its operational outcomes.

Keywords. Plans for the Removal of Architectural Barriers; Universal Design; Public Policies; Urban Planning and Design; ICT Decision Support Tools

1. Introduction. Accessibility as a Driver for Integrated Approaches

Moving across urban spaces autonomously is becoming an increasingly hard task for everyone, especially for the most fragile citizens. Many physical obstacles prevent an extensive use of streets and squares, parks, schools, social and health care services, public transport hubs, and cultural equipment. These barriers can be of different types: motor impairment, sensory, cognitive, to orientation [1]. However, accessibility should be addressed not only with the purpose of eliminating single spatial criticalities, but with the broader goal of creating urban environments that are "usable by all people, to the greatest extent possible, without the need for adaptation or specialized design",

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according to Universal Design (UD) philosophy [2], and with the aim to foster social practices and inclusion [3].

Although accessibility is currently recognized as a requirement of building and planning regulations across Europe, its enforceability is often limited. In Italy, efforts are mainly focused on solving problems on a punctual scale rather than in an intersectoral way and at an overall city level. One of the biggest challenges for the redesign of urban spaces as "accessible for all" thus concerns a deep cultural change.

Many Italian local administrations still adopt an approach to urban planning and design that follows the so-called "silo model". This situation makes it difficult not only to integrate different policies, plans, regulations and spatial interventions [4], but also to improve the communication between the information systems and data management tools that are used by different administrative sectors (e.g., for education, health, public transport, housing), and levels (from the municipal to the regional one) [5]. As a result, the joint work and synergies among a variety of public action's fields that a holistic approach to accessibility to collective spaces and equipment calls for are rarely pursued. Another critical issue refers to the lack of systematization and dissemination of good practices: when single experiences remain isolated, they do not have the potential to upscale and prompt other ones to follow. In spite of the attempts to fill in this knowledge gap on a national scale [6], further work needs to be done towards keeping information updated and effectively shared on the territorial and local scales.

Since the end of the '80s, the instrument that in Italy allows municipalities to intervene with respect to accessibility is the Plan for the Removal of Architectural Barriers (PEBA) (national Laws no. 41/1986, 104/1992) [7]. PEBA is a sectoral tool, specifically conceived to detect and eliminate physical obstacles in a specific area, with reference to public buildings and open spaces (e.g., streets, squares, parks, gardens, urban furniture, collective equipment). PEBA is addressed to coordinate major spatial interventions for enhancing accessibility conditions, according to a process structured in different steps: from the survey of obstacles, to the definition of solutions for each detected barrier, of their costs and priorities, up to the monitoring of their implementation. PEBAs are compulsory by law, but many Italian local administrations still have not adopted this tool [8]. The absence of an up-to-date census of PEBAs does not help identify the precise reasons for this situation. However, the lack of application of sanctions (even though established by the national regulations) and funding concur to make accessibility issues largely underestimated by urban policies.

In the recent years, some administrations have committed to inverting this trend, by adopting the principles of the *UN Convention on the Rights of Persons with Disabilities* (2006) and the *European Disability Strategy 2010/2020* (2010), and by promoting the use of a broader and inclusive interpretation of accessibility within urban planning and design. This article discusses an institutional initiative that is proceeding towards this direction. Since 2018, the Friuli Venezia Giulia Autonomous Region, located in Northeastern Italy, has started a set of actions aimed at encouraging a concrete application of "accessibility for all" issues. Main beneficiaries are municipalities, that now can count on the financial and methodological guidance and support of the Regional Government and Offices. The purpose is not only to change procedures, but also to foster an integrated design attitude. The focus is on providing PEBAs with a new form and role, by understanding this tool not only as a program for the removal of architectural barriers, but as a fundamental component of general planning instruments and spatial interventions for cities' regeneration in a UD perspective.

2. Methodology and Objectives. Building a set of Decision Support and Dissemination Tools

Since 2009, the Universities of Trieste (UNITS) and Udine (UNIUD) have been engaged in joint initiatives addressed to investigate and disseminate the issues of environmental accessibility through research activities, training of future professionals, and support to institutions and the civil society. The Regional Council of Associations of People with Disabilities and their Families (CRAD), and the Regional Information Center on Environmental Wellbeing (CRIBA) are two other fundamental actors.

In 2018, with the promulgation of the Regional Law no. 10, *General principles and implementation provisions on accessibility*, CRIBA became the reference center for accessibility at the regional level. This Law not only enforced the implementation of PEBAs, but also (and for the first time) decisively introduced UD as a criterion for urban planning. In general terms, the assumption is that disability should not be interpreted as the condition of single individuals, but as the outcome of the daily interaction with a living environment that is more or less able to enhance their motor, sensory, and cognitive potentials. In a stable or permanent way, these capabilities change for everyone, in the different phases of their existence.

The Law no. 10 set the start of the project *FVG Accessibile* (Accessible Friuli Venezia Giulia), where the composite institutional partnership of the Regional Office for territorial policies, UNITS, UNIUD, and CRIBA found stable collaboration. Promoted by the Regional Government, this project understands accessibility to urban spaces as a driver for making cities more equitable and inclusive. Within a long-term vision, and under the umbrella of *FVG Accessibile*, the process underway addresses some key goals:

- to improve the quality of urban design and public works through solutions that are not conceived for a specific type of user (and disability) but are designed for everyone;
- to support place-based approaches and adaptation of planning methods and tools to different situations;
- to promote processes where the expert and every day knowledge of institutional actors, professionals and citizens intertwine in the different steps of a PEBA's definition, not only during presentations of already developed proposals;
- to systematize and to disseminate the good practices that will be developed in the region, in order to promote a continuous "learning by doing" process by all the actors involved.

The proposed methodology is: i) *participatory and interdisciplinary* (it engages different subjects in co-design, co-building and co-validation of PEBAs, also providing the organization of a series of activities for training and sharing of experiences among researchers, institutions and technicians); ii) *systemic* (it is based on the selection and prioritization of interventions with a view to integrated renewal of open spaces and collective equipment); iii) *intersectoral* (by conceiving accessibility as a cross-cutting issue, it calls for strong cooperation across different local government' sectors, scales and areas of intervention).

The activities of *FVG Accessibile* are currently focusing on the delivery of a structured set of Decision Support and Dissemination Tools. To date, these tools (either developed or underway) are: *Guidelines* to orient the elaboration and implementation of a PEBA; a *Software Application* to help administrations and professionals in the construction of the plan; a *Library of Solutions*, as a system of normative references, design criteria and examples from realized plans and urban interventions, to be further

implemented over time. Moreover, the testing of the Software Application with some municipalities and technicians is starting, with the aim to promote its improvement and future use. The final objective of the Regional Office is to achieve the construction of a *Web Portal* providing information and an observatory for the mapping of accessibility conditions in the region. The following paragraphs offer a critical analysis of the main contents and approaches at the basis of this rich set of instruments.

3. Results. The Issues of a Research in Action

In 2020, the signature of a two-year agreement among UNITS, UNIUD and the Region officially initiated what can be acknowledged as an experience of research in action [9]. Namely, a process where the production of knowledge has deeply intertwined with the assessment of its concrete applicability and uptake in the definition of planning and design processes and tools. Following a non-linear path, continuous adjustments were developed thanks to a constant dialogue among the Universities, the officials of the Region (Central Directorate for Infrastructure and Territory), the services in charge of the elaboration of ICT tools (INSIEL and INFOFACTORY, respectively as the manager of the regional databases and the subject selected for the realization of the Software Application), CRIBA, as well as through meetings with local administrations and professionals who are working on PEBAs in the region and beyond.

3.1. Guidelines

Drawing up the Guidelines for the elaboration of PEBAs [10] has implied the construction of an operational definition of accessibility helping reframe the approaches, contents and steps that are useful to provide address to municipalities and professionals when drafting these plans.

The sections of the Guidelines outline a general sequence of operations, from the conception to the implementation of PEBAs: "Overview", "Preliminary analysis", "Survey of the current state" of urban spaces, "Definition of design solutions" and "Estimation of the related costs", "Programming", "Approval", "Monitoring implementation", "PEBA as a driver for innovating plans and projects". However, the Guidelines are not conceived as a manual to be rigidly applied, but as a methodological support. They highlight some precise standpoints, with the aim both to encourage the assumption of a cross-sectoral and multi-scalar approach to accessibility, and to show the strategic role PEBAs can play in urban renewal.

Since a PEBA may limit its extension to individual parts of the municipal territory –albeit according to an incremental vision towards the progressive coverage of the entire urbanized area– a pivotal issue concerns the selection of the places where to focus on its drafting. Therefore, the Guidelines assign a strategic importance to the preliminary analysis, whereas administrations are invited to identify as priorities the areas where the most relevant collective equipment and services are located, as well as the public spaces and routes connecting them. The reference is to the public facilities that are regulated as planning standards (parks and sports fields, schools and libraries, civic and cultural resources, social and health care centers). To them public transport nodes, council housing estates, pharmacies and neighborhood shops, places of symbolic and tourist interest are also added.

As regards the approaches to the drawing of a PEBA and the definition of its technical solutions, the Guidelines focus on some process and design issues. On the one hand, the need to set the construction of the plan within a stronger coordination of municipal offices (town planning, traffic and mobility, public works, etc.), and to foresee continuous interaction with citizens in order to discuss and provide answers to their real needs. On the other hand, the call is for using the plan as a chance to define more complex urban upgrading processes, where interventions on the surfaces and furniture of pedestrian paths, pavements, squares and green areas combine with those on the outdoor and indoor accessibility to public buildings. In this sense, the Guidelines invite local administrations to take on a contextual and project-oriented attitude; the prompt is to go beyond the removal of single obstacles, and to understand accessibility as an opportunity for an overall redesign of public spaces and equipment.

3.2. Software Application

The Software Application translates the single tasks described in the Guidelines into an ICT tool to support the administration's technicians and/or the professionals when drawing up a PEBA. The analysis of some applications that are currently used to this purpose has highlighted a number of limitations: in particular, the risk of making correlations among important interpretative and design steps too automatic, and consequently of reducing PEBAs to a mere sum of punctual and standardized interventions. Moreover, the collaboration with the ICT developers has brought to light further issues, being both of a technical and conceptual nature. In order to overcome these criticalities, some choices have ruled the construction of the Software Application, which is now entering its testing and finalization phases.

The first task of the Software is to help public administrations develop the "Preliminary analysis", and a proper selection of the spatial coverage of the PEBA. To this end, it has been necessary to critically evaluate the possibilities for effective harmonization of the data and technical cartographies that are available on a regional basis, and are subject to periodic updating by different administrative sectors and levels (e.g., referring to planning standards, public transport, council housing, etc.; their location, typologies, and users). The aim is to provide the Software with a direct link to a broad set of information, being now scattered in different databases.

In addition to this data and mapping aid, the preliminary analysis section of the Software is integrated with a weighting and prioritizing system, that is meant to foster the selection of urban areas where fundamental services are located: first, the equipment playing a pivotal social role (in order of importance: for health, education, public offices, and social life); then, other collective facilities (e.g., itineraries for users with special needs, neighborhood commerce, and tourist destinations). However, in order to better customize the coverage and contents of the plan to a specific urban context and the needs of its inhabitants and users, the Software will allow local authorities to partially modify these weights. Moreover, the ICT tool will permit municipalities to include in the preliminary analysis and assessment sheets other important contextual factors, such as citizens' claims, synergies with ongoing or planned interventions, and with already implemented accessible itineraries and networks of spaces.

A second group of software screens concerns the "Survey of the current state"; namely, the recording of all the obstacles detected by administration technicians or external professionals during the field investigations of the urban area included in the PEBA. In order to foster strong linkage of urban accessibility with overall and larger-

scale city regeneration, the Software structures the annotation of punctual criticalities into a tree cataloguing system, where open spaces and buildings are classified and related each other. In fact, this has been a non-trivial step. It originated from the need to overcome a significant weakness of the current legislation on accessibility, where the interventions on buildings are still recognized as a priority, while outer spaces are catalogued according to only three headings (paths, paving, and parking lots; cf. Italian Ministerial Decree no. 236/1986). The analysis of other normative references, guidelines and adopted PEBAs has brought UNITS and UNIUD researchers to define two distinct but integrated tables for public/collective open spaces and buildings. Further ontological and taxonomic work allowed to recognize their specific "domains", "components" and "elements", with the aim to prompt designers to take into consideration if and how the removal of a single barrier (element) can integrate into more comprehensive design solutions (referring either to a component or to a domain) (Figure 1).

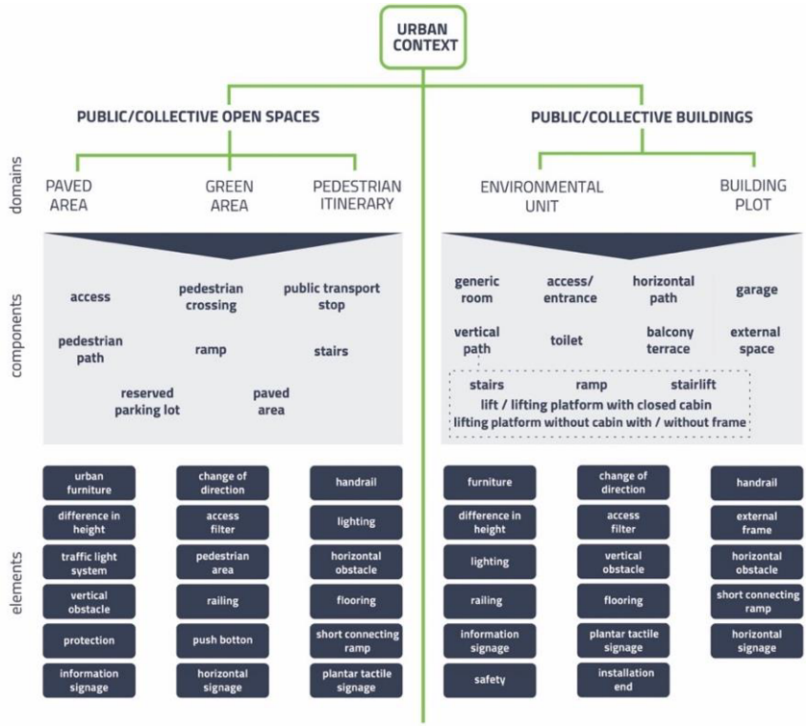

Figure 1. Tables for public/collective open spaces and buildings: domains, components and elements. Processed by V. Novak.

Specifically, the Software provides geo-referenced sheets that technicians and professionals can use to register the criticalities detected for each element during the survey. Sheets allow to report pictures, quantitative and qualitative data that are useful to provide an overall description. To help identify and assess the single criticalities, the Software offers references to specific definitions, lists of attributes and requirements, regulatory provisions relating to the individual elements. At the end of the survey, the software makes it possible to reorganize and visualize this set of precise information on a map, and to appreciate the contiguity of punctual barriers and obstacles (e.g., all the critical aspects referring to the elements that make up the component "pedestrian

crossing": from those related to ramps and differences in height, to horizontal and vertical obstacles, signage, etc.).

After the "Definition of design solutions", the Software supports the "Estimation of the related costs" trough the direct link to the regional price list for public works. Since the setting of priorities and related criteria has already been the subject of the "Preliminary analysis" phase of filing work, the final programming of interventions is deliberately left to the discretion of the public administration, as it is closely linked to the project idea, the policy of the municipality, and the actual availability of funding on the public budget.

3.3. Library of Solutions

The Library of Solutions is a tool that complements the Software. It is conceived both to support the design of interventions addressed to enhance accessibility, and to contribute to the dissemination of UD culture among regional professionals and administrations.
Various meetings have been organized to develop shared guidelines for defining the structure of the Library, and to ensure its adherence to the general objectives of *FVG Accessibile*. A crucial issue to be solved was the definition of the relationships between criticalities and solutions. If, on the one hand, a direct and linear correlation of a solution to each detected obstacle could help the economic evaluation of the works to be implemented, on the other hand, this approach could lead to a too punctual and mechanical conception of the planning and design phase. Therefore, in order to promote an organic vision and the realization of interrelated interventions, it was necessary to structure the Library as a system of information, criteria and design suggestions, not as a collection of prescriptive technical rules. This choice is consistent with recognizing the key role of designers in improving the quality of architectural and urban projects.

The structure of the Library is open and dynamic, conceived to be enriched over time with good practices from the PEBAs adopted by the municipalities in the region. In particular, the first section of this tool is composed of a series of performance requirements accompanied by graphic schemes of the components the Software refers to. The aim is to stimulate technicians to critically chose the solutions that better fit to a given context, and to consider them as an overall and interconnected spatial system. The graphic language is intentionally abstract and limited to essential aspects. The second section of the Library consists of an annotated bibliography: a collection and selection of references to good practices and solutions, organized into different categories. The two sections are complementary and connected to each other through tags helping the consultation. The finalization of the Library is currently underway, as well as its integration into the Software.

4. Conclusions. An Open and Learning by Doing Process

Developing new approaches and processes requires time, economic and human resources, before measurable results are achieved. In the Friuli Venezia Giulia Region, the constant work of mediation and dialogue between researchers, institutional actors, and ICT developers is now leading to the finalization of an innovative set of tools (Guidelines, Software, Library of Solutions) that, hopefully, will help overcome the limitations identified in other guidance and technological instruments that are today used for the drafting and management of PEBAs. This operation is nothing but simple. In fact,

the building in parallel of the Library of Solutions and the Software has led both to a repeated review of the modes of recording the criticalities and to the fine-tuning of the software layout. Moreover, to become fully operating, these instruments should be properly understood and accepted by effective users (policy-makers and technicians from public administrations, professionals, citizens), according to their different competences and roles within the planning process. In line with these objectives, the completion and development of further important steps are needed.

Testing the usability of the Software Application. The technical test is constantly ongoing: both Universities and CRIBA, in cooperation with ICT developers, are checking the different parts of the Software to guarantee its consistency with the overall conceptual framework. At the same time, some reviews to the tree cataloguing system (namely, its organization into elements), and to the relations between elements, criticalities and the Library of Solutions are under discussion to better meet the Software functional features. In addition, an operational testing phase is starting with the involvement of local administrations. Through a call, some municipalities have been selected by the Regional Office to use the Software Beta version and obtain feedback. These administrations, identified on the basis of the diversity of their contexts –e.g., territorial characteristics and geographical position, urban dimensions, social and economic trends– will be supported by *FVG Accessibile* team to understand the optimal functioning of the Software. However, even after its finalization, the improvement process of this ICT tool will remain open: in fact, the Software is not considered as a static instrument, but as a device that will be enriched and improved through the monitoring of its use by professionals and local administrations.

A Web Portal as a dissemination and continuous monitoring tool. The Guidelines, Software and Library of Solutions will be soon integrated into *FVG Accessibile* Web Portal. The Portal is under construction. It will provide not only a showcase of overall information concerning the project, the different initiatives organized for the dissemination of its results, the funding opportunities provided by the Regional Government, and other Italian good practices concerning accessibility and the PEBAs. It will be also and especially useful to monitor the progress of the various plans developed in the region. In line with the principle of transparency and the provision of reusable data, in the future it thus will be possible for anyone to consult the regional maps reporting an updated view of ongoing and implemented interventions addressed to increase the degree of urban and territorial accessibility.

Training and capacity building. In the next months, training activities will be promoted throughout the region to raise the awareness and knowledge of the new tools among their direct users. To better calibrate these activities, during the launching event addressed to professionals and administrations –*PEBA Conference. From Regional Guidelines to the experiences of the Municipalities in the region Friuli Venezia Giulia* (Udine, 03/12/2021)–, a questionnaire was distributed among the participants with the aim to collect information on both already adopted operational instruments, and specific training needs. The outcomes of this survey highlighted a great interest in the issues of accessibility and UD, the administrations' acknowledgment of the importance to adopt PEBAs, and a general willingness to participate in training activities and fieldwork helping reach this result. In addition, the usefulness and effectiveness of the Guidelines were confirmed, as well as the need for a deeper understanding of the technical and procedural aspects related to the survey of criticalities and the solutions for the removal of spatial obstacles within a PEBA.

In the view of these fundamental operations, UNITS, UNIUD and the Regional Office are currently establishing a new agreement, in order to confirm a collaboration that has proved to be highly effective. The stabilization of an interdisciplinary team – ready to monitor the implementation of Decision Support Tools and PEBAs, and to provide future opportunities for training and dissemination– is one more significant result of the continuous sharing of knowledge and discussion among regional officers, researchers and professionals the project *FVG Accessibile* has brought to. In fact, when the challenge is to help real cultural change towards more accessible and inclusive cities, technical instruments are not enough. Keys to success are also a strong commitment by all the actors involved, a clear direction of public policies, and the establishment of advisory (both scientific and technical) boards in charge of taking care of the actual implementation of a variety of instruments, learning by doing and mutual exchange processes. What *FVG Accessibile* is showing is that when these boards are truly interdisciplinary and "intermediate" (namely, standing in between the routines, demands and interests of institutions, professionals and the civil society), they can better help regional and local administrations collaborate and face complex issues in an innovative way.

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Improving Accessibility and Usability in the Built Environment. Case Study: Guide Lines by the Lombardy Region, Italy

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Abstract. Accessibility of the built environment, including open spaces, products and services, is essential for people with disabilities and people with special needs such as the elderly and children to access, move, use and enjoy the services and the urban spaces, exercise their rights and fully participate in social life. Local administrations can, and must, identify strategies and tools that are useful for achieving this goal, with effectiveness, efficiency and satisfaction. The case study of the "Lombardy Region Guidelines for Accessibility Plans" that each Municipality of the Region is required to draw up and implement will be illustrated. The Guidelines were drawn up in a very short time, promoting a participatory method, involving decision makers and stakeholders since the very beginning, and providing indications for building up Accessibility for All, inclusive and non-discriminatory. The founding concept was that of a City for All or of a "Plan for the accessibility and usability of the built environment, social inclusion and environmental well-being". Considering the different characteristics, abilities, needs, conditions and preferences of people, this concept extends the recipients of the Plan to all citizens, as well as to occasional visitors such as tourists. They were approved by the Regional Council in November 2021. The approach adopted complied with the most recent normative, legislative and cultural indications, both national and international. Training courses have been scheduled for municipal officials, technicians and plan editors. Synergies have been established with universities and UNI, the Italian standardization body.

Keywords. Accessibility, usability, built environment, regional policies

1. Introduction

Accessibility of the built environment, including open spaces, products and services, is essential for people with disabilities and a large segment of the population, including the elderly, to access, move and enjoy the services and public space of the city, to access transport, leisure and cultural facilities, in safety and autonomy, exercise their rights, and fully participate in social life

As highlighted in the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD), implemented by the Italian State with Law 18/2009, the environmental and spatial factor is considered among the essential elements capable of

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positively influencing, or on the contrary hinder / impair the execution of the most important daily functions such as living, moving, relating, communicating, getting information, working, studying, having fun.

The presence of barriers or facilitators can heavily prevent or favor the participation in the social life of citizens and therefore their well-being in a broad sense. Already during Alma Ata works in September 1978, the World Health Organization recognized that health is not referable to merely functional facts, as it is not identified with the pure and simple absence of disease, but with the whole psychophysical well-being. The same definition of "disability" of the UN Convention assumes, as a reference principle, the health condition of the person in interaction with the environment. It also requires not only accessibility to the built environment, but also to information, communication and transport.

Local administrations can, and must, identify strategies and tools that are useful for achieving this goal, with effectiveness, efficiency and satisfaction.

With reference to the national and regional obligation of drafting Architectural barriers elimination Plans in public buildings and urban spaces (Law 41/1986, 32.21; Law 104/1992, 24.9; Lombardy Region Law 6/1989, as amended by Lombardy Region Law 14/2020) and to the support measures for municipalities with population up to 5,000 inhabitants (regional resolution 4139 of 21/12/2020), the Lombardy Region took the opportunity to draw up innovative Guidelines, which contain the most recent principles introduced by the UN Convention for the Rights of Persons with Disabilities, taking the approach and the tools of Universal Design / Design for All, as required also by the European Union, and by the very recent regulatory instruments developed following some EU mandates.

Also the European Disability Strategy 2010-2020 (and the most recent 2021-2030) has implemented the legal requirements of the UN Convention in the EU Directives, in the Accessibility Act for products and services and in the standardization of accessibility, with the so-called "Design for All ". Through the "mandates", called "standardization requests", the European Commission requested the European standardization bodies (ESOs) to develop and adopt standards in support of European policies and legislation. The directives of the European Union and the UN guidelines in the field of accessibility and social sustainability, integrated with environmental sustainability policies, have been incorporated as new essential references, for the drafting of the Lombardy Region Guidelines for Plans for Accessibility in 2021[1], plans that each Municipality of the Region is required to draw up and implement on the basis of Italian law.

2. Method

These Guidelines have been drafted after research of the state of the art and tools to achieve an inclusive and accessible design of the built environment [2], [3], [4], [5], [6].

Their cultural approach is to consider the city as a system, and every factor that can promote environmental well-being, social participation, the beauty and vitality of the territories, with all possible users, both citizens and occasional visitors. The goal is to overcome the simple concept of eliminating a set of barriers and problematic elements for some categories of people, by adopting a systemic approach, which involves all the actors, decision makers and stakeholders, from the very beginning of the process, as well as the national technical legislation in force.

2.1 Recent legislative and regulatory references.

With reference to the national and regional obligation to draft plans for the elimination of architectural barriers in public buildings and urban spaces (Law 41/1986 art.32.21; Law 104/1992, art.24.9; Regional Law 6/1989, as amended from LR 14/2020), the Lombardy Region has made € 1,000,000 available to promote the drafting of the "PEBA - Plans for the Elimination of Architectural Barriers" in Municipalities with a population of less than 5,000 inhabitants (regional resolution 4139 of 21 / 12/2020).

The Region therefore took the opportunity to draw up innovative guidelines for all its municipalities, which contain the principles most recently introduced by the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), adopting the approach and tools of the Universal Design / Design for All (UD/DfA), as required also by the European Union, and by the very recent regulatory instruments developed following some EU mandates to European standardization bodies.

These European mandates have produced, with a long participatory process (with more than 50 representatives of various Bodies), some innovative and shared rules at European level, on the subject of accessibility and Design for All. Among these:

- The EN 17161 standard "Design for All - Accessibility following a Design for All approach in products, goods and services - Extending the range of users"[7] to include Design for All in all relevant standardization initiatives of member countries (EU M473 / 2010);
- The European standard EN 17210 "Accessibility and usability of the built environment - Functional requirements"[8]: to provide the performance requirements (without dimensions), to be used as technical specifications or criteria for the award of public contracts (with reference to the Directives on procurement public spaces, but not limited to), of spaces, buildings, structures and transport. It is accompanied by two Technical Reports, one with some minimum dimensional requirements, to support each functional requirement, and one with the indications and format for the declaration and certification of conformity: CEN / TR 17621 "Accessibility and usability of the built environment. Technical requirements"[9], and CEN / TR 17622" Accessibility and usability of the built environment - Conformity assessment"[10]. (EU M420 / 2008).

The main reference standard was ISO 21542:2011 "Accessibility and usability of the built environment". Its updated version was drafted with the participation of some members of the Project Team of the second phase of the M / 420 selected by a specific call for experts in 2016, including Isabella T. Steffan, in order to make these rules as consistent as possible. All these documents have been received by many standardization bodies, including UNI, the Italian standardization body, and published in 2021.

The requirements of these standards represent a very useful methodological and planning framework for going beyond the now obsolete approach of the national and regional legislation in force. UNI CEI EN 17210: 2021, consulted in parallel with the relative TR1, can be a fundamental resource because it provides the basic performance and dimensional requirements in terms of accessibility and usability, on the different elements and types of buildings, such as roads, parking lots, orientation system, bathrooms, schools, museums.

The Lombardy Region in the drafting of the Guidelines has adopted the aforementioned documents, thus implementing the path indicated by the EU.

2.2 Fundamental concepts of the Guidelines

The key concepts of the Guidelines recommend the drafting of Plans for: A city for all including occasional visitors, accessible, usable and inclusive; an environmental sustainability integrated with social sustainability; and to relaunch the attractiveness of the territories and promote their economy and tourism.

i) The first key concept is that of a "Plan for the accessibility and usability of the built environment, social inclusion and environmental well-being", with the aim of creating a City for All. Thinking about building an accessible and inclusive city does not only represent an intervention aimed at improving the quality of life and social integration of a specific social group (people with disabilities, children, young people, adults and the elderly) but it also means improving and facilitating the quality of life of the whole community (people with strollers, the elderly who see their visual / auditory perception or agility progressively diminish, people with environmental allergies, obese people, all those who live temporarily in situations of reduced mobility, pregnant women), in particular with a view to a territory called to host the Olympic and Paralympic Winter Games in 2026. Considering the different characteristics, abilities, needs, conditions and preferences of people, this concept extends the recipients of the Plan to all citizens, as well as to occasional visitors and tourists.

It is recommended to move away from the uniqueness and rigidity of design solutions based on references that are not sufficient to guarantee a city liveable by all, independently and safely and to propose multimodal and multichannel solutions, i.e. different alternatives and responses to the multiple needs of people at access and use of the built environment, communication and information

ii)The second key concept is that of a Plan for environmental sustainability integrated with social sustainability, with the aim of generating vital, welcoming, safe public spaces, soft and usable mobility networks; improve performance, health, well-being, satisfaction, participation of as many people as possible.

The UN Convention (UNCRPD) emphasizes the importance of integrating disability issues as an integral part of sustainable development strategies. The European Consensus on Development, a project to align Union development policy with the 2030 Global Agenda for Sustainable Development, reaffirms the EU's commitment to a human rights-based approach to development and to rights of persons with disabilities. In particular, the Sustainable Development Goal SDG 11 - Making cities and human settlements inclusive, safe, long-lasting and sustainable expresses how it is necessary to "guarantee everyone access to a safe, convenient, accessible and sustainable transport system, improving the safety of roads, especially by enhancing public transport, with particular attention to the needs of those who are most vulnerable, women, children, people with disabilities and the elderly" and "to enhance inclusive and sustainable urbanization, plan and manage a human settlement that is participatory, integrated and sustainable". The integration of UD/DfA in the procurement, design, construction, management and use of the built environment contributes to sustainability, providing buildings and spaces that are accessible and usable by all, but also easily adaptable for future use and the different and changing needs of users.

Designing for the entire human life cycle promotes social inclusion and cohesion: the functionality of an accessible built environment is more flexible and the infrastructure is more sustainable as there is less need for costly adaptations at a later stage than they can be costly in economic and environmental terms.

iii) The third key concept is that of a Plan as an opportunity to promote the beauty of Lombardy's cities, with the aim of relaunching tourist attractiveness and the economy. The accessibility of the built environment must be considered as a system, not just as a sum of individual elements. To ensure a safe, accessible and usable urban system, it is important to develop urban planning tools and promote the design of new urban areas and routes, the redesign and good maintenance of existing ones. Accessible tourism can be a lever to reactivate local development processes in internal and marginal areas of our country, and to raise the quality of living.

The dimension of accessibility, usability and well-being all refer to the living space, which is the city par excellence, or the public space, a place for relationships and participation, a place of identity and a place of community recognition. Accessibility Plans require specific attention and adequate resources from public administrations also because these plans represent an investment and a wealth for the area capable of producing efficiency and functioning for citizens, and tourists /occasional visitors.

2.3 Structuring of the Process

The development of the Plan was conceived as an opportunity to be seized to structure two permanent tools within each municipality, one dedicated to community consultation and participation and the other to coordination and technical support.

These tools are functional to accompany all the stages of elaboration of the Plan, and subsequently, they are configured as tools that continue to act over time for monitoring the Plan and for the promotion of policies and projects in an accessible and inclusive key. The two tools have been identified as follows:

- Scope/framework of the permanent consultation on city accessibility: place of listening, proposal, participation and sharing of all the actors and stakeholders (configurable for example in an Observatory, a city Council);
- Coordination scope/framework and technical reference for accessibility: internal technical reference tool of the Municipality to support the elaboration of the Plan and to disseminate accessible-inclusive projects and policies in all the Departments (it may include, for example, an internal managerial figure to the Municipality, possibly flanked by a more technical figure).

Analysing some good practices of pathways that have guided Accessible Planning at the same time as the development of the Plan (e.g. in Reggio Emilia and Crema), the Guidelines require the promotion of actions, projects and work tables that concretely aim at supporting and revitalizing the path towards an accessible and inclusive city, such as:

- promotion of awareness and information initiatives for citizens and administration decision-makers on accessibility issues;
- training of technicians and designers to aim at the qualification of projects in terms of accessibility and UD/DfA as well as the effective application of the legislation;
- direct the municipal calls for the design of spaces, goods and services towards planning and solutions in terms of accessibility and UD/DfA;
- update of the Building Regulations to include the discipline of accessibility with the UD/DfA approach and the principles of Accessible and Inclusive Design;

- promote projects to facilitate the accessibility of shops and commercial activities in the city;
- promote initiatives for a tourist reception accessible to all people with motor, sensory and intellectual disabilities and with specific needs (elderly people, families with small children, etc);
- promote soft mobility, walking, cycling and public transport

The systematic implementation of all these actions, from the very beginning of the Plan development, promotes multiple direct and indirect objectives. Among these is the involvement of different areas and subjects of the community and bringing to life concrete and pragmatic actions.

2.4 Features and methodology of the Plan

These guidelines do not contain technical prescriptions, minimum or standard dimensions but are performance-oriented, that is, they provide indications on the methodology and on the useful process for starting and structuring the so-called PEBA.

The methodological indications and characteristics identified by the guidelines for the development of the Plan for accessibility, usability, inclusion and environmental well-being are summarized as follows:.

- Plan for an accessible, usable and inclusive environment. It is recommended to implement the UD/DfA approach indicated by the UN and the European Union respectively.
- Plan shared and participated with the community and citizens. This involves the active involvement of the representatives of the stakeholders (stakeholders / community holders) in the main phases of the processing process
- Interdisciplinary and integrated plan. The issue of accessibility cannot be treated only at the building scale, it is necessary that the adaptation operations of the individual spaces are framed within a planned process, as components of a coherent and larger-scale strategy. The Plan must be coordinated with the other instruments and plans of the city (eg. Territorial government plan, maintenance plan, urban plan for sustainable mobility, urban furniture plan, etc.)
- Digitized, dynamic and upgradable, monitored plan. A digitized (and geo-referenced) plan configures a fundamental tool both in the detection of barriers and in the planning, management and monitoring of interventions.

2.5 The articulation of the Plan into phases

To facilitate the drafting of the Plan, the guidelines present an articulation in phases of the processing process, which develops from the preliminary phase to the definition of strategies and objectives, to the analysis of the critical issues carried out at the same time as the identification of design solutions. The last two phases are focused on the elaboration of the Plan and the planning of priorities and ends with the presentation of the Plan to the citizens (Figure 1).

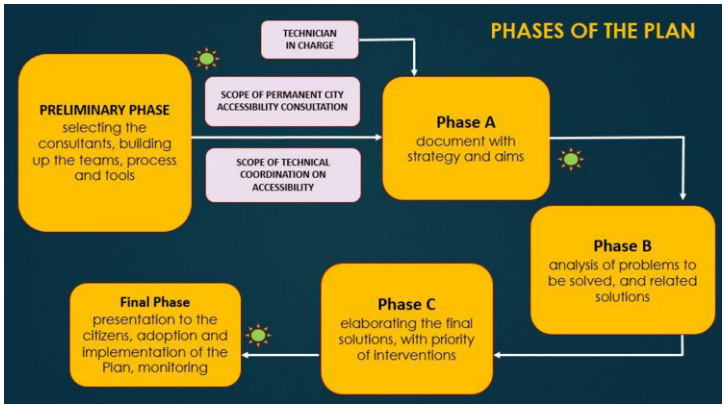

Figure 1. Phases of the Plan of Accessibility

3. Results

The Lombardy Region Guidelines simply suggest the tools, they represent an example of a methodological support to accompany the Municipalities in the preparation and adoption of Accessibility Plans, that can be replicated in other regions.

These Plans can integrate general urban planning tools (such as the PGTU - Territory Government Plans and the PUT- Urban Traffic Plan) so that the issues of accessibility for all take on a strategic role.

They also contribute to spreading the culture and skills necessary for the preparation of tools for a city accessible to all, according to the most recent national and international regulatory, legislative and cultural indications.

They promote a participatory method, which involves decision makers and stakeholders, from the very beginning of the process, and provide indications / strategies to build Accessibility for All.

The Guidelines were drawn up and approved in a very short time, in 2021, following the establishment by the Lombardy Region of the Regional Electronic Register of PEBAs and the related change in LR 6/89.

Two webinars have already been held for technicians / designers, officials and decision-makers of municipalities and local authorities, in December 2021. The second training phase was scheduled for 2022; synergies are envisaged with some universities and the Italian standardization body.

4. Conclusion

To start an effective and solid path aimed at urban accessibility, it is necessary to provide supra-municipal indications on actions, tools and methods, such as those for the elaboration of a Plan of accessibility and usability of the built environment, social inclusion and environmental well-being and its implementation over time. It is first of all necessary to organize the process and structure the appropriate and dedicated working tools, to share strategies, objectives and actions with all the players.

Municipalities are invited to overcome approaches and solutions exclusively dedicated to people with disabilities, to identify solutions that are more able to respond to the different needs of access and use of spaces, services and collective equipment, supporting the ability of each to perform independently daily life and work activities. Considering the different characteristics, abilities, needs, conditions and preferences of people, the recipients of the Plan extend to all citizens, as well as to tourists.

It is a question of planning and managing an open space or a built environment with the broadest and most inclusive vision possible, guaranteeing personal mobility and networks of paths that can be used in safety and autonomy, by the greatest number of people possible, which connect the places of greater interest and attractiveness, services for the citizen and the occasional visitor, also in collaboration with other Municipalities, putting the various interventions into a system and indicating the priority ones. With this approach there will also be benefits in the prevention and resolution of public emergency situations deriving from events or disasters. The aim is to improve the quality of the architectural and urban planning project and consequently that of everyone's life.

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The Level of Inclusiveness of Current 15-Minute City Models. A Qualitative Analysis on How Far City of Proximity Strategies and Design for All Are Merging

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Abstract. This article seeks to analyze different city plans in terms of proximity and accessibility. A total of 6 highly-recognized pedestrian models were chosen to compare their inclusive micro-mobility measures, not only in international contexts (Paris, Melbourne or Portland); but also a closer look will be taken at Spain, as it has managed to present its own referents (Valladolid, Vitoria and Pontevedra). A qualitative approach study was undergone to assess the real extent of inclusive proximity criteria, triggering a more in-depth, critical analysis by recognizing implicit, non-explicit, inclusive micro-mobility measures. The findings show disconnections between accessibility and proximity policies, mainly regarding exclusion of explicit accessibility measures and pedestrian mobility comfortability.

Keywords. micro-mobility, city of proximity, universal accessibility, design for all, inclusive cities

1. Introduction

The 15-minute city model advocates for bringing the city closer to the people, allowing them to reach any essential urban use in a 15-minute walk [1]. Not only does it support universal access by reducing the need to own or be able to drive a private vehicle, but also upholds the inclusion of people with mobility issues making streets pedestrian-friendly, more comfortable to navigate [2], [3].

Although some of the earliest projects date back from the 19th-20th century with the utopian urbanism movement, such as the Garden City and Neighbourhood Unit [4]–[6], these days numerous locations around the globe have rushed to include proximity practices ever since the COVID-19 crisis. These emergent models are willing to guarantee a more convenient, just and sustainable way of pedestrian micro-mobility [7]–[9].

All these models focus on 3 main aspects of the urban scene that must be included in every chrono-typed units [10]:

- Services: they should be varied, equitable and distributed.

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- Streets: they should be pedestrian-friendly, barrier-free, and connected.
- Transport: they should provide near and varied access to public transport.

This article seeks to analyze different urban plans, both established and new ones, in terms of proximity and accessibility. Additionally, there would be a debate around how proximity measures have fostered and promoted pedestrian inclusive micro-mobility. Finally, a closer look would be taken at the Spanish context, in order to compare the international arena to the variations suffered even inside a national context.

2. Method

Proximity projects have been gradually implemented in many cities around the world over the last 20 years, setting precedents for current actions. Some of the most echoed ones at an international level are Paris, Melbourne or Portland, a set that provides an ample perspective due to their varied contexts. Spain has also managed to present examples of its own, such as Valladolid, Vitoria and Pontevedra, whose examination will confirm that even within the same country there are not distinguishable patterns. For each of the six cases, it has been analyzed the scope of proximity policies and how far they much with inclusive criteria to create a city-for-all city.

A qualitative approach through 75 indicators, extracted from a previous state of the art revision, have been used to assess the real context and extent of proximity and accessibility policies, distributed by the 3 main aspects of the urban scene [10]:

- Services: Adequate identification of uses through visual and tactile signs, variety of basic and specialized uses, well-distributed inclusive services for all ages, avoid big lots that may create urban barriers, focus key uses along an axis to reduce journeys, sufficient and varied urban furniture, …
- Streets: Adequate signing on accessible itineraries, continuous and fully connected pedestrian itineraries, pertinent number of crossings with inclusive measures, offering sidewalks of at least 1,5m wide, deep consideration of the slopes' length and inclination, maintenance plans to control surface quality, …
- Transport: Tactile indicators in the vicinity of stops and accesses, correct identification of accessible stops and accesses when not all of them are, strategic location of stops and accesses, creation of a proximity public transport network to ease micro-mobility, …

Each indicator has been assessed under the criteria of "In favour", "Not Considered" and "Against". This results in a comparison between all contexts according to the number and proportion of indicators matching each criterion.

3. Cases of study

Paris, Melbourne and Portland were the selected cases for the international scenario, since they portray different approaches toward urban regeneration: foundation date, primary land use records, demography and extension. These same principles guided the Spanish cases, Pontevedra, Valladolid y Vitoria, which also present a variety of strategies to deal with proximity cities. For all of them, a study of inclusive proximity indicators was applied as it was previously mentioned.

3.1. Paris – 15-minute city

The 15-minute city, or *ville du quart d'heure*, can be the best worldwide-known case of a chrono-typed project due to its high repercussions in the political scene since the recent victory of Anne Hidalgo, the current mayor of Paris.

One of the main actions that are already being implemented is the creation of new car-free streets, which has led to an increase in pedestrian and cycling activity in Paris. Furthermore, its condensed patchwork fostered the incorporation of a policy for public buildings, such as schools, to open their playgrounds out of service hours for the general public, enlarging the available space for people to use it recreationally.

The references used to assess the case of Paris are [1], [11], [12].

3.2. Melbourne – 20-minute neighbourhoods

Inherited from previous projects from the 90s, such as Liveable Communities, the 20-minute neighbourhoods in Melbourne aims to create a better-connected city, where social and infrastructural resources are distributed in proximity nucleus, even in the most sprawled areas.

One of the key contributions of this project, thanks to its extensive trajectory since the 90s, is that public transport and bike lanes should be another of the services provided by the proximity city, and not a means to reach those services. Not only does it increase people's safety, but also promote social awareness towards inclusive environments.

The references used to assess the case of Melbourne are [13]–[15].

3.3. Portland – Healthy Connected Cities

For the past decades, Portland has implemented urban strategies to create more engaging urban environments that could revert the criminal rates and increase pedestrian comfort. Their strategy is to regenerate the city's health by connecting people, the built environment and natural resources (water and wildlife).

They opted for a 20-minute neighbourhood model, using the term "complete neighbourhood" or CN to refer to a whole unit that could grant a set of essential services, active streets, and sufficient public transportation. In this case, they excluded work from its essential-uses list, while including community gardens to promote self-production of groceries.

The references used to assess the case of Portland are [16]–[18].

3.4. Pontevedra – Ciudades que caminan (Walking cities)

In their pursuit to reduce the noise, the pollution, and regain pedestrian mobility quality, Pontevedra opted for a renovation of their urban space. By getting involved in the "Ciudades que caminan" project, they restricted the car rides in their city centre to the minimum needed.

In addition, they developed the "Metrominuto" (Meter-minute) in 2012, a strategy to present the city as walkable and proximal, where all essential uses are displayed in the form of an underground map. This way citizens know how to get to key points in their area and the estimated amount of time required.

The references used to assess the case of Pontevedra are [19]–[22].

3.5. Valladolid – Valladolid Ciudad Próxima (Valladolid Proximity City)

Like any other medium city in Spain, Valladolid allowed cars to enter the historical centre of the city for several decades. However, now they have promoted Valladolid Ciudad Próxima, with which they remove cars from the city centre streets, and substitute them with public transport and pedestrian/cyclable streets.

Its main objective is to integrate all essential uses into a single, nonpolluting network. This has led to the creation of 35,000 m² of pedestrian spaces, where schools, shops, workplaces, and so on, can be reached within a safe, walking distance. However, their proximity plan is unlinked from both the urban and accessibility strategies, making it complex to find the balance between all plans.

The references used to assess the case of Valladolid are [23]–[25].

3.6. Vitoria – Supermanzanas (Great apples)

Vitoria seeks to create streets for pedestrians rather than for cars. For this purpose, they divided the current patchwork into multiple nuclei in which all their inner streets are pedestrian, so the only ones allowed to be cycled by car are the perimeter ones.

This model has been being implemented for the past 20 years and has already proven its benefits towards land use distribution, pollution reduction, and active means of transportation fostering. It has also encouraged the settlement of a variety of uses inside those nuclei so as to create fully-equipped pedestrian streets.

The references used to assess the case of Vitoria are [26], [27].

4. Results and discussion

All 6 cases present their proximity and accessibility plans in different formats. Paris', Melbourne's, Pontevedra's and Valladolid's proximity policies were developed separately from the general mobility plan. As for Portland and Vitoria, their proximity models are included in the general mobility plan. As far as accessibility is concerned, Melbourne, Portland, and Pontevedra added inclusivity measures in their mobility strategies, while Paris, Vitoria and Valladolid excluded them and needed independent plans to achieve healthy and inclusive mobility.

4.1. International cases of study

Multiple levels of inclusiveness were detected in the 3 analyzed cities, varying from Paris, which uses "handicapped" and excludes design for all from the 15-minute city discourse on the assessed documents; to Portland, which directly supports attractive and safe space for "all ages and abilities", including them both explicitly and implicitly in their general urban plan; or Melbourne, which has developed a cohesive set of mobility, accessibility and urban plans, all of them under the same statement of creating "Livable communities" to foster coherence throughout plans.

However, although establishing a set of plans can help maintain coherence throughout all urban strategies, not including explicit guidelines on inclusive criteria in the proximity model could lead to misinterpretations. Not only may it create incongruences when implementing them into a proximity project, but also a sense of

inclusive city strategies being unnecessary. As for Melbourne, this resulted in high rates of Not-Considered indicators as far as the 20-minute neighbourhood plan is concerned.

For their part, Paris presented the most elevated percentages of Not-Considered, mainly due to its lack of connection to other accessibility plans, since no mention of accessibility plans was found, and little consideration for people with disabilities and other affected collectives – as shown in the terminology analysis –.

In contrast to Paris and Melbourne, Portland offered an integrated perspective, finding it unnecessary to redirect to external accessibility references. Although the global level of merging between proximity and accessibility is about Melbourne's, it is the only city that presented a positive percentage of "in favour" indicators in the service set.

4.2. Spanish cases of study

While the 3 Spanish cases were selected to detect possible divergences or patterns inside the same national context, the analysis has shown that there is no relation between none of the models even when they are looked at under the same national standards.

One of the main outcomes is that certain cities, such as Pontevedra, limit their actions to the street itself, presenting little mention to the relationship between the pathways and the services located in the adjacent buildings. This goes against the theory of urban surveillance developed by Jane Jacobs in the 60s, which states that such a relationship is key for pedestrian attraction and wellbeing, thus resulting in safer and more inclusive spaces. This issue is amplified by the excessive focus on private vehicles' policies rather than on pedestrian urban quality, which raises the number of Not-Considered items in every set of indicators. In fact, Pontevedra showed this lack of pedestrian care by delivering a higher proportion of Not Considered items.

Following this line, Valladolid sets a higher number of actions towards the reduction of the traffic in the city centre, setting the focus on the private vehicle. Hence, it may fail to highlight that "no cars" is not synonymous with better pedestrian quality, which risks ignoring pedestrians' necessities over cars'. It also hinders public transport policies, as the percentage of Not-Considered indicators in Pontevedra's and Valladolid's shows.

Vitoria, on the other hand, prioritized pedestrian perspectives, which made it have the lowest Not-Considerate percentages among all 3 Spanish cases. In other words, cities with a people-centred perspective tend to have a better understanding of their needs, resulting in more inclusive models.

4.3. International and Spanish parallel evaluation

Each of the 6 cities has taken different approaches when implementing proximity policies. While some aimed to create nuclei of essential uses and pedestrian comfortability, such as Paris, Melbourne, Portland and Vitoria, other strategies focused on pedestrian mobility as a means of healthy and sustainable transportation, which would be the case of Pontevedra and Valladolid. No relationship has been located between each approach and the level of accessibility of their proximity plans, nor between the geographical contexts of the cities and their potential solutions towards inclusive mobility models.

From all the studied cases, it is clear that a very high number of indicators are not considered in current urban mobility and proximity policies, making it necessary to conduct further studies on improvement measures. On the contrary, few indicators were marked as "against", which is a hopeful sign for inclusive mobility.

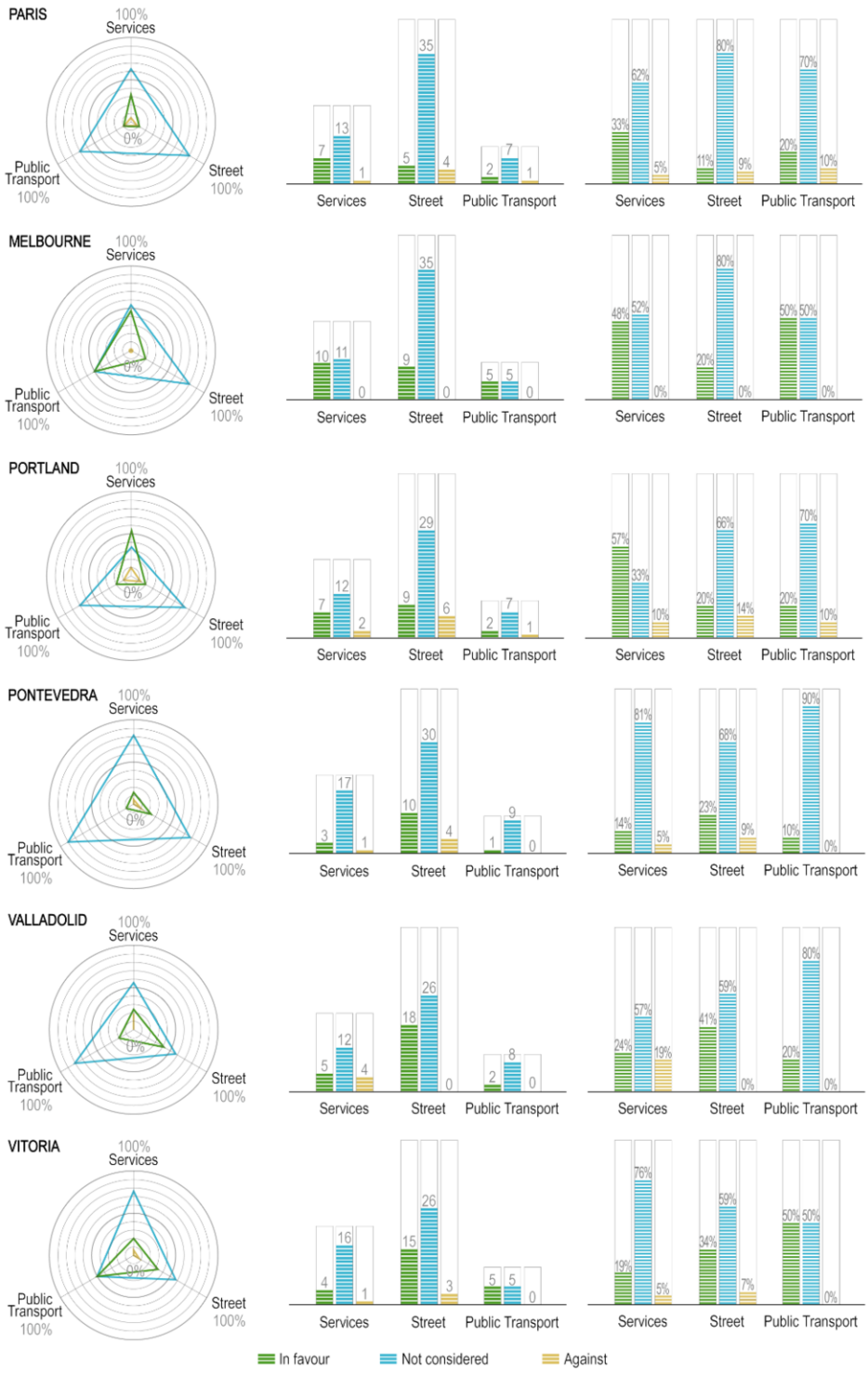

Figure 1. Comparative of cases of study. Author's editing.

As for the public transport set, this low rate of "against" indicators in every case implies that public commuting's promotion has been effective regardless of the context. Although public transport's main objective might not be to improve the mobility of people of all ages and abilities, it helps create more accessible, inclusive and just cities.

In Figure 1 it can be noticed how the different cities have scored in the 3 analysed sections. It clearly reflects all previous comments and shows an eye-level comparison of the results of the indicators. Cases such as Pontevedra and Paris display a noticeable decompensation between non-considerate items and other categories, while Melbourne, Valladolid and Vitoria show more balanced levels. Portland, on its side, presents the only case where one of the indicators set, Services, presents a higher in favour rating than non-considerate.

5. Conclusion

Disconnections between accessibility and proximity micro-mobility policies are present in today's plans. This issue was evidenced by the present study as far as the exclusion of explicit accessibility measures and pedestrian mobility comfortability are concerned.

Firstly, while some cities put forward numerous, unrelated plans, such as Paris, Pontevedra or Valladolid, other locations create more complex policies coordinating multiple disciplines, although the risks of this approach were also highlighted in the case of Melbourne. Lower Not-Considered indicators were delivered by those including accessibility measures in the proximity city models, without referring to external documents, such as Portland. In other words, the fact that urban and mobility plans rely on separate accessibility policies may cause a low presence of measures that could lead to an inclusive proximity city model. Thus, it seems necessary that specific design-for-all measures are included emphasizing their importance and pedestrian safety.

Secondly, connected to the car-centred position, urban comfort also determines citizens' willingness towards using urban space. Walkability can be fostered by improving pedestrian-car interaction and positioning people first, which would improve the relationship between the street and the provided services as Vitoria does. Locating them at a manageable walk time and making that path attractive can grant that people used it. Also, public transport becomes essential to endorse inclusive mobility, ensuring full access to any part of the city for all people, even if they cannot drive.

Overall, this indicator-based analysis has outlined the main problems with the inclusion of accessibility measures in proximity models. Although these disciplines are yet far from each other, the key issues have been detected to promote their resolution, which would result in the creation of more inclusive, proximal environments.

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Inclusive Path Through Pavia: A Study to Link the Langobardic Heritage

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Abstract. The Italian historic centers have an architectural and archeological heritage widespread in the urban structure, which is not always easily accessible due to the orography and materials the streets and the squares are paved with. The topic of the urban accessibility is extremely complex and not easy to solve, also because the removal and overcoming of the architectural and sensorial barriers that could alter the original layout and consolidated historical memory must be avoided. The research investigates the accessibility and usability conditions of the urban environment between the Langobardic building and archeological sites in Pavia (Italy) to identify pedestrian routes that can be covered by weak persons in autonomy or with the help of a companion. The analysis and synthesis of the urban environment produce some maps which report the level of accessibility of the streets and allow to identify the best route between the Langobardic masterpieces in the downtown. The adopted evaluation system is the result of an investigation methodology defined and consolidated over the years by the activities of a group of researchers from the University of Pavia and is independent of the heritage of Langobardic origin; the same methodology can also be used to other types of widespread heritage in the historic center of the city (Romanesque, Lombard Gothic, etc.). The same methodology can be exported to other historical centers and can constitute the tool for the promotion of the architectural and archaeological heritage.

Keywords. Cultural Heritage, inclusive cities, public building and spaces, tourism

1. Introduction

The historic centers of Italian cities are characterized by a rich architectural heritage (which in some cases is accompanied by an equally prestigious archaeological heritage) which represents a strategic resource for the post-pandemic recovery; the last two years, in fact, have significantly changed the way not only of living everyday life, but also of interpreting free time and traveling for holidays.

The research and demand for cultural tourism (already growing in the years before the crisis due to the COVID-19 emergency) is in fact destined for a new growth, also dictated by the limitations and uncertainties that characterize long journeys.

Together with this consideration, it should be noted that one of the objectives of the 2030 Agenda for Sustainable Development [1] (SDG 11) is focused on "making cities and urban settlements inclusive, safe, resilient and sustainable", which calls for the strengthening of efforts to “protect and safeguard the world’s cultural and natural

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heritage" (11.4) and the implementation and adoption of "integrated policies and plans towards inclusion" (11.b).

Before the 2030 Agenda, also the UN Convention on the Rights of Persons with Disabilities [2] (written in December 2006 and adopted in Italy with the National Law n. 18 in 2009) has a specific article (n. 30) about the importance of the Cultural Heritage: "Participation in cultural life, recreation, leisure and sport" and the subparagraph (c) invites to implement the necessary measures so that people with disabilities "enjoy access to places for cultural performances or services such as theatres, museums, cinemas, libraries and tourism services, and, as far as possible, enjoy access to monuments and sites important for national cultural importance".

It is therefore evident the need to find the right balance between a cultural tourism proposal that can attract and satisfy visitors and an urban environment capable of enhancing (but at the same time protecting) the historical, architectural and archaeological heritage; this heritage cannot be traced back to individual building artifacts but often resides in the integrity of the urban environment where open and public spaces are as important as the buildings that define the morphology and the city structure.

The cultural tourism is the realization of the desire to exchange, share and know, dictated by the wish to shorten the distance between oneself and the objects of knowledge and historical testimonies. The identity of the Italian culture can find new opportunities for development in the new forms of relationship between heritage and users, both tourists and residents.

Therefore, it appears appropriate to change the focus on the historical-architectural heritage which can become an element of appeal and attraction, especially if it is included in an integrated tourist-cultural system, capable of satisfying the different needs expressed by potential users.

According to this approach, it is logical not only to adequately intervene on architectural and archaeological emergencies (preserving them and making them available to the community) but also a careful study of the surroundings is necessary, respecting the pre-existing environmental values and also ensuring the entire community the chance of visiting and enjoying them safely and independently.

It cannot be forgotten that in public spaces the perceptive values of the ancient environment are so important as the issues of vehicle traffic management, signage, services, equipment and street furniture. The Cultural Heritage conservation needs proceed hand in hand with the re-appropriation of their public use and the overcoming of architectural and sensorial barriers becomes a technical design point that is not limited to the ancient building, but must affect the urban environment, the usability and availability of services such as transport, accommodation and recreational facilities.

In fact, it is believed that the legibility of the value of the individual artefact cannot be separated from the city and its surroundings, from its practicability and functionality, and also the protection of the image of certain areas must be evaluated according to the real needs of conservation and enhancement.

There are several factors that can make problematic the use of historic centers: from the differences in height to the distances to be covered, from the difficulty of orientation to the phenomena of daytime glare or low light at night; these are elements of discomfort that are perceived by a large number of users, not only by people with disabilities: persons suffering from heart disease, obese people or the elderly and children, who have manners of movement and perception completely different. These difficulties can sometimes be due to physiological or communicative reasons and are differentiated from each other as well as the consequent needs and expectations; for this reason, in recent

years an inclusive design approach has become increasingly widespread (as also recalled by the 2030 Agenda), capable of satisfying the different needs of possible users with different solutions, rather than one based on Universal Design, aimed at identification of a single solution "for all".

The University of Pavia has been working on the theme of the inclusive approach and the usability of urban spaces for several years, taking advantage of a historic center of the city (characterized by a rich historical-architectural heritage) as an ideal laboratory in which to develop methods of analysis and solutions to make an environment capable of satisfying the different needs expressed by the users of the city itself.

2. Method

Pavia is a town in the North of Italy, not far from Milan, characterized by an urban structure in which the Roman origin and the Medieval texture can be easily recognized; it was the capital of the Langobard reign and the seat of one of the first universities in Italy (it has more than 650 years). The morphology of the ground, the proximity of the River Ticino, the pavements of a lot of streets (often cobbled) represent some problems that people with disabilities can find moving in the downtown.

During its history, Pavia has been the capital of the kingdom twice in the Early Middle Ages, first with the Goths and then with the Langobards from 572, when it was conquered by Alboin, until 774, when it was conquered by Charlemagne. Important signs of this significant historical period remain in the historic center; some of them are evident and easily recognizable, others are not evident but no less significant from a historical-cultural point of view.

Figure 1. Sant'Eusebio Crypt, one of the most suggestive Langobardic site in Pavia downtown. (Photo by Elisa Bifano, 2021)

The interest of this work for the Langobard age of the city comes from the peculiarities of this heritage. Different studies, recent archaeological excavations and, in particular, the Paolo Diacono's stories in the *Historia Langobardorum* [3] underline the wealth of this era, but the current experience gives us a heritage that is difficult to read

and to be recognized; from this situation comes the appellative of "extraordinary submerged Atlantis" [4] (Romanini) to refer to a precious treasure of art, that survived only underground in the crypts, or hidden by substrates, incorporated into walls or reused in new architecture, waiting to be rediscovered and unveiled.

The research is focused on some Langobardic buildings and sites located in the downtown and on the identification of an accessible and enjoyable path linking them; the research motivation comes from the idea that the recognition and the taking care of a path for a specific historic period can make the Cultural Heritage more appealing, more apparent and so more accessible and enjoyable.

The research can be synthetized in these steps:

- recognition of the most relevant Langobardic elements in the downtown;
- analytic surveys of the streets within the Langobardic heritage;
- digitization of the survey and database organization;
- depiction of maps of the inclusive path between the Langobardic heritage.

First of all, a historic research was developed to identify the Langobardic heritage and its characters: there are buildings but also archeological sites, that cannot be recognized because of the lack of information and signals; moreover, some churches have been transformed in civil buildings, sometimes private so that it is not easy to enter and visit. This study allows to distinguish 12 buildings/sites that become the milestones of a "Langobardic tour".

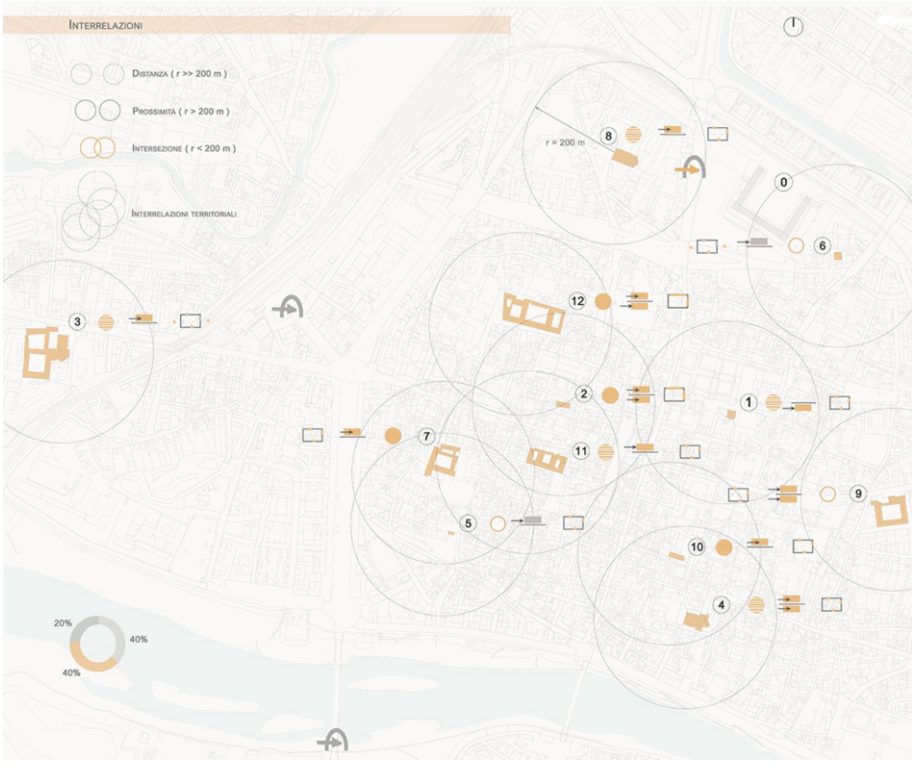

Figure 2. Map of Pavia city center with the Langobardic Heritage masterpieces and the distance within them, in order to identify the best linking path. (Final Thesis Project by Elisa Bifano for the Master in Building Engineer-Architecture at the University of Pavia, *Towards an inclusive town: a method to approach the Cultural Heritage,* 2022)

The urban relationship between the different sites was observed, assuming a radius of 200 m as the "influence" area of each Langobardic site; looking at the downtown (considering the old Spanish surrounding walls) they are so close that it is possible to find a path linking them that respects the radius.

The next step was developed applying an evaluation objective system created during several studies focused on Pavia since 2008 [5]. The assessment tool defines the accessibility level of streets and squares, divided into path's sections, pedestrian crossings and pedestrian areas. The tool works through the identification of macro-indicators structured on objective parameters.

Each area of investigation includes several elements to be carefully considered and the tool is structured to give automatically a value in relation to a "tick" or "not tick" of these elements in the evaluation card. The sum of each value gives a number (positive or negative) which is the reference to assess the accessibility level of the path detached: for values less than or equal to zero the path's section is considered "not accessible" (identified with red color in a map that was realized at the end of the analysis), for values between one and four it's considered "accessible with assistance" (in yellow in the map) and for values equal or greater than five it is considered "accessible" (in green).

The analysis of the path's sections is divided into four macro indicators:

- general characteristics;
- paving of footpaths;
- car parks and public transport;
- urban furniture.

Each macro-indicator is divided into several parameters and the filling includes multiple choices from a list of elements, that takes into consideration both motor and sensorial disabilities. For example, the macro-indicator of "general characteristics" is composed of:

- type of path;
- sidewalk;
- covered path;
- path profile.

The analysis of pedestrian crossings is structured with the same methodology, but with only two macro- indicators with different elements. These macro- indicators are:

- general characteristics;
- paving of crossing.

Finally, the accessibility assessment tool applied to the squares includes the whole pedestrian area. In this case the macro-indicators are:

- general characteristics;
- paving of footpaths;
- urban furniture.

The analysis was recorded between October 2021 and February 2022; the cards have some photos that show critical (pavement narrowing to less than 90 cm, minimum awning and brise soleil height less than 210 cm, inclination of the slope, etc.) or significant elements for promote the independence of people with disabilities.

After the survey's phase and after that the cards were transformed in Excel files to obtain the value of the level of accessibility (as described above), the results are summarized on different maps that show the three levels of the pedestrian paths between two Langobardic sites:

- green: accessible;
- yellow: accessible with a guide;
- red: not accessible.

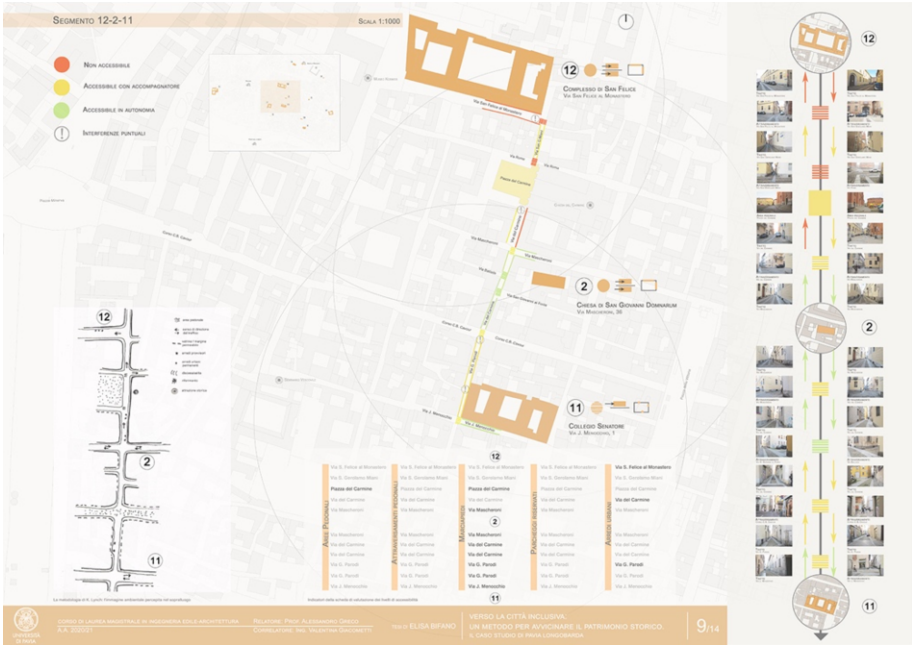

Figure 3. Map showing the path between San Felice and Collegio Senatore (Final Thesis Project by Elisa Bifano for the Master in Building Engineer-Architecture at the University of Pavia, *Towards an inclusive town: a method to approach the Cultural Heritage,* 2022).

3. Results

The results of this part of the research are different maps that show the analysis of the urban environment enclosed within the Langobardic sites.

From the observation of the maps, some conclusions can be obtained:

- many crossings are not accessible, and this is often due to the lack of connection ramps between the paths and the road in addition to a poor signaling for blind and deaf and hearing impaired persons;
- some streets are not accessible, and this is due in large part to morphological issues (slope of the roadway and sidewalks) that cannot be resolved in terms of design without changing the original Medieval image;
- many problems are related to the pavement;
- some pedestrian areas are often critical issues related to street furniture (which is sometimes hindrance to the movement of pedestrians), or to their own morphology.

Moreover, the assessment of the territorial interrelationships between the different Langobard sites highlights the compactness of the sites within the historic center (the maximum distance between one site and another is about 650 m) and allows the

identification of 2 Langobard macro areas in the historic center that develop, from north to south, following the orientation of the cardo maximus (Corso Strada Nuova) and which communicate through 2 parallel axes to the decumanus (Corso Cavour-Corso Mazzini).

Five maps show the best results in terms of distance and accessibility. Each map contains the representation of the current accessibility levels (distinguishing between road sections, crossings and pedestrian areas), a sketch of the perceived environmental image and a scheme that compares the indicators of the accessibility evaluation form.

The union of the different paths creates a "ring" between the Langobardic sites located in the historic center; moreover, the maps show the qualities, in terms of accessibility, and the residual criticalities that have to be solved in order to improve the enjoyability of the Cultural Heritage.

4. Consideration

The research confirms that the historic urban structure has some morphological and material situations that make not easy to move for persons with disabilities. However, it is possible to improve the level of accessibility and facilitate the use of space for persons with disabilities showing them the best path.

The results also represent a useful tool for the planning of maintenance work on public spaces and can be the starting point for the development of projects, wider and more detail to improve the accessibility of the city of Pavia.

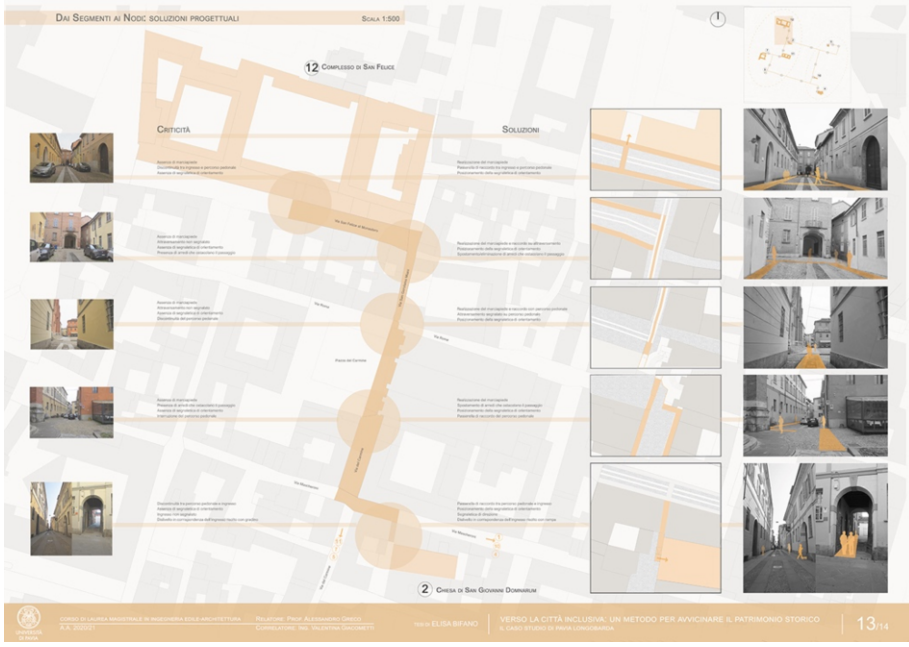

Figure 4. Map showing the critical point of the path that can be useful for programming architectural interventions at the urban scale (Final Thesis Project by Elisa Bifano for the Master in Building Engineer-Architecture at the University of Pavia, *Towards an inclusive town: a method to approach the Cultural Heritage,* 2022).

The structure of the accessibility assessment tool and the syntheses developed into this research are very easy to be understood and to be applied not only for engineers, architects or researchers, but for all.

The objective methodological approach and the systematic application of the assessment system on different case study can represent an important aid for the planning of architectural interventions at the urban scale. The exportability of the methodology can also create an inclusive view about accessibility problems to allow the identification of possible design solutions according to a conscious process.

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Metropolitan MaaS and DRT Schemes: Are They Paving the Way Towards a More Inclusive and Resilient Urban Environment?

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Abstract. Mobility-as-a-Service and Demand-Responsive-Transport schemes are promoting progressively a user-centered approach, made of modularity, flexibility and tailor-made travel experience, and pandemic emergency has furthermore enhanced this new way of thinking, thus representing an unprecedented occasion to develop a new paradigm for a more sustainable and resilient transport system, thus ensuring a greater level of social and territorial inclusion beyond traditional urban borders and outdated distinctions of targeted services for particular users' categories. This paper discusses the main features of MaaS and DRT schemes in order to assess if they could be able to cope with Universal Design principles and to improve metropolitan accessibility accordingly to the urgent request for social and territorial inclusion as sustainable development pre-requisites, made by different stakeholders in the international and European debate (see UNO SDGs or EU Cork Declaration 2.0), and re-launched by many national initiatives (SNAI for Italy, Espana Vacia for Spain…). To re-think metropolitan mobility as a service that can be shaped accordingly to user's needs and to redefine transport supply as a complex puzzle made by different and complementary services could represent a unique opportunity to overcome one of traditional public transport dramatic problems: low mobility demand, whether it be due to sparsely populated areas or connected with specific demands of targeted population categories. Hence this paper recalls some of the recent DRT experiences already active in Genova Metropolitan Area -the so-called DRINBUS above all- along with the on-demand mobility strategy for Ligurian internal areas in order to discuss how this new user-centered approach is acting on the marginalization of remote territories and fragile user categories. The choice to develop a MaaS scheme could re-shape metropolitan mobility as a comprehensive and global mosaic made by multiple pieces, thus making more resilient the entire system thanks to its modularity and redundancy. This allows to make more sustainable "niche" services as well, according to the systemic nature of this mobility platform, thus opposing the present unsuccessful approach of creating ad-hoc options, focusing indeed on the user's request to travel from point A to point B, without the need to define him as urban resident, commuter, disabled or not, towards a greater social inclusion and territorial cohesion.

Keywords. Mobility-as-a-Service, Accessibility, Inclusion, Demand-Responsive-Transport, Universal Design

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1. Introduction

Public Transport in the last decades has been usually offered as a one-fits-all solution, that following its quantification, tries to meet mobility demand of a given territorial context through fixed routes and scheduled timetables (that become more frequent on peak hours and get sparser on non-rush hours).

Entry and Exit hours' time-shifting for workers and students, general population ageing and overall, a deep change in mobility routines, anyway, make transport demand more and more unsystematic, so that traditional PT offer doesn't fits any longer (ISFORT, 2019). Traditional PT offer, anyway, had already showed many criticalities in particular towards most vulnerable users, as the elderly and disabled citizens, or low-transport demand (be them urban peripheral areas or rural settlements) residents and following Covid-19 pandemic outbreak is experiencing a deep crisis (*Potter et al*., 2021).

Subsequent lockdowns, social distancing, smart working and distance learning diffusion, e-commerce led to a sudden contraction of mobility demand (that nowadays in Italy is strongly re-bouncing (Italian Transport and Infrastructure Ministry, 2021) and to a radical change in mobility patterns.

That's why in these days gets more and more frequent the idea to define new mobility models able to guarantee flexibility, modularity, and customization. Demand Responsive Transport and Mobility-as-a-Service are now experiencing a world-wide spread.

Their diffusion doesn't have to be linked only to a greater resilience towards external events, and a consequent higher economical sustainability, but above all because this emergency period can represent a unique opportunity to rethink metropolitan mobility scheme towards a higher level of social inclusion and accessibility, towards an innovative and truly universal mobility offer.

High levels of service customization allow to meet different needs of different user segments, without the necessity to develop unpleasant ad-hoc solutions that in the past addressed specifically the elderly and the disabled, improving their mobility opportunities, thus defining special services, thought as exceptions, more than following a systematic approach towards universal accessibility.

In the following sections some of the experiences from Genoese Metropolitan Area will be explored (as the DRINBUS initiative and DRT for Internal Areas), in order to discuss how this innovative approach can contribute to shape a more inclusive and resilient urban environment, offering tailor-made mobility solutions to update one-fits-all traditional transport offer, according to Universal Design fundamental principles.

2. Universal Design principles and tailor-made mobility solutions

Speaking of Universal Design solutions' implementation in transport sector, the most common initiative concerns the "hardware" actions to guarantee universal access to mobility services.

Usually ex-post solutions are preferred, taking for granted actual mobility scheme and conceiving UD principle of social inclusion as a purpose to be reached through progressive corrections and updates in the long term.

Anyway, as previously introduced, Universal Design aims at more ambitious goals than a simple, thus necessary, ex-post adaptation process: re-thinking the whole services offer and use schemes must be the real objective.

That's why it's particularly important to understand how deeply and significantly innovative solutions as Mobility-as-a-Service and Demand Responsive Transport can affect social inclusion and land accessibility issues: this strong link can find clear explanation referring to Universal Design basic principles.

Looking at the seven key principles introduced by the *Centre for Universal Design at North Carolina State University* in 1997, the connections between this kind of new mobility initiatives and the main universal and inclusive design goals appear direct and evident.

MaaS and DRT implementation represent firstly an equitable and flexible use guarantee. Travel choice modularity and customization, starting from the simple definition of departing and arrival points, are the key features of these new mobility schemes. According to personal capabilities, characteristics and needs, user can choose between different travel alternatives given by MaaS platform, without the necessity to fit in a standard PT offer or rely on his/her own car. Likewise, on-demand services allow usually high customization levels in terms of routes, stops and time to meet universal mobility needs, children, the elderly, and the disabled above all, thus reducing physical effort, too, offering door-to-door solutions. Planning, reservation, and payment operations in both cases are available as simple, intuitive, and seamless functionalities of a digital application, specifically designed to be clear, universally, and easily accessible. The idea is basically to provide universal accessibility to mobility services in order to overcome traditional barriers separating urban and non-urban services, local users and commuters, people who have mobility impairment and people that don't.

Hardware (transport vehicles above all) and software (apps and websites) components goal is not to offer "special" functionalities and infrastructures for specific users' categories, but to introduce a new user-centred approach to meet the user's needs in a targeted and customized way, thus granting a widespread and greater accessibility level.

This principle leads to the use of vehicles that enable people to hop on and off without limitations or barriers of any kind, that are by default designed to meet mobility needs of every user's category and to the implementation of digital platforms which ensure an easy and intuitive use regardless of the user's capabilities.

In this regard, the new perspective offered by Mobility-as-a-Service paradigm, where users are the key element of transport supply which shapes around him/her and his/her need to get from point A to point B, allows to define tailored solutions, without the need to pre-design specifical (thus segregating) ad hoc options to target user's features and necessities.

This innovative and holistic approach overcomes the initial steps of DRT services implementation where they were usually designed to meet transport demand of some "fragile" user's categories (the elderly, disabled..), enhancing their autonomy and self-reliance, their capability to reach essential services, thus making it in a special and different way from the majority of users, supporting in some way those involuntary segregation which *Preiser and Smith* (2011) blame as a failing attempt of social inclusion and engagement.

3. Territorial accessibility

Social inclusion and accessibility improvements are often discussed in relation to specifical users' segments who risk social segregation from the rest of the community due to their mobility impairments linked to physical, economical, age reasons.

It's necessary thought to recall that one of the main pre-conditions to individual mobility is undoubtedly represented by spatial and territorial asset. Local context is at the basis of every individual mobility limitation, thus risking exacerbating personal criticalities.

That's the reason why mobility services planning activities often pay particular attention to low-transport demand areas. Low-transport demand areas are specifical land portions where historical, economical, geomorphological and settlement contingencies are characterized by a poorly dense e little transport demand, so that defining and implementing traditional PT services is particularly unfavorable.

Low-transport demand areas can be found among different local contexts: they can be urban peripheral neighborhoods, hilly or rural settlements, where a complex array of urbanization, orographic, social, and economic factors determine low potential for transport demand (ART, 2018).

The impossibility for local administrations to sustain traditional PT services supply in these contexts often led to substantial cuts to the local PT coverage and extension, thus making personal cars the only way to reach urban hubs, especially during off-peak hours. It's clear that unsystematic mobility boom made this issue even more dramatic.

Peripheral areas accessibility is nowadays pivotal in sustainable development debate on every scale. UNO SDGs in 2030 Agenda, as well as EU Cork 2.0 Declaration, focus on the need to promote an inclusive and universal development scheme, through the engagement of the communities that remained on the fringes of global economic and social growth: this represents the only way to slow down wild urbanization processes, to maintain come level of territorial presence and to design new sustainable development strategies. On a national level, Italy has defined too a National Strategy for Internal Areas in 2013 to focus new attentions and energies on peripheral contexts that went through marginalization and depopulation processes.

To define "universal" mobility services, able to include and not segregate, to engage and involve, is thus fundamental a user-centered approach, not only for individual reasons, but in territorial sense too. Contemporary transport supply has to meet the users' needs overcoming traditional physical and social barriers but getting over those visible and invisible borders that nowadays separate central and peripheral areas, urban and rural contexts.

4. Genova Metropolitan City experiences

To investigate how MaaS and DRT solutions can pave the way towards a more resilient and inclusive urban environment, thus meeting UD principles and needs, it can be interesting to refer to a couple of mobility experiences from Genova Metropolitan Area.

Genova Metropolitan City is located in North-Western Italy, with an 1830 sq.km surface, 67 municipalities and 820 000 inhabitants.

It is a very peculiar and complex context, a thin land stripe between the Mediterranean and the Alps, where urban settlements develop mainly along the coastline, while on the hills only small and rare villages can be found.

Concerning PT services, Genova Metropolitan Area is particularly remarkable as an only operator manages the entire network (with the only exception of railways where a national operator is present). This framework, which is common only to another couple of metropolitan areas in Italy, represents a particularly favorable factor in order to implement MaaS and DRT solutions supporting traditional PT offer.

This is one of the main reasons why several initiatives were launched to support a gradual process of network and fares integration on local transport services (including PT, sharing services, taxi...) to define a metropolitan MaaS platform able to re-shape a new seamless, tailored, and inclusive mobility offer.

Among these re-design operations, regarding PT component, a specifical focus was centered on DRT services. New DRT offer followed two lines of action which both aimed at a more responsive and sustainable way to meet transport demand of low-density areas and most marginalized users' category. According to a user-centered approach it was decided to implement a similar alternative for two very different contexts, which traditional PT services treated in a completely dissimilar way: hilly settlements of Genova Municipality and the peripheral and rural municipalities included in the National Strategy for Internal Areas.

Two on-demand services with pre-defined stops where implemented, focusing on the need to enhance local accessibility, regardless of the initial territorial context and focusing only on the users' perspective and centrality.

According to this approach, particular attention was paid to the equipment of vehicles that respond to updated standards for people with disability and mobility impaired, thus granting universal access also due to the reduction of physical effort thanks to the tailoring potential of DRT solutions.

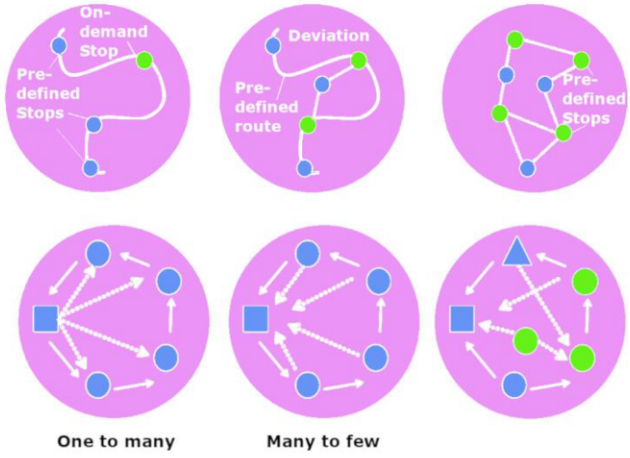

Figure 1. DRT service schemes.

DRINBUS urban experience, was born at the beginning of 2000s, to support traditional PT network in the most peripheral Genoese neighborhoods where residential areas climbed on the hills behind the coastline, without a proper PT coverage. This initiative grew fast in terms of users' appreciation, territorial and time extension.

Nowadays a further expansion would significantly concern some municipalities which are strongly physically and functionally linked to Genova (even though separate for administrative purposes), thus remarking the need to conceive metropolitan mobility as an integrated and flexible system, that overcome traditional and outdated boundaries.

The second experience, which is currently in the pilot phase, concerns a non-urban context, of the Internal Areas identified by the National Strategy, the Antola-Tigullio Area, that includes 16 municipalities from Genoese inland area, where less than 20 000 inhabitants live on a very wide territory, in poorly dense settlements.

Figure 2. Antola-Tigullio DRT pilot vehicles.

Another on-demand service with pre-defined stops was designed along different routes in order to meet several kinds of mobility-demand: municipalities immediately close to Genova demand for direct and fast connections, most peripheral contexts require a local service to link different hamlets.

Briefly introducing these initiatives allows to remark the key issue: travel experience maximum customization, in spatial and time terms, is not convenient for users' accessibility and inclusion only, it enables PT operator to apply similar solutions even to profoundly different contexts, thus determining financial and sustainability advantages due to the economy of scale principle *(Mageean and Nelson*, 2003).

It is particularly interesting to compare these initiatives which locate in very different moments of their implementation process: DRINBUS dates back to more than 15 years ago, while Antola-Tigullio DRT pilot started in February 2022. They represent

in some way two DRT generations: the first one, from the beginning of 2000s, substantially experimental, that tried (technological issues where much more present) to support and integrate urban network to allow non-car users to reach local hubs (sport facilities, commercial areas) that weren't included under traditional PT coverage; while second and contemporary generation seamlessly fits in metropolitan network, without representing a plan-B solution, and making PT more responsive and widespread, indeed.

This time-shift represents a substantial mind-shift, too. Accessibility and mobility have meanwhile become universally recognized rights to be granted to everyone independently from their age, status, origin or physical condition. Customization of vehicles and services has become a necessary pre-condition to fight territorial and social marginalization in a much broader sense: from being a technical solution to reduce costs and enlarge PT users' base to a spread paradigm to assure accessibility thanks to a greater and integrated network, that enables users to reach more destination without the need to increase physical or economic effort.

5. Conclusions

It's clear that accessibility and social inclusion are essential pre-requisites to define a new development scheme for more resilient and sustainable urban environment. Only through equal opportunities in terms of reaching basic services and involvement in social and economic relations (which are key features of urban contexts) regardless of physical conditions, age, and territorial origin it's possible to re-think cities able to face contemporary challenges, climate change above all.

In this direction, making mobility more integrated and tailored, shaping new transport offer to cope with long-distance travel and last mile displacement as well, providing several services that can be easily booked and bought seamlessly, represent the key strategy to put users' needs at the center of urban environment. This is pivotal not only on a conceptual level, but it's even undelayable looking at the present situation. Even though PT is constantly bouncing back from Covid-19 pandemic outbreak, it's self-evident as well that it's necessary to re-design its supply to guarantee economical sustainability, but above all to make it closer and more responsive to a transport demand which is deeply changed.

PT supply will have to follow this change, leaving traditional standardization on pre-defined routes and timetables behind, to reach more flexible and tailored configurations. To re-think mobility as a service, as a modular and redundant system, able to cope resiliently with external shocks, ensure PT economical sustainability, but above all to make users base greater than in the past.

User centered perspective (which is at the basis of MaaS concept) indeed implies to respond to transport demand with door-to-door solutions, often through on-demand alternatives, thus integrating long-distance solutions with last-mile options. This comprehensive approach allows to involve users' segments that need to minimize physical effort for age or mobility impairments reasons, thus offering them the opportunity to directly reach their destination.

This deep change in mobility scheme allows a further step: traditional separation of urban and non-urban services can be overcome, leaving behind the idea that PT substantially belongs to urban centers, providing an integrate transport offer able to make metropolitan mobility easy, flexible, and seamless.

Software and hardware (in terms of infrastructure and vehicles equipment) measures are progressively directing Genoese mobility towards universal accessibility: tailored services and vehicles universal design grant users to reach more destinations, to answer their needs, in an equitable and flexible way, reducing physical effort thus removing visible and invisible barriers of any kind.

Genoese experiences allow to foresee one the possible strategies to follow towards a metropolitan environment that must become more and more inclusive, connected and universally accessible.

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Section 5

Universal Design for Healthcare

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Interpreting Inclusion for Sanitation Perspectives from India: A Contextual Approach to Universal Design

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Abstract. Access to water, sanitation, and hygiene (WASH) for all is fundamental for sustenance. Goal 6 of the UN's Sustainable Development Goals urges that 'universal access to drinking water, sanitation and hygiene' is fundamental as a response in the current post-COVID scenario. Despite Government of India's efforts through programs like Swachh Bharat (Clean India) Mission, there is a long way to go to integrate equity and inclusion in the sanitation facilities of the public realm. This paper is an attempt to understand the aspect of inclusion in sanitation systems of urban public spaces of India, limiting the study to Delhi and Noida, which are in the National Capital Region (NCR). The aim is to explore the contextual challenges of universal design in public sanitation and develop an understanding of what makes a public toilet inclusive in the urban Indian context. A field-based, mixed methods approach is followed which begins with a literature review of government policies & schemes and theoretical understanding of inclusion as well as the role of universal design as an approach to achieve inclusion. This is followed by on-ground studies involving ethnographic surveys, analysis of imagery and field observations. The results show an analysis of the inclusive aspects of sanitation under the thematic domains of public perception, usage preferences and issues in the public toilet experience. The sanitation facilities in urban public spaces are used by a diverse population and the results showcase a collection of the qualitative experiences of a varied set of user groups. The subjective challenges of inclusive sanitation are highlighted through the various stages and components of the entire sanitation system - the design & infrastructure, operations & maintenance, and behavioural patterns. This paper tries to raise new grounded questions to further explore the highlighted marginal distinctions between inclusion and accessibility in the urban public sanitation experience of India.

Keywords. sanitation, inclusion, public spaces, universal design, India

1. Introduction

Access to water, sanitation, and hygiene (WASH) for all is fundamental for sustenance. Goal 6 of the UN's Sustainable Development Goals urges that 'universal access to drinking water, sanitation and hygiene' is fundamental as a response in the current COVID scenario. [1] With the government's efforts through the *Swachh Bharat* (Clean India) Mission, over 100 million toilets were built as of 2020. [2] Despite this effort, even today, the ground reality of public toilets has remained ignored for urban public spaces, although, some well-meaning attempts to understand the situation have been made.

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This paper is of critical relevance to inquire into the whole paradigm of inclusion in a complex social context of India. To understand inclusion, it is important to understand exclusion and its impact. That, by itself, is variable, as lack of inclusion differently affects people with disability, women, men, adolescents, transgenders, and other groups. Caste, class, age, religion, ethnicity, and cultural beliefs further makes the process of inclusion complex for the Indian context. [3] Now, when we add the layer of sanitation, it complicates it further. Thus, the aim of this paper is to interpret inclusion in sanitation in public toilets of the urban Indian context and try to map the issues to bring forth an understanding of the grounded reality and perceptions of varied user groups.

2. Literature Review on Public Sanitation & Inclusion

2.1. Government Initiatives

Throughout the years, the government of India has undertaken numerous initiatives to enhance public sanitation and some efforts have been made in terms of policies as well for enhancing inclusion in public sanitation. Table 1 lists the various government schemes and policies. [4]

Table 1. List of initiatives by Government of India for Public Sanitation & Inclusion

Initiative	Year of Commencement	Relevant Objective
Integrated Low-Cost Sanitation Scheme (ILCS)	1980	Constructing/converting low-cost sanitation units with variations as per local conditions where low-income households have no sanitation system to prevent open defecation.
National Water Policy	1987	Instrumental in setting grounds for the provision of urban and rural sanitation services.
The 74th Constitutional Amendment Act (CAA)	1993	Decentralisation of responsibilities of sanitation services to the ULBs (Urban Local Bodies).
The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act	1993	Prohibition of employment of manual scavengers and construction of dry latrines.
Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act	1995	Mentions adapting toilets for wheelchair accessibility but only for railway stations, bus terminals etc.
National Health Policy	2000	Recognition of the connection between unhygienic sanitation and unsafe drinking water in urban settings.
Valmiki Ambedkar Awas Yojana (VAMBAY)	2001	Mentions sanitation for the urban poor.
Jawaharlal Nehru Urban Renewal Mission (JnNURM)	2005	Instrumental in provision of sanitation infrastructure.
National Urban Sanitation Policy (NUSP)	2008	Mentions a 'focus on hygienic and affordable sanitation facilities for the urban poor and women'.
Service Level Benchmark (SLB)	2008	Included performance indicators in various domains for assessing the service levels in the ULBs.

Nirmal Shahar Puraskar	2010	Encouraged full access to sanitation for all cities.
Rajiv Awas Yojana (RAY)	2011	Enabled all existing slums to avail basic sanitation.
The Prohibition of Employment as Manual Scavengers and Their Rehabilitation Act	2013	ULBs responsible for prohibiting manual scavenging and providing sanitation infrastructure.
Swachh Bharat (Clean India) Mission	2014	Instrumental in pushing every region to become open-defecation free.
SMART City	2015	Promoting 'sustainable and inclusive cities'
Sugamya Bharat Abhiyan (Accessible India Campaign)	2015	Achieving universal accessibility for persons with disabilities in the Built Environment, Transportation, and ICT ecosystem
Rights of Persons with Disabilities Act	2016	Adaptation of toilets for usability persons with disabilities
Transgender Persons (Protection of Rights) Bill	2016	Safeguarding access to public spaces which includes public and community toilets

Apart from various schemes and laws, the government has also launched multiple handbooks and guidelines which promote inclusion for public sanitation. It is evident that multiple initiatives have taken place to make public toilets more inclusive and accessible, and this study helps us in taking a closer look at the on-ground translations of the initiatives.

2.2. Theoretical Understanding

If one is to go a step ahead and interpret the standard definition of 'inclusion', one looks at two things – 'what' to interpret for and 'where'. Here, the 'what' is clearly public sanitation and the 'where' is urban Indian cities. Keeping in mind the context ('where' and 'what'), an attempt is made to develop an understanding, which guides the interpretation of inclusion for the study (Figure 1).

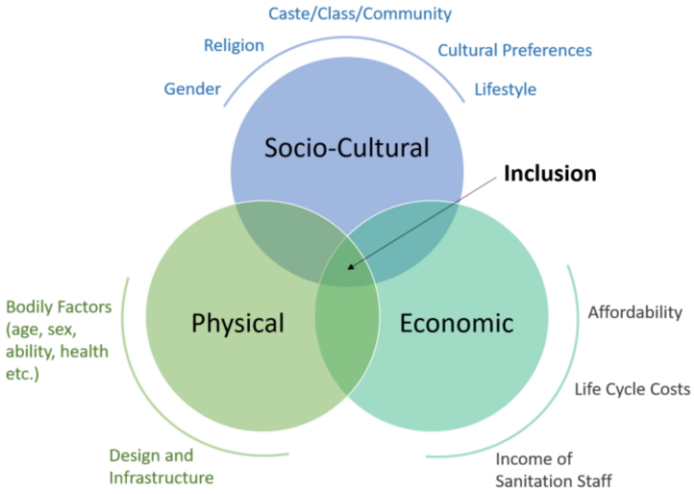

Figure 1. Factors of Inclusion for Public Sanitation. (Authors).

2.3. Role of Universal Design

To achieve the state of inclusion that we have mentioned above, the approach is of universal design. In the context of India, some attempts have been made to better understand universal design as an approach for public sanitation with a prime example being developing five principles of Indian universal design which are as follows: equitable (*'saman'*), usable (*'sahaj'*), cultural (*'sanskritik'*), economy (*'sasta'*) and aesthetics (*'sundar'*). [5] The need for a universal design in the context of Indian public toilets are demonstrated in a study that uses full scale simulation methods to derive specifications of universally accessible toilet design. The study concluded that there is a need to develop thorough universal toilet design standards for India. [6]

3. Study and Its Context

This study was conducted within the Delhi NCR (National Capital Region), specifically the cities of Delhi and Noida, since the aim was to understand the on-ground reality of the public sanitation systems specific to urban Indian context. Six public toilets situated in different urban public spaces of Delhi and Noida, were selected for this study. The context of each of the locations varied from Metro stations, urban marketplaces, malls, commercial hubs and/or a mix of more than one of them.

4. Research Methodology

The methodology was survey-based, and a qualitative approach was followed. The process involved selection of public toilets, photo-documentation, conducting qualitative surveys of users, passers-by and sanitary workers/operators. This is accompanied by field observation and developing field notes.

4.1. Selection of Public Toilets

The toilets were purposively selected after a reconnaissance survey on the following criteria – location feasibility, unique design distinctions and diversity of contexts of the urban public spaces.

4.2. Tools

- **Data Collection**: The tools used for data collection are short, semi-structured, qualitative surveys, photographs and field observation notes. The reason this method was adopted is that most people in the chosen busy public areas do not have much time to spare.
- **Data Analysis**: Once the user responses, photographs and field notes were collated, they were manually analysed. As per the analysis, the emerging and recurring points were grouped to develop thematic clusters.

4.3. Research Ethics

Ethical considerations have been ensured throughout this study. The survey participants gave their due consent for the study. The intent and purpose of the study was explained to them before they gave consent. All the survey participants were free to opt out of the survey at any point of time. The anonymity of the participants has been maintained as all personally identifiable data has been kept confidential. No physical, social, psychological or any other type of harm has been caused to anyone in this study.

5. Field Survey: Ground Reality Perspectives

Based on the data collected we can classify the various stakeholders into two groups as follows:

- Sanitary Workers and Operators (**S1**)
- User Groups
  - Male (**S2**)
  - Female (**S3**)
  - Elderly (**S4**)
  - Persons with Disability (**S5**)

As is evident, this study primarily focuses on out of the list of all user groups possible. The survey was qualitative in nature which involved the following open-ended questions.

1. What do you think about the public toilets that you have visited?
2. How would you narrate your experience of using public toilets?
3. What are the issues you face in using a public toilet?

Out of the six (06) public toilets that were selected for the field study, two (02) were primarily located near a metro station, one was a female-only 'PINK' toilet located near a highway, one located near a popular marketplace and metro station simultaneously and two located in the central commercial hub of New Delhi known as Connaught Place. (Figure 2) A total of 42 individuals participated in the user surveys. The sample set has individuals aged between 19-76 with a representation of diverse user profiles.

Figure 2. Public Toilet Imagery. (Authors).

6. Results and Discussion

Policy schemes of the government primarily focuses on making India an open-defecation free nation, ensuring sanitation for all. The impact of such schemes has been phenomenal – leading to over 100 million toilets being built. However, it would now be critical to ensure access to person with disabilities and other diverse needs, as an inclusive thought and not as a segregated concept. Universal accessibility thus has a potential to be contextualized with this Indian lens that supports the Universal Design India Principles of availability, accessibility and affordability as overarching ideas of inclusive sanitation. With this direction, the analysis of the responses of the participants for each of the questions that were explored in the previous section leads to three distinct thematic domains as given in the following sub-sections.

6.1. Public Perception

Majority of the participants (~60%) with representation of men (~70%), women (~30%), elderly (~7%) and persons with disability (~5%) reflected about the unhygienic conditions as a challenge in public toilets. Most women highlighted the issues of cleanliness and odour (foul smell). However, most men had a perception of improved existing toilets. Senior citizens had a perception that in certain areas, public toilet condition has improved a lot but in other areas, the condition still has a scope of improvement. Persons with visual impairment and locomotor disability mentioned that despite some well-meaning design interventions in public toilets, accessibility is still a major concern apart from cleanliness and hygiene. A select few participants highlighted their perception being that 'mostly people from lower socio-economic classes' use public toilets.

6.2. Usage Preferences

Half of the participants (~50%) prefer to use public toilets only in case of emergencies or do not use them at all. These participants alternatively prefer to use toilets in a nearby restaurant/hotel or prefer to wait till they reach their destination during commute within the city. The reasons quoted varied between 'never had the need to use public toilets' to 'too dirty to use'.

6.3. Issues

Diverse issues have been tabulated from diverse stakeholder perspectives as documented in Table 2. (S1 – Sanitary worker/Operator, S2 – Male users, S3 – Female users, S4 – Elderly, and S5 – Persons with Disabilities)

Table 2. Issue Mapping of Public Toilets

Issue	Description	Stakeholders
Location and Availability	Often toilets are located at inappropriate places (e.g., locations with insufficient lighting) or are unavailable which makes it difficult for multiple user groups to access.	S3 (23%), S5 (100 %)
Accessibility	Some toilets are wheelchair accessible but not accessible for persons with other disabilities. Different layouts and unavailability of tactile features makes it challenging for persons with visual impairment.	S5 (100%)
Infrastructure	Doors, fixtures, etc. are often working improperly/damaged, with other issues of leakage, electrical equipment issues, water supply issues and poor construction quality.	S1(17%), S2(10%), S3(27%), S4 (100%), S5 (100%)
Amenities	Unavailability of handwash liquid/soap, waste bins, napkins/hand dryers, sanitary pad disposal systems and pad dispensers for menstruating individuals.	S2 (10%), S3 (40%), S5 (100%)
Safety and Privacy	Broken doors and inappropriate location lead to privacy and safety concerns, primarily for women.	S3 (32%)
Hygiene	Cleanliness and odour issues were widely reported, with issue of insufficient cleaning supplies.	S1 (60%), S2 (41%), S3(63%), S4 (66%), S5 (100%)
Aesthetics	People mention that the overall look of the toilet should stand out else they miss it.	S3 (5%)
Public Behaviour	Irresponsible disposal of sanitary pads, diapers, etc. and indecent behaviour by users towards sanitary workers and vice versa. Homeless individuals are discouraged from using toilets.	S1 (100%), S2 (7%), S3 (10%)
Finance	Staff prevents the use of toilets if not carrying change of low denominations, with unavailability of digital payment methods. On the other side, the sanitation workers earn a very meagre income and often reside in the toilet complex itself.	S2 (7%), S3 (11%)

6.4. Key Findings

Some key findings from above mentioned issues and field observations are as follows:

- Users with disabilities need more time to use a public toilet and that leads to impatience of other users in queue.

- Women face a queueing issue as the number of WCs are not always sufficient. Additionally, there is a lack of provision of a sufficiently large waiting space.
- The accessibility of the elderly in public toilet design requires further studies owing to the various dimensions of elderly needs, e.g., incontinence owing to health conditions,
- People, largely men, prefer to urinate in open and secluded areas despite availability of public toilets nearby.
- Some users are not comfortable to use Western toilet typology and hence, they tend to search for toilets which have an Indian toilet typology.
- The subject of toilets and public sanitation is considered a taboo topic to converse about, as reflected by some respondents' hesitation.

7. Concluding Remarks

This paper has been able to bring out the marginal distinctions between accessibility and inclusion and decode the perceptions of accessibility from a grounded urban Indian perspective, to bring universal design to a uniquely contextual perspective where age, gender and ability are reflected. Developing inclusive sanitation for heterogeneous groups, like the ones represented in this study, reflects the need of rethinking universal design in the Indian context.

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Healthcare Facilities and Dementia Development of a Framework to Assess Design Quality

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Abstract. Abstract. In recent years, thanks to advances in medicine and the role of prevention, life expectancy has experienced rapid growth (from 77.6 to 81.3 years), resulting in an increase in Non-Communicable Diseases (NCDs) and years lived with disability. One of these is dementia, with about 7 million people currently affected in Europe while the number is set to double by 2050. These patients are complex due to the serious changes in their cognitive sphere, altering perceptions of their physical space. Because of age and multimorbidity, they are the most frequent users of healthcare facilities, but these structures often are not suitable to them. For example, during the COVID-19 pandemic, healthcare facilities demonstrated criticalities in structural and social issues. To this end, a rethinking of these spaces is urgent, and the use of Evidence-Based Design (EBD, the design based on findings from scientific research) can be a method to create safe and suitable environments. This study aims to develop an evaluation framework to assess the design quality of healthcare facilities for people with dementia. A systematic literature review was conducted to define a set of requirements that the space must have to be prosthetic for the patient. The framework consists of three macro areas (i.e., physical, social, and cognitive aspects), seven criteria, and 24 sub criteria. The proposed framework is a starting point for the development of inclusive projects for people with dementia and cognitive disabilities. Architecture has recently begun to approach the topic of dementia, especially in Italy. Therefore, it is urgent to investigate which are the main aspects to be considered in the design and renovations of facilities to make them as therapeutic and prosthetic as possible, creating places where the wellbeing of patients is the priority, both physical and psychological. To this end, EBD needs to become a habit for designers to create facilities suitable for people with both cognitive impairments and for every user, in line with the principles of Universal Design.

Keywords. *Dementia, Evidence Based Design, Healthcare Design, Users Centered Design, Wellbeing*

1. Introduction

In 1946 the World Health Organization changed the definition of health, from the absence of diseases to *"a state of complete physical, mental and social well-being"*[1].

Alzheimer's acts on all parameters used by the WHO to define the state of health. In fact, Dementia is defined as *"a syndrome – usually of a chronic or progressive nature – that leads to deterioration in cognitive function (i.e. the ability to process thought) beyond what might be expected from the usual consequences of biological ageing. It*

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affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement" [2].

Dementia is an *umbrella term* that encompasses several different specific syndromes, including Alzheimer's disease (the most frequent representing 60% of total diagnoses), Lewy Body Dementia, Vascular Dementia, Frontotemporal Dementia, and others like Parkinson's disease. Discovered for the first time in 1906 by Alois Alzheimer, Alzheimer's disease predominantly affects people in their elderly years (over 65 years old) with the World Health Organization (WHO) estimating that about 60% of those affected by a state of dementia are affected by this disease.

These patients are complex due to the serious changes in their cognitive sphere, altering perceptions of the space. Because of age and multimorbidity, they are the most frequent users of healthcare facilities, and often these places become their homes. Unfortunately, a lot of these structures are not suitable to them, as emerged for example during the COVID-19 pandemic, where healthcare facilities have demonstrated criticalities in structural and social issues [3].

It therefore becomes of extreme importance the creation of adequate health structures, correctly designed, and built as places within which the sick find themselves having to live with diseases. One of the major challenges in the relationship between the built environment and aged patients occurs when they have problems with the perceptions, like cognitive disorders and dementia.

Currently, there are no definitve treatments for dementia but only pharmacological therapies which may help manage certain symptoms.

2. Research Aim

Dementia become a health priority only in 2017, when WHO provide the *Global action plan on the public health response to dementia 2017-2025*.

In this document is mentioned as a proposed action to: *Develop a pathway of efficient, coordinated care for people with dementia that is embedded in the health and social care system (including long-term care), to provide integrated, person-centered care as and when it is required.* [2]

Another aspect to take into consideration is that in recent years, the field of healthcare facilities has witnessed a great deal of development also in the field of investments. In fact, we often witness the realization of new structures by large groups present on the European scene.

Healthcare facilities for Alzheimer's patients are, unlike ever before, a social infrastructure that are to be considered fundamental for a country like Italy. The data of the disease mark a continuous increase on a global scale and the trend does not show signs of decreasing, with a 50% increase from 2005 to 2013 [4].

The problem has both economic, due to the cost in public spending, and social impacts, because of the problems in the cognitive sphere.

It becomes of extreme importance the creation of adequate health facilities, properly designed and implemented as places within which patients find themselves having to live as their disease slowly progresses. There is a clear and urgent need of instruments that can support both institutions and designer in creating news structures and renovate the existent ones in the with a view to putting the patient's well-being first. The use of Evidence-Based Design (EBD, the design based on findings from scientific research)

offers insight into how to create these safe and suitable environments [5] for people with cognitive diseases.
This study aims to develop an evaluation framework of the main aspect in the design of the built environment for people with dementia.

3. Methods

To deeply analyze the current existing studies and methodologies applied by other researchers and scientific experiences at national and international level, a systematic literature review has been conducted. The goal is to identify, evaluate and interpret the existing body of recorded documents [6].

This phase is focused specifically on the relationship that occurs between the built environment and patients with dementia, analyzing the problem statement and trying to provide which specific criteria can determine the relationship. This research has shown the specific needs that a structure for elderly patients has to provide.

The research was performed in October 2021 using scientific database Scopus, PubMed, and Web of Science but, additional information has been gathered from secondary sources, known as "grey literature", using search engines that merge both scientific literature and documents not published in an official database. For example, using websites like https://www.healthdesign.org.

To specifically select the part of literature which deals with this topic, it is fundamental to select a group of words that belong to different research fields to combine them. The main research field that has been analyzed using three level of keywords as shown in the following Table 1.

Table 1. Searching strategy.

Searching themes	Searching terms
Dementia	"Dementia" OR Alzheimer OR "Memory loss"
Facilities	"Nursing hom*" OR "Long-term care" OR "Assisted living" OR "Care home"
Built Environment	"Built environment" OR Design OR space*

Some combination of words led to literature outputs based on neurobiology or psychology field, as the terms "architecture" and "personal space" generating biases. For these reasons, eligibility criteria have been applied to separate in-scope from out-of-scope results, and avoid biases generated.

Inclusion criteria are English or Italian Language, time: after 2009, when the first village for dementia has been developed. Exclusion criteria included articles that were related only to medical or biological issues.

4. Results

The review began with a total of 276 articles, but thanks to the restrictions of the field, the search returned a total of 173 results.

The application of eligibility criteria allowed for selecting 94 papers (removing 32 duplicates and 45 articles written before 2009). The final articles were selected by

analyzing the keywords, titles, and abstracts, so the other 57 were excluded. Remaining articles have been fully read, resulting in a final 25 selected articles. The Prisma analysis clearly shows the process (Figure 1).

The data collection was made using an Excel table to extract data.

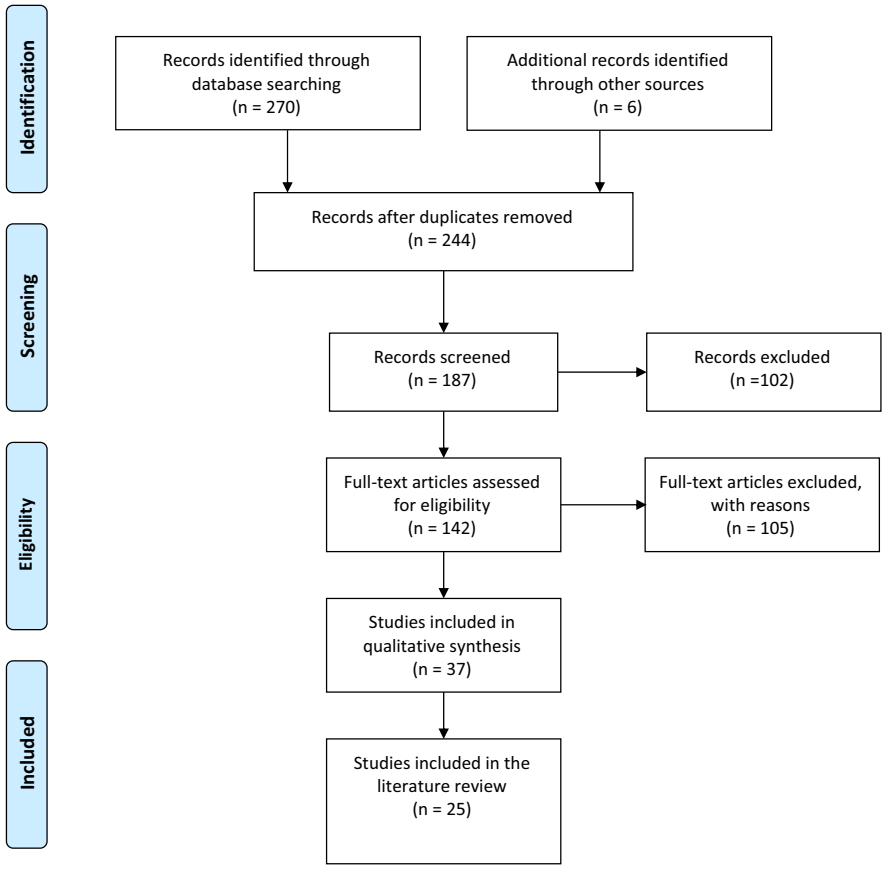

Figure 1. Prisma flow process

Of the total papers, 20 are articles, 4 reviews, and 1 book. The studies were both experimental (11) and theoretical (14). The 28% of papers have been written in 2021, 12% in 2020, and the remaining 60% between 2019 and 2009 (pre covid).

According to the analysis of 25 papers that have been selected, some common points emerged. In particular: criteria for reach patients' wellbeing (11), assessment tools (7) or checklists (2), and design strategies (5).

The review of the papers about criteria (11) and design strategies (5) allows also to identify some aspects that emerged as relevant in the relationship between built environment and architecture, that are: *homelike environment*s (7), *safety* (8), *layout* (5), *outdoor and green spaces* (3), *wayfinding* (5), *activities* (3), *scale* (3), *location* (2), *indoor environmental quality* (IEQ) (5) and *technologies* (2).

These findings have been identified by comparing the two analyses that were then divided into three macro areas (i.e. physical, social, and cognitive aspects) with 7 criteria

and 24 sub criteria, fundamental in the relationship between built environment and dementia (Figure 2).

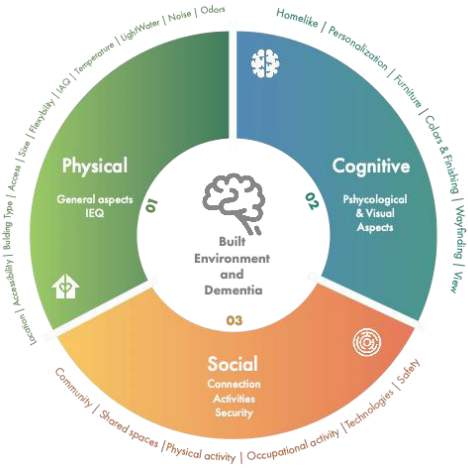

Figure 2 - Framework

Regarding the *macro areas* and *criteria*, it is possible to describe them as follows through the information gathered from through the literature.

Physical Aspects, the physical environment in which we live significantly influences our well-being. A patient with dementia who finds themselves living in a different place than the one they have long been accustomed, will experience the relationship with his new living environment in a unique and challenging way. For this reason, some aspects may particularly affect their well-being and behavior.

Physical aspects are those related to the configuration of the various rooms in the facility and can be divided into *general aspects* and aspects of *indoor environmental quality*.

General aspects: those related to the configuration of the space.

- **Location:** the place where a structure stand can play a crucial role. An ideal facility must necessarily be well connected to the urban center to enable caregivers to travel to it easily.
- **Accessibility:** easy accessibility must be allowed (e.g., bus stops and large parking areas), and environments must be easily used by different users (considering the distance, size, weight, and number of people)
- **Building Type:** architectural conformation can have a positive or negative effect on the users of a space, architecture should provide a connection between indoor and outdoor spaces, connecting outdoor and indoor spaces at each level
- **Access:** the access should be controlled 24/7 and be placed in strategic locations
- **Size:** the size of each facility should be 8/10 people per household and no more than 20 to provide a family environment
- **Flexibility:** space should be able to be repurposed as needed, for example, the creation of several small areas for activities

Indoor Environmental Quality (IEQ): these are the aspects related to space quality according to different parameters such as air quality, temperature, light.

- **Indoor Air Quality (IAQ):** Indoor air comes from the outside (outdoor) atmospheric air and enters confined spaces through ventilation (natural and/or artificial). Adequate ventilation, as well as a stable humidity level (40-60%), must be ensured in enclosed or semi-enclosed spaces
- **Temperatures:** inside the facility, temperatures should be between 20°C and 24°C in winter and between 22°C and 26°C in summer
- **Natural Light:** Natural light should be provided in as many places as possible to promote circadian rhythm
- **Artificial Light:** Artificial light must make up for the absence of natural light and provide even lighting throughout the facility
- **Water:** The water temperature of bathroom faucets should be controlled, as well as the amount of flow, to avoid scalding accidents and excessive water consumption
- **Noise:** The level of noise within spaces must be controlled to avoid situations that may cause confusion and disorientation in patients with dementia.
- **Odors:** Odors should be used as positive stimulation for patients, and bad odors should be contained through, for example, appropriate storage of soiled material

Cognitive Aspects, Cognitive/perceptive aspects are those related to perceptions of the environment. Indeed, the patient with dementia has among the symptoms a different perception of the environment, often accompanied by significant visual disturbances. Two sub-criteria are included in this macro-area, those related to psychological aspects and those more purely related to the visual sphere.

Psychological aspects: aspects that can influence the psychological well-being of patients are contained

- **Homelike:** the space should resemble as much as possible the common domestic environment of homes, presenting comfortable furnishings and spaces
- **Personalization:** the facility should allow, within the limits of the legal provisions on fire prevention, for personalization of spaces, especially the most private ones such as patient rooms
- **Furniture:** furniture should be usable and comfortable for all patients, regardless of physical condition. For example, tables and counters must be of adequate height to be easily used even by elderly people in wheelchairs and with mobility difficulties

Visual aspects: these are the aspects related to the visual perception of spaces and signs by patients with visual impairment

- **Colors and Finishing:** the colors should be used as prosthetics for people (e.g., providing contrast to make certain aspects such as doors and bathroom fixtures stand out clearly)
- **Wayfinding:** aspects that help patients recognize the space they are in; signage should be properly designed, according to the latest guidance, using both text and images in contrasting colors
- **View:** a view toward the cornerstones of the city or town where the facility is located allows the patient to understand where he or she is and identify with a known context

Social Aspects, are related to the patient's sociality, both toward caregivers and through activities that may affect behavior

Connection: the presence of connection with caregivers, for example in activities and time spent together

- **Community:** allowing connection with the community through different activities
- **Shared Spaces:** the presence of different spaces that can encourage sociality between patients

Activities: the facility must provide different activities to maintain cognitive function

- **Physical activity:** the physical activity must be allowed and guaranteed within the facility, either through the presence of special gyms or by encouraging movement through protected and safe circular paths
- **Occupational activity:** occupational activity is essential for patients to control behavioral disorders and is a nonpharmacological approach to therapy control. These activities must be carried out in specially designed areas, in spaces properly sized to accommodate groups of patients in varying numbers.

Security:

- **Technologies:** the use of various technologies to monitor patients' health conditions, movements, and provide rehabilitation strategies as needed
- **Safety:** ensuring safety in both emergency and common situations for different users, without stigmatized solutions and minimizing risk

Table 2. Framework definition

Macro areas	Criteria	Sub Criteria
PHYSICAL ASPECTS	**General Aspects**	P.01.1 LOCATION
		P.01.2 ACCESSIBILITY
		P.01.3 BUILDING TYPE
		P.01.4 ACCESS
		P.01.5 SIZE
		P.01.6FLEXIBILITY
	Indoor Environmental Quality	P.02.1 IAQ
		P.02.2 TEMPERATURE
		P.02.3 LIGHT
		P.02.4 WATER
		C.02.5 NOISE
		C.02.6 ODORS
COGNITIVE ASPECTS	**Psychological**	C.01.1 HOMELIKE
		C.01.2 PERSONALIZATION
		C.01.3 FURNITURE
	Visual	C.02.1 COLORS AND FINISHING
		C.02.2 WAYFINDING
		C.03.3 VIEW
SOCIAL ASPECTS	**Connection**	S.01.1 COMMUNITY
		S.01.2 SHARED SPACES
	Activity	S.02.1 PHYSICAL ACTIVITY
		S.02.2 ACTIVITIES (OCCUPATIONAL)
	Safety/Security	S.03.1 TECHNOLOGIES
		S.03.2 SAFETY

5. Conclusions

The environment in which one lives assumes a role of primary importance for the definition of one's identity, allowing a person to acquire self-awareness through a path of continuous exchange, experiences, and stimuli coming from space as a scenario of life. In other words, humans recognize themselves through the relationship we establish with the physical and emotional environment in which we move. Several aspects of the built environment in care homes can impact residents with dementia [7].
This research sets the stage for a thorough definition of what specific design/architecture requirements a health care facility for the elderly with dementia should have.
This literature review showed how relationships between the built environment and patients occur in different qualities of space, whether physical, perceptual, or social. These can have different implications on users, acting as a positive stimulus on patients' quality of life and clinical outcomes.
This framework is proposed as a starting point for the development of inclusive projects for people with dementia and cognitive disabilities. Architecture has recently begun to approach the topic of dementia, especially in Italy. Therefore, it is urgent to investigate which are the main aspects to be considered in the design and renovations of facilities to make them as therapeutic and prosthetic as possible, creating places where the physical and psychological wellbeing of patients is a priority. The next step in the research is to analyze in detail the aspects most likely to influence outcomes such as disease progression and affect objective factors such as activities of daily living or well-being. To this end, EBD needs to become a habit for designers to create facilities suitable for people with both cognitive impairments and for all users [8], in accordance with the principles of Universal and Inclusive Design [9].

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Designing Hospitals Through the Lens of Universal Design. An Evaluation Tool to Enhance Inclusive Healthcare Facilities

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Abstract. Various studies highlight a gap on reliable methods to measure the quality of projects and environments in terms of Universal Design (UD) and Design for All (DfA). In particular, healthcare facilities need decision support systems to improve the well-being of as many users as possible through a systematic approach. The present research proposes an evaluation tool to support designers and decision makers in the adoption of UD to develop healthcare facilities suitable for a wide range of users. Several methodologies have been adopted: an in-depth literature review on the current state of knowledge on UD evaluation, workshops and focus groups with both users and experts, and the analysis of four hospital case studies. The result was an evaluation framework built by using a Multi-criteria Analysis (MCA) methodology. The first version of the tool was applied to an American hospital and validated d in an Italian pilot case study. The research outlines a tool called *Design for All A.U.D.I.T.*, able to evaluate Physical, Sensory-cognitive, and Social qualities based on a hierarchical framework with criteria and indicators based on UD and DfA. The framework evaluates the different areas of the hospital from outdoor to indoor spaces, allowing hospital administrators to act to improve the well-being of users according to the critical aspects of UD identified by the tool. The analysis provides a report of the facility status and design strategies to support designers for new projects or buildings renovations. The application shows that *DfA A.U.D.I.T.* can assess hospitals by examining both spatial qualities and DfA criteria. The tool could represent a decision support system in the national and international context, where many hospitals are not newly built. Further research will include application in different facilities and building typologies, aided by the flexible structure of the tool, which allows measurement of the environment's quality in terms of DfA and UD.

Keywords. Inclusive Design; Design for All; Evaluation; Hospital; building performance assessment

1. Introduction

More than 25% of the European population faces accessibility problems every day in both indoor and outdoor spaces. The issue is crucial, especially in hospitals, which are

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used by people with varied needs and health statuses. The design of healthcare facilities is gradually placing people at the center to meet the needs of many users, without being limited to purely functional aspects. Therefore, research focuses on the hospital environment as a complex social structure, because of the plurality of functions and users (e.g. patients, visitors, workers) with varied needs and impairments [1]. In the hospital environment, aspects such as accessibility, orientation, and comfort, too often report criticalities and disabling situations, with a negative impact on the well-being of people, which compromise the performance of the entire service [2]. However, if users' needs are considered early in the design process, they can be integrated into interventions, limiting the cost of later modifications [3].

Awareness of the benefits of an inclusive environment on all people is growing, to allow everyone to take part in social activities with the same quality of experience, ensuring the dignity of all users [4]. Different approaches to universal design (UD) exist in relation to the geographical context where they have been introduced. UD was developed in the United States [5] followed by the Principles of UD to guide professionals in the application of UD (Connel). *Design for All* (DfA) was defined in Europe in 2004 as "*the design for human diversity, social inclusion and equality*" [6]. All of the theoretical approaches have the common objective to "enable and empower a diverse population by improving human performance, health and wellness, and social participation" [7]. This paper uses the term *UD* to describe all of the aforementioned design philosophies.

Even if the effectiveness of UD is proved on people's well-being [8], there is no official and scientific agreed upon methods to support the design of inclusive environments in a practical way, neither to evaluate objectively how UD is applied or what outcomes are achieved [9-10]. Sustainability assessment protocols for post-occupancy evaluation (e.g. LEED, BREAM, WELL) perform an assessment with objective indicators; however, they only consider legal accessibility standards or a single UD indicator in the whole protocol.

Systematic and scientific approaches that support the translation of inclusive strategies into design practice are still used in few studies [10]. They would make the benefits that UD has on a wide range of people with diverse needs tangible [11]. It is therefore necessary to introduce a performance-based approach that can assess the quality of usability and inclusion of environments by means of measurable and objective criteria in order to support designers and decision-makers on issues of such complexity [12]. In particular, this is crucial in healthcare facilities, to integrate human factors in the design process and provide a real impact of inclusive design on people's well-being [13].

The present study proposes an evaluation tool to support designers in the adoption of UD to develop healthcare facilities suitable for a wider range of users [14]. To date, there are no systems in Europe to assess and certify the inclusion of a building or an environment. The tool allows an objective and performance-based evaluation of the quality of hospitals according to UD and DfA strategies [15].

2. Objectives and Research Questions

The objective of the research is the development of a tool aimed at supporting decision-makers in the hospital environment to enable the design of inclusive environments according to UD goals by evaluating the quality of the environments in an objective and performance-based way. To date, in Europe, there are no systematic evaluation methods

to certify UD and measure the impacts of inclusive design. The developed tool assesses physical, sensory-cognitive and social quality, focusing on the needs of people, from staff to patients and visitors, ensuring a support system for decision-makers and designers. The research aims to bridge the gap between theory and practice in UD, showing the tangible aspects of UD through indicators that allow users to define its quality. In this regard, the main research questions address the following issues:

- RQ1: How is it possible to measure the quality of a project in terms of UD, assessing the usability of environments and social inclusion through a performance approach to generate objective and evidence-based data?
- RQ2: How is it possible to measure the usability and inclusion in hospital environments and projects to improve the well-being of diverse users?
- RQ3: What is the best way to evaluate these factors to support decision-making for both new projects and existing buildings?

3. Method

The research methodology is set up according to three different phases that define a process: (1) Analysis: State-of-the-art; (2) Elaboration: Research and definition of the tool; (3) Application and validation: Case studies. The research is based on an interdisciplinary approach, since the tool is the result of a plurality of methods involving both theoretical and empirical analysis.

3.1. Analysis phase

This phase provides an overview of UD and DfA strategies in the national and international context, with references to the related legislation framework. A systematic literature review addresses the relationship between UD/DfA and evaluation [12]. Through *Scopus* and *Web of Science* databases, more than 1,700 scientific contributions emerged. Of the 21 most relevant, the existing evaluation theories, criteria, methods, and tools on DfA/UD are analyzed. Finally, an analysis of DfA in relation to healthcare environments is performed, from which current gaps emerge, including that there are no specific tools for the hospital environment.

3.2. Elaboration phase

This phase describes the development of the tool. The UD assessment framework is generated from data collected through the analysis of results obtained from the literature review; with the analysis of four existing hospital settings; and direct involvement of stakeholders (experts and users with and without disabilities) through six workshops aimed at understanding the objectives behind an inclusive project [16]. Data were gathered following a Multi-criteria Analysis (MCA) methodology [17] to adopt a reliable approach to compare qualitative and quantitative data of the same project. The framework was then reviewed through interviews with national and international experts to gather data on the characteristics of UD in health care settings.

3.3. Application-validation phase

This phase involves testing the tool on two existing private hospitals as pilot case studies to test the reliability of the assessment system. The first version of the methodological tool was applied to a hospital in Buffalo (NY), to test the usability of the method in an international context. This study allowed for revision of the structure of the tool along with a focus group with experts. In addition, a questionnaire was developed with expert support and applied to the hospital. The questionnaire was used to compare the objective analysis of the tool in relation to the users' experience (staff and visitors) within the same hospital. The study confirmed the validity of the evaluation instrument by comparing its requirements and categories with the items of the questionnaire. A second version of the tool was validated at a hospital in Milan (Italy), highlighting the strengths and weaknesses of the new version.

4. Results

The study explored the evaluation of UD quality in relation to the hospital environment to improve the use of spaces and social inclusion for all different individuals, going beyond the minimum accessibility requirements for specific categories of users. This research fills the gap identified by the extensive literature review: a lack of DfA or UD assessment and support tools that can measure performance through a scientific and systematic approach (RQ1). Especially in the context of healthcare facilities as complex constructs, methods for prioritizing interventions are needed to support decision-makers in managing the complexity of user needs.

Table 1. *Design for All A.U.D.I.T.* evaluation framework.

Categories	Criteria	Indicators
1. Physical quality	1.1 Usability	Comfort in using spaces Comfort in using furniture
	1.2 Functionality	Flexibility Distribution
	1.3 Safety & Security	Minimize risk situations Safety and security perception
2. Sensory/cognitive quality	2.1 Wayfinding	Orientation through the layout Visual and perceptible information
	2.2 Understanding	Information is easy to understand Communication and info awareness
	2.3 Environmental Factors	Light Acoustic Thermal comfort Air quality
3. Social quality	3.1 Well-being	Healing environment Health promotion and physical activity Hygienic conditions and maintenance
	3.2 Social inclusion	Users care and cultural appropriateness Social relation Design process

The research develops the *Design for All A.U.D.I.T.* (Assessment Usable Design & Inclusion Tool) [14], a UD performance assessment tool, capable of evaluating both hospital projects (decision support system) and existing buildings (post-occupancy

evaluation) (RQ2). The structure of the tool is based on sections related to the various areas of the buildings and the proprietary UD assessment framework is related to each of them (Table 1). The spaces that represent the various sections are: outdoor spaces, entrance, internal circulation, support spaces, core spaces, and general service.

For each section, the evaluation adopts a performance-based evaluation framework (Table 1) developed in the study through MCA (phase 2). The framework is composed of a hierarchical structure able to evaluate three DfA/UD outcomes: physical quality; sensory-cognitive quality and social quality; eight criteria; 20 indicators; and nearly 500 requirements derived from the literature and case studies [12] to compare quantitative and qualitative aspects of the same project. The tool's requirements represent the performance design strategies that the project should reach as goals. The UD quality assessment is the result of meeting the requirements defined for each environment through a binary and weighted system The tool is based on a performance approach through goals to be achieved, in a process of dialogue with designers and decision makers.

The diagram (Figure 1) shows the overall assessment of the 'Entrance' area carried out during one application in a hospital. The score for each of the indicators is derived from the presence or absence of various requirements (building's features).

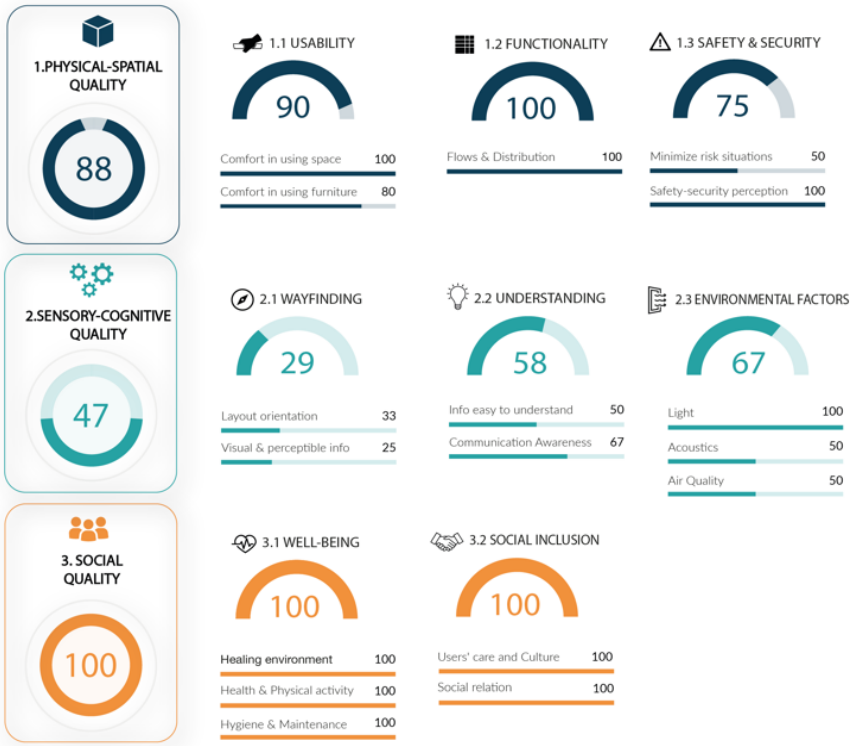

Figure 1. Outcome of one hospital pilot case study assessment through the *Design for All A.U.D.I.T.*

This hierarchical structure allows the tool to be easily implemented and updated over time by modifying the indicators and requirements related to new evidence. In addition, the framework is composed of a flexible criteria and indicators (C&I) structure for all building types, applied and developed in this study for the hospital environment.

The proposed evaluation method is based on a performance approach, providing architects with targets to achieve related to user needs, overcoming the performance approach of current accessibility legislation. The framework clearly defines the relationship between UD goals and outcomes on people's well-being.

With respect to the comparison between UD and DfA evaluation, this research sets the stage for a relationship between the American and European scientific scenarios on these fields, to support the improvement of the inclusive environment for a wider range of users. The tool is based on the UD approach that the Goals of UD [7] promote: an evaluation using objective and performance indicators.

On the other hand, the few accessibility and inclusion assessment tools that have been developed in the last twenty years are based on checklists that provide only percentage values with respect to the quality of various environments. *DfA A.U.D.I.T.*, intercepts from the European DfA strategy, the need to consider each project in a specific context and provide the designer or decision maker with descriptive knowledge [18]. The requirements, which in existing tools are simply divided by areas of the building, in *DfA A.U.D.I.T.* are organized through the DfA framework, which allows users to understand the specific characteristics and the real impact of UD/DfA strategies. For example, it is possible to assess the 'Wayfinding' or 'Security' criteria in relation to the entrance, and not just the entrance area in a general way.

Finally, the tool is able to provide the following different feedback: graphs that directly show the percentage of quality achieved with respect to each space of the building and the different UD/DfA criteria; floor plans analysis; reports with qualitative and quantitative information on the evaluation, which include different levels of detail related to areas of the hospital or UD features (RQ3).

4.1. Findings from the tool application

In both pilot case studies, hospital administrators and designers familiar with the project were involved during the evaluation process and data review prior to completion of the study. It was demonstrated how the tool can be incorporated into a post-occupancy evaluation analysis to provide objective data, combined with other methods, such as interviews, focus groups, and questionnaires, which were conducted in the first pilot case to obtain feedback from users.

The applications demonstrated that *DfA A.U.D.I.T.* can assess hospitals by examining both spatial qualities and DfA criteria. For spaces, ‘horizontal circulation’ had the best scores in both hospitals (76% Italian, 88% US). Regarding DfA/UD principles, the lowest score was ‘social inclusion’ (87%) in the Italian hospital and ‘wayfinding’ the lowest in the American one (39%).

In addition to the percentage, the evaluation can also be graphically represented in plan, with colors assigned by the evaluation representing the judgments (Figure 2). In this way, the evaluation report provides a direct understanding of the critical areas using a six-color rating scale. The same analysis can be completed at the level of categories, criteria and indicators for each area.

The assessment can be used to compare different case studies or to give suggestions on how to improve the building periodically thanks to the indicators. The outcome of the assessment, in the case of existing buildings, highlights the criticalities in the DfA/UD characteristics and provides design strategies for improvement, while in projects, it provides best practices to be followed with respect to aspects not yet considered. In addition to assessing the quality of spaces, the tool aims to provide decision support to

identify priorities for intervention. The tool is intended to be used to support decision makers, designers, and managers of facilities, from the beginning of the design process, focusing on the needs of people.

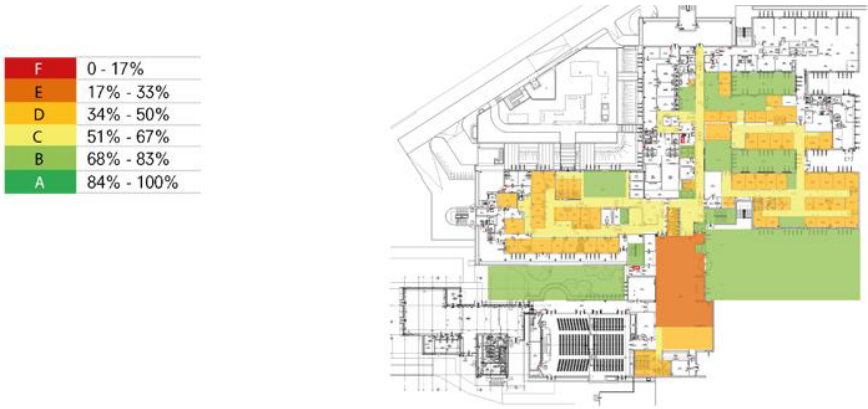

Figure 2. Graphical representation of the color-based evaluation of the Italian pilot case study.

Through the adoption of MCA, it demonstrates it is possible to measure DfA quality through an objective evaluation process and compare quantitative and qualitative aspects of the same project.

5. Conclusions

A method to improve inclusion in healthcare facilities has been developed, adopting both DfA and UD strategies in a rating system that evaluates buildings' performance. On the one hand, the study demonstrates that UD strategies can be applied in hospital design to improve accessibility and well-being for all users. On the other, the evaluation of hospital buildings highlights the importance of discovering the impact of the built environment on user well-being and making the benefits of UD measurable.

Currently, the tool is being applied in a larger sample of hospitals and healthcare facilities, to continue the validation process. The research has only tested the tool on existing hospitals, but there are plans to apply it in new projects as well. In this regard, a comparative study could be carried out between the performance of a new hospital designed (following the assessment proposed by *DfA A.U.D.I.T.)* and a hospital that does not consider the DfA assessment to collect evidence-based data, demonstrating influence of DfA on people's well-being.

The tool could represent a decision support system in the European context, where many hospitals are not newly built, and have problems with accessibility, wayfinding, user comfort, and inclusiveness, which compromise the overall service. In addition, *DfA A.U.D.I.T.* could also be used for the design of new Italian local healthcare facilities to support the main hospitals called "*Case di Comunità*" and "*Ospedali di Comunità*".
The proposed DfA evaluation framework is flexible for other types of public buildings (e.g. offices, restaurants, schools, etc.) by modifying some requirements and indicators, as a system for a UD validation. In particular, in the Italian context the Italian Recovery Fund P.N.R.R. has allocated several resources for the promotion of Social Inclusion (mission 5). The research could then not only support making cities more accessible, but

also more inclusive for different users. In addition, the flexibility of the tool would allow its use by public administrations to assess the inclusion of projects and the quality of space usage in terms of accessibility. In Italy, the evaluation of the accessibility of public buildings is mandatory for each city with P.E.B.A. (*Piani di Eliminazione delle Barriere Architettoniche*) prescription. *DfA A.U.D.I.T.* could propose a systematized and innovative evaluation process to support public administrations, which would also favor the involvement of citizens as an active part of the process.

Overall, the research aimed to bridge the gap between theory and practice on DfA evaluation and to support the design of inclusive hospitals to improve the well-being of as many users as possible.

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Transforming our World through Universal Design for Human Development
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Developing Innovative Solutions for Universal Design in Healthcare and Other Sectors

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Abstract. For over half a century, researchers have sought to better understand the needs of people with disabilities in the built environment, and for more than a quarter century, they have sought to understand the effectiveness of universal design (UD) on a wide range of people and populations. This research led to the creation of the *innovative solutions for Universal Design (isUD)* building certification program, which addresses knowledge gaps in the practitioner's field with UD criteria. The *isUD* focuses on commercial buildings but aims to expand to other sectors including healthcare and residential settings. The research and outcomes used in the development and evaluation of the *isUD* combined with lessons learned from implementation of the *isUD* program suggest a path forward to improve and expand the program. Several research studies have evaluated the effectiveness of UD standards. One study compared university residence halls, one of which was built using a draft version of UD standards using a guided tour and online surveys among other methods.[1] Another study used online surveys to compare a workplace built using the *isUD* with the former workspace.[2] Another study used in-person surveys to compare public right-of-way features pre- and post- design intervention.[3] Lastly, an innovative doctoral dissertation that proposes a new methodological tool to evaluate UD in healthcare settings [4-5] has been analyzed to inform the *isUD*'s expansion into the healthcare sector. The results indicate there is value in using UD to address equal access to and use of facilities for people with and without disabilities, and people of diverse social, cultural, and economic backgrounds. Facilities built using UD standards and tools are more usable, comfortable, and satisfying for users. However, the results also indicate there is room for improvement to make the *isUD* tool more effective. These improvements will better enable expansion of the tool to be usable in settings with more specialized requirements. While UD is often effective at improving human performance, health and wellness, and social participation across some measures, and while tools that assist with UD implementation may further help achieve these outcomes, to gain widespread adoption across multiple sectors, such tools must be shown to be consistently effective in achieving UD outcomes across all measures. These improvements can help expand availability of UD to a wider, more diverse audience.

Keywords. Inclusive design, healthcare, standards, certification

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1. Introduction

The effectiveness of universal design (UD) can be ascertained by measuring performance of users of an environment and the extent to which the environment enables full participation, inclusion, integration, and equality for users, regardless of users' age, size, gender, abilities, or circumstance.[6] Benchmarking for UD in practice is often frustrated by the lack of standardized data types and quality, particularly for post-occupancy evaluations and action research addressing case-specific problems.[6] However, improving generalizability is only part of the difficulty in benchmarking UD. One definition of UD is "a *process* [emphasis added] that enables and empowers a diverse population by improving human performance, health and wellness, and social participation."[7] Its authors explain that "[UD] should recognize the context in which design takes place rather than posing an absolute standard to every situation."[7] Other definitions also recognize the utopian nature of UD, but often include the caveat that the pursuit of inclusion be reasonable. [7] Thus, UD is an ideal in the long-term, but must also be realistic to be practiced in the short-term.[7] So, in addition to generalizability, another challenge is the ability of researchers to identify whether or not a particular design is in-fact UD, given that UD is a continual and contextual process.

One means is to measure the relative success of a design in achieving specific UD *outcomes*, as expressed in the definition, "to improve human performance, health and wellness, and social participation."[7] The definition's authors also specify eight *Goals of Universal Design*: body fit, comfort, awareness, understanding, wellness, social integration, personalization, and cultural appropriateness.[7] It is reasonable for researchers to measure UD outcomes by comparing user performance in one setting to user performance in another setting specifically designed to achieve UD outcomes. One challenge is that each setting must be similar in as many aspects as possible but different enough in key UD criteria such that one setting can be defined as UD while the other cannot. It is not enough to measure whether outcomes have been achieved in one setting but not another. One setting must have implemented UD criteria aimed at achieving those outcomes and the other setting must not, but be otherwise similar. Additionally, the study instruments must be sufficiently narrow to elicit responses related to those UD criteria. Thus, determining the specific UD criteria existing in a setting is critical to evaluating the effectiveness of UD.

In the U.S., civil rights legislation and building codes offer minimum criteria to accommodate people with disabilities.[1] These criteria do not identify how to address best practices related to UD outcomes, nor usability, comfort, and convenience for the population at-large.[1] Until as recently at 2015, there were no evidence-based standards on how to achieve the desired outcomes of UD – only informal checklists.[1] Subsequently, standards have been developed for benchmarking UD, such as the *innovative solutions for Universal Design*, (*isUD*).[8] *isUD* is described as a set of research-based solutions for public and commercial buildings paired with a certification program.[8] However, *isUD* currently focuses only on public and commercial buildings, but does not address other settings such as residential or healthcare. Previous research exists examining individual UD features [9] and examining buildings as a whole [1-2], but this research is still limited to specific settings. Research is needed in various settings to validate the findings of initial research on the value of UD standards.[2] Research in university residential life [1], workplace [2], public rights-of way [3], and healthcare settings [4-5] has now been completed. The latter research proposes a new performance-

based *Design for All A.U.D.I.T.* tool to evaluate UD in healthcare settings through a framework of criteria and indicators.[4]

While these four settings cannot represent all of the settings that exist in the built environment (so more research will still be needed), now is an appropriate time to begin to compare the research across these various settings to determine the commonalities and differences between the studies. Are the data types and quality standardized? What improvements can be made to future research in different settings too improve the generalizability of results, if any? If UD is an iterative "process," [7] does this research suggest any directions for improvement? How can the research inform improvements to UD standards to ensure they are reliable benchmarks for future research and expansion?

2. Methods

A researcher reviewed the methods and results of four studies, each involving evaluations of the effectiveness of design in achieving desirable UD outcomes. The involved different settings: university residential life [1], workplace [2], public right-of-way [3], and healthcare[4]. A researcher reviewed the methods, results, and conclusions to determine similarities and differences, and identify areas where greater uniformity could improve the generalizability of results. The researcher also evaluated each study to determine what improvements to UD standards or new UD benchmarks could be beneficial for future research and future standard development.

2.1. University Residential Life

This study used a post-occupancy evaluation "to determine if a universally designed building provides a significantly better user experience than a similar building that was not."[1] Other objectives included "determin[ing] if the draft [UD] standards were effective in contributing to the improved experience."[1]

One of the evaluation methods was a guided tour of people with little or no experience in two buildings: one built using draft UD standards, and the other not, while collecting task ease/difficulty ratings on a seven-point Likert scale, along with structured interview responses. Researchers compared responses using a two-tailed paired samples t-test. Another method collected online surveys of people residing in each building, asking residents to evaluate specific features in terms of satisfaction, safety, and comfort on a five-point Likert scale, and open-ended feedback. Researchers compared responses using a two-tailed independent samples t-test. Additionally, three expert evaluators assessed the extent to which a specific UD feature was present in each facility, with their scores weighted on five-point "level of agreement score."[1]

2.2. Workplace

This study also used a post-occupancy evaluation to compare two workplaces for the same employer, one designed with UD features, which replaced a non-UD facility. Employees at both sites completed an online survey before and after occupancy of the new facility. The survey used some of the same questions from the first study, but also new pilot-tested questions on physical spaces, environmental conditions, and alignment with outcomes of comfort, health/well-being, safety from accidents, work collaboration, informal interaction, productivity, and satisfaction. The response format was a five-point

Likert scale, with open-ended feedback in each section. Researchers compared sites using the Mann-Whitney *U* test, and examined the relationship of overall UD outcomes to outcomes in specific areas using the Spearman rank correlation test.[2]

2.3. Public Right-of-Way

This study evaluated a public streetscape before and after an improvement project to determine user perceptions of satisfaction, convenience, and safety. The study also evaluated specific opinions on elements of the environment and design preferences. The study used an in-person interview of pedestrians using the streetscape both before and after the project, which included sidewalks, crosswalks, landscape, signals, and installation of bulb-outs at crossings. The response format consisted of a five-point Likert scale, and general open-ended feedback. Researchers compared participant demographics using the Mann-Whitney *U* test and Chi-square tests, and captured impact on the outcome variables using a series of ordinal logistic regression models.[3]

2.4. Healthcare

This study outlined a UD assessment tool proposing a new evaluation framework able to assess different buildings' typology, focusing on healthcare facilities.[4] The new hierarchical framework includes three categories of UD qualities (physical-spatial; sensorial-cognitive, and social qualities) with related criteria, indicators, and requirements resulting from multiple methods: a systematic literature review on UD evaluation, workshops with users and experts [5], and analysis of four existing hospital settings. Data were gathered following a multi-criteria analysis approach. The tool has been applied in two hospitals' pilot case studies. The first application (U.S.) allowed testing of the first version of the rating system, which was reviewed by an expert focus group. The second version was validated in a second pilot case study in Milan, Italy. In addition, researchers used a questionnaire in the first hospital to test whether or not the objective evaluation of the proposed tool aligns with the subjective user experiences.

2.5. Summary

The first three methods use qualitative ordinal data to compare one setting to another, while the latter uses a mix of qualitative and quantitative indicators and measurable requirements arranged on a rating system. The statistical analysis models varied amongst the studies. In some cases, the design settings are different facilities with different users. In others, different settings with *some* of the same users are measured. In one case, the same setting was used pre- and post-intervention. In all cases, there was no *direct* relationship between the survey questions and specific Goals of UD or improvement areas, but there was *a* relationship. The tool used in the healthcare setting did establish a framework organizing the design requirements by category, criteria, and indicators, that assesses the quality of buildings in multiple areas, and allowing a mapping to the UD improvement areas and Goals of UD. The studies all account for user familiarity with the settings but not all report on the significance of this.

3. Results

The results indicate that settings using UD concepts are generally equivalent to or rated more favorably than comparison settings as it relates to users' perceptions of usability, satisfaction, safety, comfort, health/well-being, collaboration, interaction, productivity, and convenience, with some notable exceptions.[1-3]

3.1. University Residential Life

The guided tour and online survey both found the UD building rated significantly higher (p=0.05 or better) than the comparison on 86 comparison items (Table 1). The comparison building rated higher on 5 comparison items. There were no significant differences for the remaining 41 comparison items. This supports the hypothesis that the UD building would provide a better user experience than the comparison building.[1]

Table 1. Number of university residential life comparison items with significant differences (p=0.05 or better)

Number of Items	Guided Tour Method	Online Survey Method
Universally Designed Building Rated Higher	56	30
Comparison Building Rated Higher	2	3
No Significant Difference	27	14

Researchers did not conclusively determine if the draft UD standards contributed to the improved experience; however, a preliminary analysis used expert evaluator assessments to identify whether or not a UD feature was present in each building. Researchers calculated an "incorporation rate" based on these assessments, and compared the user ratings to the incorporation rate, finding at least twice as many items with significantly higher user ratings above the incorporation rate as below (Table 2). This may indicate a relationship between number of UD features and positive user ratings.[1]

Table 2. Number of items with significant differences (p=0.05 or better) by presence of UD strategy

Number of Items	Guided Tour Method		Online Survey Method	
Relationship to Mean Incorporation Rate	% Higher	% Lower	% Higher	% Lower
Universally Designed Building Rated Higher	15	7	17	6
Comparison Building Rated Higher	0	0	2	1
No Significant Difference	4	11	4	9

3.2. Workplace

The results indicate employee perceptions of UD outcomes were generally positive at both sites. For many UD outcomes and features, the UD site rated higher (Table 3). However, depending on the area of the building evaluated, sometimes the non-UD site rated higher. No significant differences were found in terms of overall comfort, health/well-being, safety from accidents, and satisfaction. The UD building rated higher in terms of collaboration and interaction, but lower in terms of productivity, likely because this building had more open workspaces and fewer private workspaces. Ultimately, the research showed that a higher UD certification score does not necessarily result in satisfying *all* UD outcomes. It suggests that introducing UD features alone may not offset negative outcomes caused by other design decisions not addressed by UD standards (but perhaps should be) and that user surveys may still be necessary to

determine if UD outcomes have been achieved, rather than presence of UD features alone.[2] It also supports weighing certification scores to give more importance to primary function areas.

Table 3. Number of workplace comparison items with significant differences (p=0.05 or better)

Number of Items per Category	UD Site Rated Higher	Comparison Site Rated Higher	No Significant Difference
Overall UD Outcomes	2	1	4
Workspace UD Outcomes	0	6	1
Workspace Features	4	4	1
Cafeteria UD Outcomes	6	0	1
Cafeteria Features	3	0	2
Interior Circulation UD Outcomes	0	0	4
Interior Circulation Features	3	1	5

3.3. Public Right-of-Way

Post-construction participants reported greater satisfaction than pre-construction, particularly amongst frequent walkers, with pedestrian-level improvements contributing most to this finding, such as sufficient crosswalks, pedestrian signals, and new landscaping. However, reported frequency of walking activity pre- and post-construction was unchanged (Table 4). Perceived safety and convenience of biking and walking remained unchanged (no change to bicycling was expected, as the project did not focus on bicycling). Pedestrians' perceptions of excessive traffic speed increased after the improvements, possibly due to pedestrians being closer to traffic at the new bulb-outs and mid-block crossings, and the unchanged posted speed limit. Future areas of research should include similar studies on highways with additional traffic calming measures such as reduced speed limits, bicycling improvements, and diverting traffic to alternate routes. Another area for future study is the impact complete streets measures may have on highways that are not major arterials (such as smaller, residential streets).[3]

Table 4. Public rights-of-way improvement perceptions listed by significant difference (p=0.05 or better)

Sample	Post-construction Rated Significantly Better	Pre-construction Rated Significantly Better	No Significant Difference
Full sample	Overall satisfaction Enough crosswalks	Exceed Speed Limit	Safety walking Safety biking Convenience walking Convenience biking Traffic supports walking Traffic supports biking
Frequent walkers	Overall satisfaction Convenience walking		Safety walking

3.4. Healthcare

Researchers used the *Design for all A.U.D.I.T.* tool to evaluate two private hospitals, one in Buffalo (U.S.) and one in Milan (Italy).[4] The rating system allowed researchers to analyze spaces in both facilities including: outdoor spaces, entrance, interior circulation, support spaces, core spaces, and overall service; and to analyze UD qualities through the tool's eight criteria: usability, functionality, safety and security, wayfinding, understanding, environmental factors, well-being, and social inclusion.

Regarding the facilities' spaces, horizontal circulation had the best scores in both hospitals (76% Italy, 88% U.S.). Vertical circulation had the lowest score (46%) at the Italian hospital. Outdoor spaces had the lowest score in the U.S. hospital. Regarding UD qualities, the Italian hospital's highest score was in environmental factors (84%) due to sustainable design, while its lowest score was social inclusion (54%). The U.S. hospital scored highest on social inclusion (87%) because it provides diverse services for users. Both hospitals scored low on wayfinding (59% Italy, 39% US) due to layout and signs.

The analysis demonstrates that the tool can evaluate spaces and outcomes along dimensions of health and well-being, comparing different building features. The system can identify critical aspects, suggest design strategies, and define intervention priorities.

3.5. Summary

The results generally support that UD has a favorable effect on many UD outcomes, but is inconclusive on others. However, there are some exceptions where other design objectives outweighed the UD features (e.g. the open-office plan rating lower due to lack of privacy despite other UD features). Additional research is necessary where the effect of UD interventions was inconclusive. Additions or revisions to the *isUD* design criteria and/or program as a whole may be necessary to address areas where outcomes are not achieved and where competing design objectives overshadow potential UD benefits.

4. Conclusion

While studies show that UD is effective at improving human performance, health and wellness, and social participation by some measures, there is still more research necessary to ensure this will be the case for all UD measures. Tools that assist with UD implementation (e.g. *isUD*) can help achieve these outcomes, but these tools may require revision to be more effective as currently used, and to efficiently expand to other sectors. Improvements to the *isUD* tool will help expand availability of UD to a wider and more diverse audience. The following considerations for future research and improvements to the *isUD* program may aid its expansion to other sectors and improve its usability.

The user perceptions collected should be more consistent across studies, and be more consistent with the improvement areas and Goals of UD. Future studies comparing settings should primarily attempt to measure improvements to human performance (i.e. body fit, comfort, awareness, understanding), health and wellness (i.e. wellness), and social participation (i.e. social integration, personalization, and cultural appropriateness). Future studies could further identify a common set of related sub-goals (e.g. safety from accidents as a sub-goal of wellness), and overall measures such as satisfaction. Some of these sub-goals may also change based on the setting (e.g. workplace task performance, healthcare outcomes). In expanding the *isUD* to other sectors, it is likewise important to consider consistency with the Goals of UD while developing the design interventions. The *Design for All A.U.D.I.T. Tool* [4] offers one potential framework: 1) categories relating to the quality of the space (e.g. improvement areas), 2) criteria forming the desired outcomes (e.g. goals), 3) indicators of those outcomes, and 4) specific requirements intended to achieve those outcomes (e.g. UD criteria).

Future studies should clearly define the UD features definitively present in one setting but not the comparison setting, with each intervention paired to specific Goals of UD (e.g. Comfort: Setting A gives users control over temperature and setting B does not,

with users asked to rate level of thermal comfort). This could help enable researchers to determine that a particular Goal of UD was achieved, and could help determine if the UD interventions related to that Goal *may* have been a reason (to be further explored by open-ended responses, quantitative data, and/or analysis of other features). Without this, it is difficult to determine if a specific UD intervention has the intended outcome. The study may contribute to the growing body of evidence that UD *works* in a general sense, but evidence in the specific sense is necessary to improve the *isUD* criteria and better inform the program's expansion.

Participant ratings of the importance of an issue could help improve the *isUD* scoring system, in addition to the criteria. Since user rankings of importance of an issue could change based on the setting, one possible consideration is to consider a different scoring system in different settings, using a similar set of UD criteria (e.g. user control over temperature could be worth more points in a residential setting than restaurant).

Lastly, the infinite number of design interventions that could negate positive UD features raises the question of whether or not a list of specific UD criteria (such as *isUD*) could be sufficient on its own. Is it more appropriate to certify buildings based on whether the outcomes or Goals of UD have been achieved as measured by research? Or, is a combination more appropriate; i.e. a limited set of objectively measurable design interventions coupled with more subjective user experience research? These options may make marketing *isUD* more difficult because building owners and designers could not *guarantee* an outcome until after a building is constructed and occupied, which may make expert UD consultants *necessary* to ensure certification. Future expansions of *isUD* should consider the balance of the number of UD criteria necessary, the necessity of post-occupancy evaluations as part of the certification process, and the impact this has on the usability and marketability of the program as a whole.

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Home-Based Primary Care: Adaptability Criteria for the Bedroom Layout and the Furnitures/Technological Equipments

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Abstract. Within the past decade, advances in medical technology, the desires and complex care needs of an ageing population, and innovative care delivery models have initiated a shift from providing care in hospitals to outpatient settings. And more recently, the acceleration and amplification of these factors is pushing healthcare options even further from the traditional inpatient and outpatient settings towards acute and subacute care in the home. This has led the medical community to look toward providing more tools and methods of care that patients can access safely right from home and the designers to think as the homes of the future will be flexible to support both an array of devices to provide a healthcare delivery and the humanization and personalization of the domestic space. The paper identifies criteria for the flexible design of the physical environment (including the home, equipment, furniture, etc.) that support and facilitate safety, comfort, and healing, in relation to the various patient populations, at their own physical and psychosocial needs, at the range of equipment/technology (from chronic to acute care), at the caregiving and daily living activities.

Keywords: Flexibility, Patient-Centered Design, Aging in Place, Universal Design, Healthcare at Home, Customization

1. Introduction

In the discussions triggered by the ageing of the population in the last thirty years, the impact of the ageing in place and the healthcare at home on both the healthcare facilities cost and the quality of care has only marginally been addressed. The percentage of the older people in Europe is currently the highest in the word and growing. It is estimated by Eurostat and WHO'statistics that in 2080 the share of people aged 80 and over will be more than double of 2019 (14,6% compared to 5,8%) [1]. At the same time, it increases the impact that the aging of the population has on assistance, on the costs of health services, on social organization, on the lives of the elderly and on the maintenance of their conditions of personal autonomy. These population trends are driving the shape and scope of home healthcare services. The desires and complex care needs of an aging population, the advances in medical technology and care delivery models have initiated a shift from providing care in hospitals to outpatient settings. Recently, these factors - and their the acceleration / amplification - are pushing healthcare options, even further

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from the traditional inpatient and outpatient settings towards acute and subacute care in the home. This has led the medical community to look toward providing more tools and methods of care that patients can access safely right from home and the designers to think as the homes of the future will be flexible to support both an array of devices to provide a healthcare delivery and the humanization/personalization of the domestic space.

In Italy, the Covid-19 pandemic was a period of experimentation on this issue. Territorial operational centres or telephone support services contributed to the improvement of home care for people affected by Covid-19 as well as for non-Covid subjects with chronicity/fragility, necessarily domiciled also because of the moment of great distress of the National Health Service (SSN). Keeping people at home has not only led to an improvement in the quality of care of the patients, especially the most frail ones, but also to greater safety in care, as it has reduced exposure to infectious risk factors [2] [3]. The same investments of the PNRR foresee a loan of 4 billion euros for the assistance of people suffering from chronic diseases, with particular attention to those over 65. Among the main objectives is the increase in the number of patients cared for in their own homes, increasing it to over 1.5 million by 2026.

Starting from this scenario of needs and opportunities, the paper identifies, through a literature review on Scopus and PubMed databases, the main trends concerning the main approaches on the role of the built environment in safe and effective delivery of healthcare at home, for patients and providers. Appropriate search terms have been selected based on previous literature reviews and papers collected in the field of healthcare facilities. A two-level set of keywords has been identified as well as some eligibility criteria in order to separate in-scope from out-of-scope results and avoid biases generated by the selection through keywords. (Table 1). Additional information has been gathered from secondary sources such as research centers repositories (Health and Care Infrastructure Research and Innovation Centre, International Academy for Design & Health, Center of Health Design).

Table 1. Keyword identification and eligibility criteria used.

	Type of healthcare at home	**Residential Design Approaches**
Keywords search string:	"hospital in the home", "hospital at home", "home healthcare", "home hospitalization", "Early supported discharge", "Home-based primary care"	"Universal Design", "Aging in Place", "Healthcare at Home"
Eligibility criteria (Nature of the topic)	Visual Environment, Audio Environment, Safety Enhancement, Waynding System, Sustainability" Patient Space, Family Support Spaces, Staff Support Spaces - Physician Support Spaces,	

Criteria were subsequently defined for the flexible design of the physical environment (including the home, equipment, furniture, etc.) that support both the safety, comfort, healing of the patient (with the own physical and psychosocial needs in the daily living activities), and the activities of the caregiving with the range of equipment/technology for the different levels of care (from chronic to acute care).

2. The home as a High-Performance Environment: an analytical framework

Back in 2011, the report by the National Research Council (NRC) declared, "Health care is coming home" [4]. However, the literature is confusing because there are different terms of healthcare at home (Hospital in the home, HITH; Home Healthcare; Home Hospitalization; Early Supported Discharge) [5] and different types of services, some of which focus on specialities (surgical and medical specialities, rehabilitation medicine, geriatrics, psychiatry, infectious diseases, respiratory diseases), others on diagnostic groups (e.g. hip fracture or stroke), or a mixture of them [6] [7]. Both the complexity and the intensity of the health care services provided in home settings are increasing and making changes to home care. In fact, it is changing from a service to help people or older adults – with disabilities, chronic illness, or cognitive impairment by assisting in their daily living activities – to a service that provides acute or subacute treatment in a patient's residence for a condition that would normally require admission to hospital. The key is substituting for in-hospital care. Home-Based Care includes admission avoidance (i.e. full substitution for hospitalisation) and early discharge followed by care at home (i.e. shortened hospitalisation). It can be cost-effective and convenient, reducing unnecessary hospital admissions and allowing patients to receive the care they need where they are most comfortable [8]. The advantages of Home-Based Care can be summarized in the following ways:

- greater safety for frail elders because they will have fewer of the common complications of hospitalization (such as delirium, stress etc.). The NRC [4] report noted that acutely ill older persons often experience adverse events when cared in the acute care hospital, while they value the delivery of health care at home, as it promotes healthy living and well-being when it is managed well. Living independently at home is a priority for many, especially individuals who are ageing with disability;
- greater patient-centred care [9], that leads to a better understanding of important issues, such as how medications and nutrition are handled, a more intimate clinician-patient relationship;
- greater patient autonomy [10], especially patients with lower levels of mobility and elders can benefit from the opportunity to receive the care they need where they are most comfortable. Ageing in place in the home includes efforts to help beneficiaries remain comfortable at home in the last 6 to 12 months of life.
- lower costs [9][5] and lower strain on saturated healthcare facilities (including emergency departments and hospitals with limited bed capacity) [11]. Besides, Home Healthcare can reduce unnecessary hospitalization and connected risk of healthcare-associated infections [10] [12].

While there are numerous advantages to Healthcare at Home, there also are many challenges. There are still only a few healthcare organizations that offer formal home-care models for primary and hospital-level care (e.g. Johns Hopkins Hospital at Home, Ohio Veterans Administration Hospital in Home) and there are limited researches available on the role of the built environment in safe and effective delivery of healthcare at home, for both patients and providers (Universal Design, Aging in Place, Healthcare at Home approaches). However, as Healthcare at Home is becoming more commonplace as a practice, there is an opportunity to shift thinking from the typical residential design

to a more sustainable home concept, 'how the home can support health and healing'. This has led the medical community to seek to provide more tools and methods of care that patients can safely access right from home, and the designers to think as the homes of the future will need to be laid out strategically to address both an array of ageing needs and support this form of healthcare delivery.

3. Persons, tasks, equipment/technology and environments interaction

Over the last ten years, technological progress in healthcare management and communication systems (telemedicine), the gradual replacement of the human factor through robotization (automation of care work) and digitization (magnetic resonance, CT and PET scans) have led to a reorganization of hospital facilities so that they can accommodate the changes taking place in a fruitful relationship between.

- user-centred approach that has influenced not only the modes of communicative exchange between patient and medical staff but also the physical-functional characteristics (accessibility, distribution of spaces) and the psycho-sensory and perceptive characteristics of care spaces finding confirmation in Evidence-Based Design.
- bio-technological approach that has led to a further reorganization of hospital structures and to the emergence of new, highly original and relevant forms of interaction aimed at the 'medicalization of life'.

This approach applied to home care involves a broad reflection of the human-designed system-environmental relationship, in which the quality of the designed systems is conveyed through the correct correspondence among the users, the tasks, the physical environment and the range of equipment/technology. With Regard to this relationship some considerations can be made about the type of users and tasks, the physical environment and the range of equipment/technology (Figure 1).

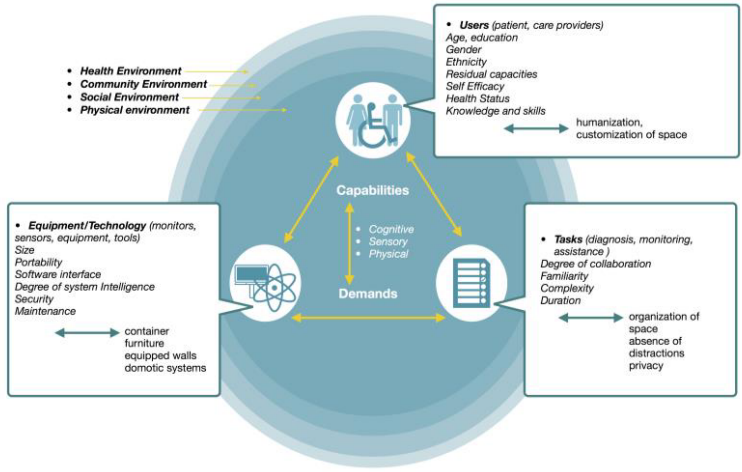

Figure 1. Model of Health care at Home

With the ageing of the population, more services will be required for the treatment and management of chronic and acute health conditions at home, especially those most prevalent with ageing (e.g. hypertension, arthritis, heart disease, cancer, diabetes, and stroke) [13]. The primary persons involved in home health care are: the health care provider; the health care recipient; family and friends, who are not primary caregivers, but are included within the social environment of the patient. The physical environment (e.g. including home, equipment, furniture) can support and facilitate – in carrying out the tasks – safety, comfort, accessibility and healing, but the people and their tasks must be considered simultaneously with the abilities/disability that evolve and shift throughout the life course (both on a temporary and permanent basis). The well-being of the users, who receive care at home, depends on the capacity of space/equipment to: maintain/facilitate their level of independence; minimize patient stress anxiety and risk of fall; guarantee accessibility, safety of use, patient satisfaction and comfort. The well-being of care-providers depends on safety against the risk of injury, such as musculoskeletal injuries from patient handling; slips/trips/lift injuries, from dangerous flooring/rugs/stairs; control of the infections [14]; mental health stressors [15].

Many home health care tasks require the use of technologies and equipment (medication administration equipment, durable medical devices, dialysis machines, feeding tubes, catheters, defibrillators, ambulation aids and oxygen tanks) by the health care providers as well as the care recipients. However, these technologies and equipment were designed by manufacturers to be used only in clinical settings by trained professionals. This most complex medical equipment leads to the highest risk of injury, as shown by an analysis of adverse events at home. Moreover, The home environment differs in many ways from the controlled environment of a hospital or clinic. This imposes unique challenges because each home a health care worker visits is different and their ability to provide adequate care may be hindered by environmental (i.e., crowded or dimly lit surroundings) and socio-environmental factors (such as family over or under-involvement) [16].

The design process aims are thus focused on designing physical and cognitive interfaces. They are intended as places where a continuous process of functional interaction occurs among the users, the systems (space and range of equipment/technology/furniture), and the environment. In this broader view of the human-interface-environment paradigm, the configuration of the interface as a prosthetic system intent on satisfying the individual's well-being can be identified on two levels characterizing the design process: Physical/technological layout level and the level of furniture/technological equipment

4. Design criteria for layout adaptability to physical and technological needs

The layout of a home environment can have important implications for delivering care safely, supporting activities of daily living, and minimizing the risk of injury, especially for impaired, elderly or otherwise physically compromised individuals. The human and private-space relationship involves considerations of spatial organization and on the technological apparatus that impacts the usability of that apparatus, regardless of the body's shape, posture or capacity to move. This level concerns the choice of spatial and technological solutions able to facilitate care tasks and ensure conditions of psycho-physical well-being, accessibility and safety for patients and operators. Likewise, the user-object system (furniture/technological equipment) relationship involves

considerations of the quality of objects constructed in relation to human needs. In order for this system to assume an interface role and become prosthetic, it must be capable of enabling the functional capacities of a person in relation to his/her remaining abilities. This is done through observation of gestures and is not leveraged on a single standard of performance but rather on the capacity to guarantee performances that are useful toward the user's remaining functionalities. Considering that the location of care delivery in the home depends on the level of care needed and that the planning for a renovation or remodel to support home healthcare needs can be challenging when future needs are unknown, designers should consider how the home might accommodate some of the more challenging healthcare needs that may arise, and prioritize from there, to determine what is most critical and feasible. Focusing on the bedroom that may be more appropriate for acute care, some researches show the following needs and consequent design criteria.

4.1. Accessibility, ease of use, safety and physical well-being of the patient

In this framework of needs, design criteria of the layout of bedroom concern: 1) maximize open areas around the bed and primary path of circulation (i.e. from the bedroom to the bathroom); 2) place the bedroom adjacent to the bathroom and on the main level (street level) of the home (or accessible by ramp, stairlift, or elevator) [17]; 3) use of smooth, level floor surfaces with minimal variations (minimize thresholds) that allow freedom of movement [18]; 4) avoid sources of falling using soft interior flooring materials (e.g., cork, rubber, or linoleum) that are gentler underfoot than harder materials and can lessen the impact of falls, also avoid deep pile carpet or loose/worn carpet and flooring materials with intricate high-contrast patterns [19]; 5) provide wainscot trim that protrudes from the wall (i.e. handrails, grab bars with wood pleasant finishes) to offer support and a reference for orientation of the patient [20].

In this framework of needs, design criteria of the furniture/technological equipment that may help to support increased independence for patients receiving care at home concern: 1) integrate technological device in the furniture system, such as an intercom system or voice-activated smartphone technology, easy-to-reach operational (remote) controls that allow natural light to be blocked/reduced during the day if needed, electrical system with sufficient output to support all medical equipment without overloading outlets, Aging Service Technologies (ASTs) including sensors and actuators that monitor and evaluate health conditions and monitor daily activities (fall- and wandering-detection technologies) [21]; 2) easy-to-open doors/furniture (consider handling grip, mechanics, and weight of the door); 3) bed and lounge chairs adjustable for safe entry and exit [18].

4.2. Psycho-emotional well-being and psychosocial support of the patient

While home care can offer many benefits to one's mental state, the same care may also present emotional challenges. Social, cognitive, personal, and behavioural factors are key when designing to support better outcomes for patients receiving healthcare in the home and for staff providing healthcare [22]. In this framework of needs, design criteria of the layout of the bedroom concern: 1) Access to positive distractions (e.g., nature-themed artwork, music, TV, Internet, reading materials); 2) movable screens/curtains for visual and auditory separation minimizing stimulation and optimizing privacy; 3) allow reorganization of space (e.g., easily movable furniture, modular elements) to accommodate changing needs; 4) ample windows that open on the outside with scenes

of good quality that can be seen from any seat, integrating to them easy-to-reach operational (remote) controls that allow natural light to be blocked/reduced during the day if needed [18]; 5) Space for people to sit with the individual receiving care without obstructing the provision of care; 6) Space for second bed/sleeping arrangements to facilitate the proximity of a family member [22].

In this framework of needs, design criteria of the furniture/technological equipment concern: 1) integrate (into equipped walls and furnishings) medical equipment (e.g., oxygen tanks, home-dialysis units, infusion pumps, blood glucose meters, feeding tubes, catheters, commodes, ambulation aids, patient lifts/hoists and specialist equipment) near the bed/chair care areas to support changing levels of care [16]; 2) movable screens/curtains to cover medical equipment whether fixed or mobile, from the patient's view during exams and/or the administration of treatments; 3) integrate medical devices (medical gases electrical devices, oxygen and) in a compact package within technical interstitial spaces such as ceiling or equipped floors or technical cores that can be expanded and integrated over time as the conditions of use change concerning the patient subjective conditions (intensity of care); 4) wireless or wired internet connection to facilitate telehealth/telemedicine [4]; 5) monitoring devices (sensors or wearable) to record daily living activities and transmit data to caregivers (where data is measured against present targets); 6) furniture that is easy to move and adjust (e.g. furniture with modular elements) can accommodate changing needs for the variety of the patient types receiving a variety of care in their home.

4.3. Efficient delivery of care and work-related safety of the caregivers

In this framework of needs, design criteria of the layout of the bedroom concern: 1) design spaces for care that are quiet or can be closed off (at least temporarily) from distractions from pets and children to support safe care procedures (medication preparation, use of sharps, exams and treatment) [16] [23] [15] and that facilitate better communication between patients and care providers through telesupport systems [16]; 2) easy access to sink or alcohol gel dispenser in care areas, in a location where caregivers can wash their hands and still keep direct visual contact with their patients; 3) guarantee adequate space for two people to provide caregiving assistance using patient-handling equipment (e.g. to move the patient to toilet, bed, car).

In this framework of needs, design criteria of the furniture/technological equipment concern: 1) easy-to-clean materials to reduce surface contamination; 2) provide computer devices for digital processing, and archiving for paper documents, and devices for viewing diagnostic images by multiple users contemporaneously; 3) integrate the furniture with telemedicine exam equipment such as a laptop with integrated medical devices (e.g., horoscopes, stethoscopes and vital signs monitors, spirometers); 4) provide a designated location for medical device and patient handling equipment manuals for caregiver access; 5) prepare the ceiling or wall for future integration of repositioning devices that support ergonomic conditions for patient handling and movement, if needed (e.g. ceiling-mounted trapeze hooks); 6) arrange multiple storage locations for personal protective equipment to facilitate proper safety protocols; 7) provide easily accessible and adequately sized storage for sharps disposal, it may help to reduce exposure to punctures or cuts [15].

4.4. Psycho-emotional well-being of the caregiver

This need can be satisfied by design criteria concern: 1) Operable windows that can be opened for cross-ventilation and fresh air inlet; 2) lighting systems with scattered light that is uniform, indirect, and not blinding, dedicated to the various work areas, with characteristics and arrangements that do not cause disturbance, and with an adequate light quality; 3) furniture and equipment organization to allow communicative exchange between health personnel; 4) efficient ventilation to minimize unpleasant smells and control system of air temperature, relative humidity and flow speed maintained at comfort level without dramatic difference between spaces; 5) use of Telehealth that may also be able to help support the psychosocial needs of care providers who in a particular context (eg. rural zone) can feel quite isolated by lack of a collegial support (burnout, stress from mentally and emotionally taxing profession).

5. Conclusions

Healthcare at Home offers potential advantages over traditional healthcare options for both healthcare organizations and patients, which suggests in the future, there will be the potential for more wide-reaching extensions of the hospital into the home environment. However, if the home is not properly equipped, or if a formal home-care model for hospital-level care is not available, hospitalization or a move into a rehabilitation or long-term care setting may be the only viable option for people with increasing healthcare needs [23]. The majority of the literature refers to individuals receiving care at home as “patients”. However, the individuals receiving care may or may not see themselves as patients in their own homes. This is an important distinction in how care is provided and designed. Healthcare at Home does not involve just a functional dimension, bat also an emotional one (sense of comfort and safety, based on familiarity and/or memory). For these reasons, the limits to the application of this model concern: the degree of adaptability of dwellings both to the evolving needs of its residents and to the evolution of the disease; the high costs of upgrading and adapting. Continental and Nord Countries are moving in this direction both with guidelines for the low-cost adaptability of the existing and new housing stock (Lifetime Homes Design Guide, UK, 2010) and with financial schemes for the adaptation of housing to the individual limitations of the people. Multidisciplinary equips (formed by owners, architects and designers in healthcare) may be the best qualified to undertake the challenge of design for Healthcare at Home. They aim to balance the provisions for safety with the preservation of the personal effects and person-centred experience that make healthcare at home such an attractive option for healing in the first place. Therefore, the validity of a project can be appreciated by the multifactorial quality of the space. It can be connected with physical, environmental, management, perceptual, psychological and relational elements, in a perspective that is not "patient-centric" but considers the totality of users.

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Section 6

Universal Design in Products and Information and Communication Technologies

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Transforming our World through Universal Design for Human Development
I. Garofolo et al. (Eds.)

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Developed an Innovative Handbike Fork Made of Composite Material

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Abstract. In this research, the design of a new competitive handbike fork, made of a composite material, is presented. The study is based both on an early finite element analysis and on a CFD analysis of the characteristics and performance of a standard fork made of aluminum, allowing to define the loading and the flux conditions and to provide a design optimization of the fork. The model was later implemented iteratively with the properties of a carbon-fiber composite material. The results obtained show that the new model allows a weight and a drag force reduction and a downforce improvement, with a stiffness and a safety coefficient comparable to the standard aluminum fork.

Keywords. Handbike, finite element modelling, CFD analysis, composite material, lightweighting.

1. Introduction

Nowadays, handcycling is a very common discipline in the Paralympic world. This research, focused on a road handbike, starts with a collaboration with an Italian professional handcyclist, Mauro Scarpari. Together we tried to optimize one of the most important and critical components of the bike, the front fork. In fact, it controls the transmission system, the braking system and the steering system [1].

The cooperation with Mauro borned with the aim to give voice to lot of paralympic athletes (as Mauro himself and others like the Olympic champion Francesca Porcellato) who, in these years, have tried many times to get the best advantages from the handbike's components manufactured and sold in Italy. Unfortunately, the market of competitive handbikes in Italy has never been as developed as in the other countries, first the USA. So, with a dedicated study, together we wanted to expand the range of available solutions and to give Mauro and the other athletes an instrument to improve their performances.

So, working together with them, in particular with Mauro, meant mainly two things. At first, the engineering was made available to the world of disability, so that it could be possible to create something new and innovative for it. Then, as a reward, thanks to the advices and the precise instructions from Mauro it's been possible to design the optimal solution for him and for all the other handcyclists. Without them, it couldn't absolutely be possible.

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In particular, the biggest help from Mauro camed in the drawing of the new fork models, in the calculation of the main forces applied on the structure and in the idealization of the side supports for the leg.

Figure 1 presents the entire handbike and a focus on the fork, whose length is near to 80 cm and weight is 1,3 kg.

Figure 1. Illustration of the handbike and the fork

The study is based on the comparison between the aluminum fork and a new model obtained with the changing of the design and with the introducing of a new composite material [2][3]. Thanks to this, we expect a reduction of weight and an improvement of aerodynamic performance. What the athlete would gain from this model is a faster and more drivable bike, hoping in a strong increase of races results.

To realize the model of the fork, the connected positions between the crucial points of the fork and the size of the sections are set.

2. Design approach

The first step of this study is represented by the modelling of the fork. As shown in figure 2/a, the frame is manufactured welding together tubular elements made of aluminum. Corner radius are set with the value of 2-5 mm, and the thickness of the tubular-shape elements is supposed to be 1 mm.

Thanks to the better properties of carbon-fiber composite, new different models are iteratively created, increasing step by step the profile radius and maintaining the same general size (Figure 2/b). This is carried out starting with some advices of the athlete and paying attention to some engineering aspects. The reduction of weight is expected to be brought by the change of material, while the profile of the fork designed next to the joints with the back frame is supposed to advantage a minimum drag force and a better control during the turning and braking operations.

This statement could be made only from the experiences of Mauro and Francesca, who both, testing different types of fork, figured out how those with the lower trim (profile nearer the floor) were the easier to drive and to control. By this, we tried to put together the comfort aspects with the engineering ones.

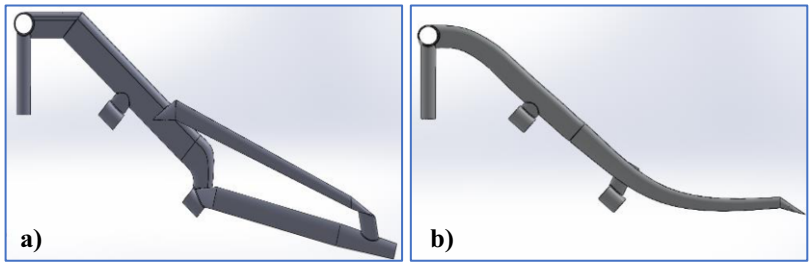

Figure 2. Standard model of the fork made of aluminum (a) and innovative model made of carbonium (b)

3. Load Conditions

To provide the mechanicals properties of the models, given a particular geometry and material, a static bending test is defined. Starting with the standard UNI EN ISO 4210-6, set for a standard-bike fork and described in figure 3, a new test is created, adapting the old one to the handbike forks.
For the UNI EN ISO 4210-6 the numerical references indicate:

1 – Rotation of a pin of the load accessory
2 – Rigid support with steering bearings

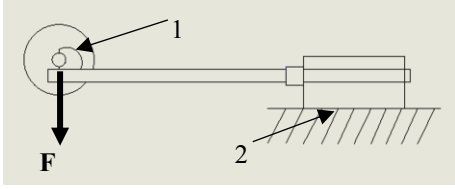

Figure 3. Loads considered in the UNI EN ISO 4210-6

In the new test the rotation of the pin and the rigid support are still present (number 1 and 2 of figure 5, while the load is represented by the chain pull (S) and the weight of the legs (F).

An example of a situation causing load conditions similar to this test is the locking of the front wheel while the athlete is pushing on the cranks at the maximum power of about 400 Watt. This value was obtained with a specific test, carried out by Mauro in which it was found the optimum cadence that let him to unleash the maximum power. In this test, called “power-cadence test”, the athlete has to make five consecutive efforts with the maximum intensity and increasing, step by step, the transmission ratio[4][5][6].

So, to reproduce this situation, the load S is set to 432 N and the load F to 200 N. The outputs from FEM analysis will depend on the different geometries and materials used. A comparison between the properties of aluminum and the composite material is reported in Table 1. For the standard fork is used a 7005 aluminum alloy while for the new models made of composite material is chosen an HM carbon fiber (the best solution for road bikes) together with epoxy resin [7].

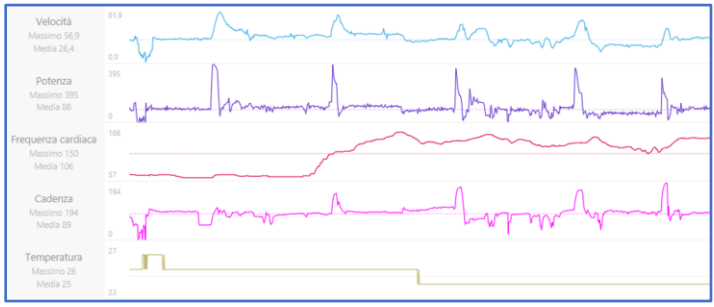

Figure 4. Report of the Power-Cadence test

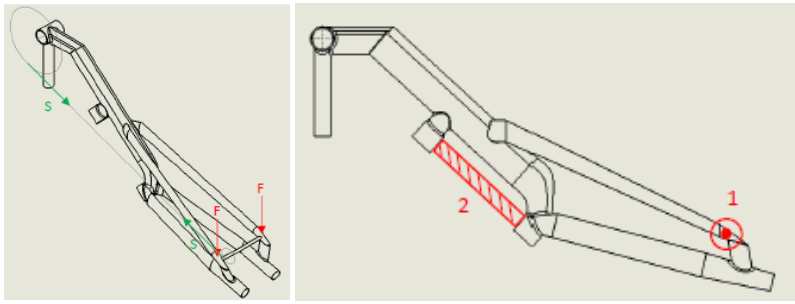

Figure 5. Loads applied on the designed fork

Table 1. Results of the main mechanical properties of an Alluminum 7005 alloy and a carbon-fiber composite.

	Aluminum 7005	**Carbon-fiber composite material**
Young's modulus [GPa]	72	207
Tensile strength [MPa]	390	1020
Yield strength [MPa]	345	-
Density [Kg/m^3]	2800	1630
Poisson's factor	0.33	0.3

4. FEM Analysis

Every model designed, both the aluminum one and those made of composite, are tested with the solver available in the software SolidWorks, initially considering the load S (propulsion on the cranks) and then without it, so that it could be shown how much the geometry of the fork stabilizes it when the athlete is pushing, and the chain is pulled. Both stress and displacements are monitored.

It's figured out how the maximum Von Mises stress value, of about 230 MPa, is localized in a limited zone under the main tubular element, at the sharp edge. Here, along all the three directions, compression stresses are registered. It can be considered a general safe zone for the component, with a safety factor always higher than 1. Comparing the stress conditions of the aluminum fork with those of the new carbon-fiber models, it can be seen how, without the connections of the tubular elements, the maximum values are always lower than 90 MPa. Even in this case, a condition of compression stresses can be registered along all the three directions, and the safety factor is much higher than one (far from the critical values). While changing the design and the properties of the fork doesn't bring to a reduction of the safety factor, it must be verified if even under the point

of view of stiffness there are no losses. In figure 6 there is a comparison between the y-displacements with and without the load S. In both situations the values are lower than 0.1 mm (0.07 and 0.02 respectively). It means that the double-tubolar structure gives a strong stability to the fork.

The purpose is now to get the same values of displacement with the new models. With the better properties of composite material, we expect to have no losses in stiffness even if the structure has only one-tubolar profile (simpler and lighter fork). The results reported in figure 7 and 8a confirm the previsions: the y-displacement in three different models changes from a minimum of 0.028 mm and a maximum of 0.061 mm, thus the stiffness could be considered similar to the aluminum model.

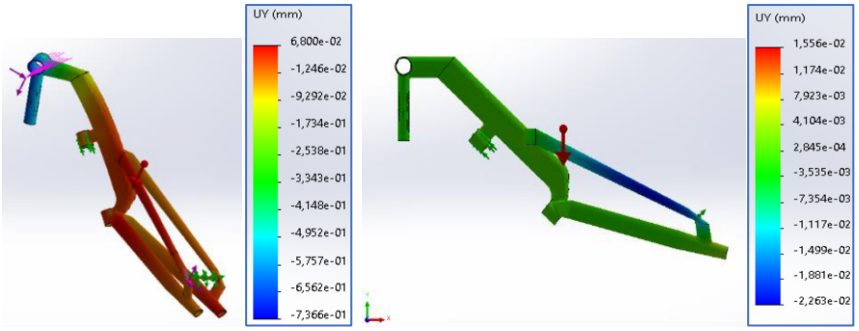

Figure 6. Y displacement in the aluminum model with the load S and without it

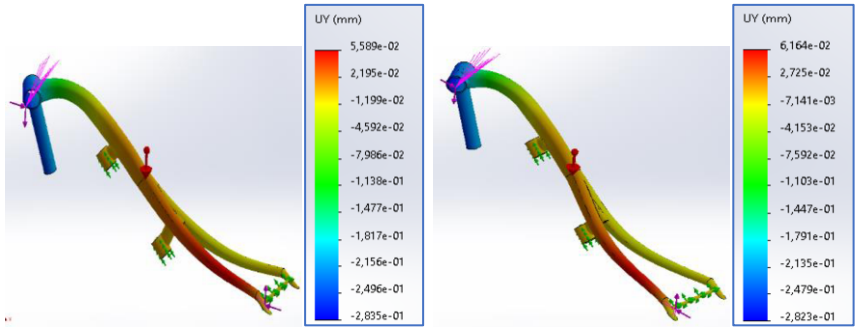

Figure 7. Y displacement in the first two models designed

From the output of displacements, a relationship between the value of y-displacement and the curvature radius of the profile appears: the last model, which is the most bent, is also the stiffest.

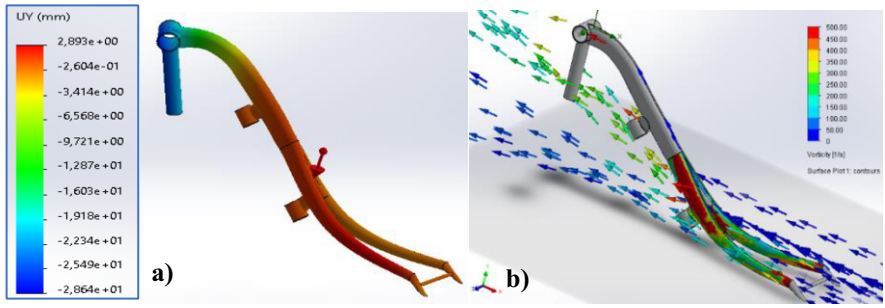

Figure 8. Y displacement (a) and vorticity [1/s] (b) in the best model designed

5. CFD Analysis

Using the solver Flow Simulation of the software above mentioned it is possible to check the aerodynamic performances of the models. To do this a unidirectional air flux at standard conditions (atmospheric pressure and temperature of 20 °C) and at the speed of 36 km/h is used, without considering the roughness of the structure. This value comes from an analysis of the average speed kept by the athlete in standard condition like flat roads. Pressure, vorticity, and lift/drag forces are monitored to verify if the most bent fork is the best even from an aerodynamic point of view [8]. If the only thing resulting from the analysis of the pressure is how the carbon forks improve the resistance to the flux compared to the aluminum one, the study of the vorticity shows how the most bent fork is the one that reduces the turbulence of the flux the most (figure 8b).

At a later time, it is possible to obtain important results analyzing the values of downforce and drag force. As shown in table 2 each carbon model reduces the drag force of about 30% compared to the aluminum one. Furthermore, the most bent model is the only one that improves the downforce (approximatively 6%), obtaining a 58% aerodynamic efficiency improvement overall.

Table 2. Results of Lift & Drag forces in all the models tested and aerodynamic efficiency.

Model	Downforce [N]	Increase % Df	Drag [N]	Increase % D	Downforce/Drag	Increase % Df/D
Aluminum	0.148	/	0.683	/	0.217	/
Carbon – 1	0.11	-25.675	0.466	-31.771	0.236	8.952
Carbon – 2	0.132	-10.810	0.469	-31.332	0.281	29.856
Carbon – 3	0.158	6.757	0.466	-31.771	0.339	56.483

6. Results

From the FEM and CFD analysis we obtained very remarkable results.

The standard fork made of aluminum is realized with a shape that reduces the displacements at minimum even with the load S application, but the cranks of the tubular elements generate over-stressed zones.

These zones are eliminated by the creation of new frames without sharp edges (maximum 90 MPa), avoiding stresses-concentration, and maintaining compression along the three directions. Among all the new models, the last one of the iteration processes provides the minimum value of displacement, and so it turns out to be the

stiffest. Thus, from the point of view of mechanical performances, it could be considered the optimal solution.

The CFD analysis shows how the forks made by composite material increase the aerodynamic performances, especially reducing the drag force. The stiffest model is also the only one which increases the downforce, and it also minimizes the turbulence of the air flux resulting the best among them.

7. Conclusion

The purpose of this study was to evaluate the performance of an innovative road-handbike fork made with a carbon-fiber composite material compared to the traditional model made of aluminum.

The studies carried out and the results obtained provided us an optimum model fork, which compared with the standard one, used by the athlete, leads to a 30% reduction in weight and a 58% increase in aerodynamic efficiency, with the same safety coefficient. That was possible thanks to the introducing of the new material and the modelling of a new shape with a one-tubular bent profile.

This new shape had great feedback even from the athlete, who thinks that such bending of the profile provides a correct feet positioning. The support of the legs remains the last development phase of the prototype, even if possible external stiff solutions have already been invented, as well as protections to avoid the falling of the legs inside the fork in the steering period. In the figure 9 these external elements are shown. They are designed in order to let everyone who uses the bike to keep the legs stopped and safe, whatever their length or dimension is.

Given the great results accomplished, the purpose now is to realize a first prototypical model, which will be made available to Mauro and other athletes for the realization of some experimental tests.

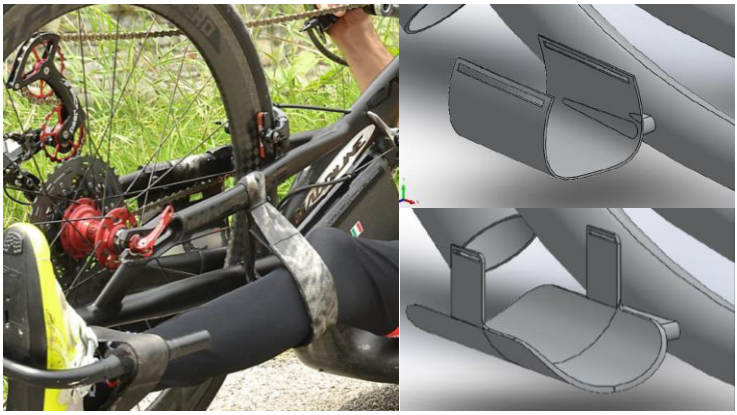

Figure 9. Old solution and new ones for the support of the legs

Francesca Porcellato, handbiker, Olympic multi-medal winner and professional athlete was also involved in order to carry out a single mold for the production of forks of different sizes. From the scans of her fork and Mauro's one, it was possible to realize a cad model available in different sizes (changing the distance from the front wheel and

the central movement), in order to obtain a mold able to cover the entire range of different shapes.

The advantage of creating a much more efficient and simpler geometry is the wide clientele that this product can be destined to. This product can be used not only by agonist and non-agonist athletes in sports, but also by amateurs, children, teenagers and adults, and they can all find in this new idea of fork a tool to amuse themselves in their daily activities. Taking advantage of different types of attachments and different sizes of the tubulars, it is in fact possible to reach every need, like the original one, designed for Mauro.

Nevertheless, the world of cycling teaches how, in most cases, the best and most innovative technological solutions are always thought for big competitions at the beginning, but they always become established year after year in a much more amateur and entry level market, proving that high-level engineering is destined to be of use for daily challenges.

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Transforming our World through Universal Design for Human Development
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A Pattern Language for Inclusive Design: A Set of Patterns for Designing Reusable Accessible Solutions

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Abstract. A common cause for inconsistent accessibility in the design of ICT applications is that designers work to develop optimal and satisfactory interfaces but they do not take care to comply with all users' needs and possibilities to access. The study presented in this paper stems from a lack of published evidence able to support designs in developing accessible interfaces for websites, mobile apps or conversational Interfaces (chatbot or voicebot). This work aims at investigating accessible design patterns that can be used by designers to implement applications accessible by multiple devices. To solve this problem, we propose a design pattern language able to provide WCAG compliant design out-of-the-box solutions. The navigation through the design patterns allows designers to gather existing solutions based on solid evidence and examples to develop inclusive applications accessible by web, mobile devices or conversational agents.

Keywords. Accessibility pattern language, HCI design patterns, Inclusive design, Web and Mobile design, Chatbot.

1. Introduction

Accessibility has always been a problem that designers tend to avoid dealing with it. Mainly because it is still unclear what makes up accessible interfaces and what developers need to know to get there.

From a legislative point of view, the Web Accessibility Initiative published the Web Content Accessibility Guideline (WCAG 2.1) [1] intending to provide a single shared standard for web content accessibility. Nevertheless, without clear practical suggestions or examples about what designers need to do for designing an accessible user interface (UI), the development of WCAG compliant applications can be challenging and expensive.

This paper aims at investigating a solution devised by exploiting design patterns strategies proposed in the HCI (Human-Machine Interaction) field [2-5]. The main research question we want to answer concerns how the design patterns can provide designers with techniques and strategies they need to be aware of when building accessible, inclusive interfaces for different devices and interactions styles.

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An interaction design pattern is a general and re-applicable solution for a usability problem that occurs with recurrence in the design of user interfaces or the design of interaction strategies. To date, design patterns specially developed for suggesting WCAG compliant solutions do not exist in particular for the design of multi-device devices such as websites, mobile applications and conversational agents (also known as chatbots voicebots). A conversational agent is a dialogue system that responds automatically using human language usually employing a chat-based or voice-based bot over the internet or as a portable device assistant.

For this reason, after Section 2 described accessibility issues that generally affect the design of inclusive applications, we propose in Sections 3 and 4 a pattern language for helping designers in dealing with accessibility design problems. Section 3 discusses the main works and theories in the fields of HCI design patterns. Section 4 focuses on presenting a design pattern language as an organized and coherent set of patterns, each of which describes a problem and the core of a solution. Problems are described through high-level design patterns that are solved by evaluating low-level design patterns.

To define our design pattern language, we extended the structure proposed by Jan O. Borchers in [4, 5]. This extension aims to enrich the pattern schema with a section dedicated to incorrect examples for illustrating recurring error situations; a section used to show which points of the WCAG are satisfied with the pattern; three sections that describe technical solutions specifically designed for websites, mobile applications and conversational interfaces. Section 4 also presents a practical example of the application of our design pattern language to develop an application for registering user data through a form. In section 5 we draw some conclusions and discuss the main problems we dealt with in the discovery of multi-device accessibility solutions.

2. Accessibility issues to design inclusive applications

One billion people, or 15% of the world's population, experience some form of disability, and disability prevalence is higher in developing countries[2]. The number of web accessibility lawsuits continues to steadily rise in early 2021[3]. General trends show an increase in lawsuits filed in federal courts and state courts. These two pieces of data alone should convince us of the importance of designing for accessibility.

Accessible features can be used not only to ensure access to people with disabilities but also to make webpages more usable both by people using older computers and by people using the latest technologies (such as personal digital assistants, handheld computers, or web-enabled cellular phones). This rule is also regulated at the legislative level. Regulations such as the Americans with Disability Act (ADA) [6] or the EU Web Accessibility Directive [7], say how public websites or applications have to be accessible for visitors of all abilities. By analyzing these regulations, we can see that they stem or are an extension of the WCAG (Web Content Accessibility Guidelines) [1], which is an international standard recognized as the benchmark for web accessibility.

Creating a truly accessible website requires expert assistance and testing. For this reason, many businesses assume that the investment will not yield a return immediately. This is one of the most common misconceptions. What we want to demonstrate in this paper is that it is not true that web accessibility design necessarily implies an expensive

[2] https://www.worldbank.org/en/topic/disability#1

[3] https://www.essentialaccessibility.com/blog/web-accessibility-lawsuits

or unnecessary addition to a development project. Nevertheless, web accessibility has indeed associated expenses in particular when you have to retrofit a website for adding accessible features. Despite this extra expenditure, correcting an already inaccessible site is always beneficial in the end since accessible sites are easier and cheaper to maintain. On the other side, to make from scratch a website that is accessible could cost virtually the same as developing one that is not.

According to these considerations, in this paper, we propose a design strategy based on the use of HCI designs patterns specifically designed to support designers in the development of accessible websites, mobile applications and conversational agents.

3. HCI design patterns

The concept of design pattern has been proposed as a solution to help designers in developing more usable systems [8,9,10]. Design patterns were created in the field of urban planning and architecture and subsequently became popular within the software engineering community [11].

The basic idea is to acquire information about frequent problems and how to solve them. Patterns aim to capture and communicate the best practices of user interface design with a focus on the user's experience and the context of use. As a result, they are an attractive technique, with interesting ramifications for designing across a variety of contexts.

Design patterns made their appearance in the software engineering community when Gamma et al. published one of the best-selling books on software engineering [12]. Riding on the success of this work, many design patterns and design pattern languages have been published in the field of software engineering. In recent years, HCI design patterns have become increasingly important and are frequently used for the design of successful user interfaces and user experiences [2-5]. An HCI design pattern describes a recurring problem together with a proven solution in the field of Human-Computer Interaction discipline. An HCI design pattern has a well-defined form, which is dependent on the individual author's preferences. Besides the publication of books, it is possible to find several works on the World Wide Web to disseminate and publish HCI design patterns across the HCI community.

On the web, many repositories are published including Jennifer Tidwell's pattern language for HCI design [2], UI Patterns – User Interface Design Pattern Library [13], Yahoo!Design Pattern Library [14], Welie.com – Patterns in Interaction Design [15]. Together with these design pattern repositories, several portals exist that provide collections of references to design pattern resources such as The Interaction Design Patterns Page [16], hcipatterns.org [17], The Pattern Gallery [18].

A pattern form follows the specs defined in its pattern language or pattern collection. Regardless of its form, a pattern is designed for facilitating the users in understanding the problem, context, and solution of a specific problem. The pattern itself, when it is part of a collection or a pattern language, may have references to other patterns. These relationships are used to provide users with a strategy to navigate through interconnected patterns that solve different parts of the same problem. Borchers in [3,5], proposes to organize the pattern language by using a graph structure to visually represent their interdependencies. This hierarchical structure leads the designer from patterns that solve large-scale design problems, to patterns that concern small design details and helps her/him to quickly identify related patterns.

In this paper, we aim at proposing a language of HCI design patterns that goes beyond Brocher's definition to create multi-device accessible applications. The language can be considered a universal design resource, to help designers in creating accessible graphical interfaces for web, mobile and chatbot/voicebot applications that comply with WCAG guidelines. The representation of knowledge through design patterns aims to reflect the problem-solving approach usually followed by designers, while the hierarchical organization of patterns defines a structured language for guiding designers throughout the design process.

4. HCI design patterns for designing multi-device accessible applications

This section illustrates the design pattern we defined by levering Borchers' language. Our extension aims at enriching the language structure with different sections. The first one focuses on incorrect examples to illustrate recurring error situations, the second describes which WCAG points are satisfied by the pattern and the third section is dedicated to presenting technical realizations of possible multi-device solutions. The last section is dived into three parts that are respectively dedicated to describing solutions for the websites, mobile applications and chatbots. Therefore, each pattern has the following components:

- **Name**: It describes the intention of the pattern, facilitating the navigation in the language and making the pattern distinguishable.
- **WCAG 2.1 checkpoints**: List of WCAG points that are met thanks to the application of the pattern.
- **Problem**: A brief statement of the problem addressed.
- **Sensitizing image**: An image that introduces the topic and the solution proposed by the pattern.
- **When to use**: It defines the situations compatible with the application of the pattern.
- **Solution**: It briefly illustrates the solution to the problem presented.
- **How to use**: It describes in detail each point that makes up the pattern solution.
- **Why to use**: It provides the reasons that motivate the application of the pattern.
- **Examples**: Practical examples of the application of the techniques that make up the solution.
- **What not to do**: Examples of error situations that lead to solutions that do not comply with the WCAG directives that the pattern must comply with.
- **Patter application - Websites**: Techniques dedicated to using the pattern if the graphical interface in question is part of a website.
- **Patter application - Mobile devices**: Techniques dedicated to using the pattern in case the graphic interface in question is part of a mobile application.
- **Patter application - Chatbot/Voicebot**: Techniques dedicated to using the pattern if the graphical interface in question is part of a chatbot or voicebot.

Based on the structure proposed in [8] and according to the type of problem dealt with, we have defined a hierarchical structure by breaking down a tree into three sub-trees defined as follows and depicted in Figure 1:

- **Multi-format presentation**: It deals with patterns related to the presentation and organization of contents of different formats.

- **Navigation**: It defines patterns useful to provide a correct and simple navigation interface.
- **Interaction**: Set of patterns that deal with the various problems that a user might face when interacting with a graphical interface.

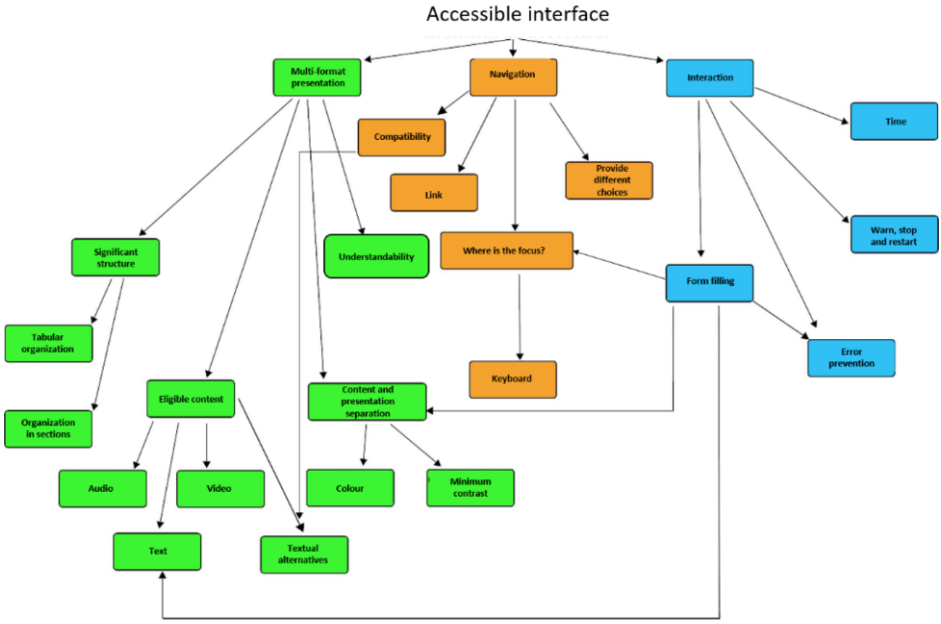

Figure 1. The structure of the tree. It represents the HCI pattern language.

4.1. How to navigate the design pattern tree

The navigation in the design pattern language starts from the root of one of the three sub-trees according to the graphic interface to create a multi-format presentation, navigation or interaction. In practice, once the designer identifies a leaf pattern related to the specific problem to solve, she/he has to go up the hierarchy to the root of the sub-tree. From the identified root pattern, the designer has to follow the hierarchy of the tree recursively applying the child patterns. Thanks to this categorization, the designer can focus on one aspect of the interface at a time, which is then preparatory to the application of the following category.

To connect the patterns, we defined relations of parent-child type as specified in [8]. This type of relationship defines a dependency between parent and child, in the sense that the correct application of the parent pattern depends on the correct application of its child pattern. However, different types of relationships are also possible, for example between the "*Compatibility"* pattern and the "*Textual alternatives"* pattern in Figure 1, there is a relationship that, while being of type parent-child, connects patterns of different sub-trees. These types of relationships allow designers to follow different strategies of design interconnecting navigation or interaction issues or problems related to the

presentation of the content for reusing the proposed solutions across many applications without reinventing the wheel.

4.2. Chatbot design accessibility: the main problem

With a growing number of businesses now using chatbots, it is now clear how the design of accessible chatbots is more important than ever. If the designer's objective is to develop a chatbot, the temptation of using a completely pre-built chatbot platform is very high. Nevertheless, this solution may not provide out-of-the-box accessibility support. Chatbots can present a range of difficulties for users. All of the graphical and textual content needs to fit together in a way that creates obvious connections and makes it intuitive to navigate to and within the chat. Screen readers need to be able to notify users of the context of chatbot conversations and replies. The chatbots are often programmed to speak, play music, use pop-up windows, and require users to click images to activate them. However, all content must be perceivable.

In our work, we investigated several online resources to detect accessible solutions for implementing different parts of a chatbot. These parts compose the final solution and can be explored by navigating the patterns presented in our design pattern language.

For example, regarding the "*Navigation*" pattern, if the user cannot use the mouse, the designer has to check if it is possible to click on all the buttons ("*Tab key*" to move the focus, "*Enter key*" to activate a button) for typing and sending messages. Moreover, it is necessary to move the scrollbar with the arrow keys (see Figure 2). To do it, the designer has to make this element focusable using a "*tabindex*" attribute.

As described in this example, although solutions to make a chatbot accessible exist it is not simple to find all possible indications to meet the WCAG criteria. In our proposal, we discovered solutions for only a part of the patterns composing our language. At the moment, we are working to complete the design pattern language but it is an expensive activity that needs more time to deal with.

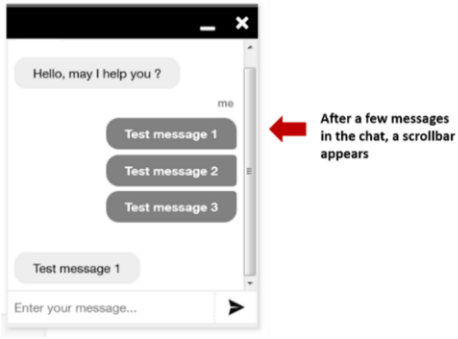

Figure 2. Chatbot screenshot that presents the appearance of a scrollbar. The designer has to find a solution for allowing the user to use the arrow keys for scrolling the messages.

4.3. Example of use

This paragraph shows an example of how to use the HCI patterns for accessibility to design a registration form for websites, mobile applications, and chatbots.

First, the designer must identify the "*Form filling*" pattern in the language tree (see Figure 1). Going up the trees, the reference root is the "*Interaction*" pattern. To develop an accessible application form it is necessary to recursively implement all patterns connected to the identified pattern up to the leaves of the design language tree. The pattern "*Form filling*" depicted in Figure 3 presents the main sections that characterize the pattern. For implementing a complete solution, the designer has to explore the design language tree along with the relationships that connect the pattern "*Form Filling*" to the other patterns: "*Content and presentation separation", "Colour", "Minimum contrast", "Text", "Where is the focus?"* and *"Error prevention"*. For each pattern, the designer can find solutions to develop a website or a mobile application or a conversational agent according to her/his needs. The patterns present what to do and what to not do for designing a final application that could be compliant with the accessibility criteria.

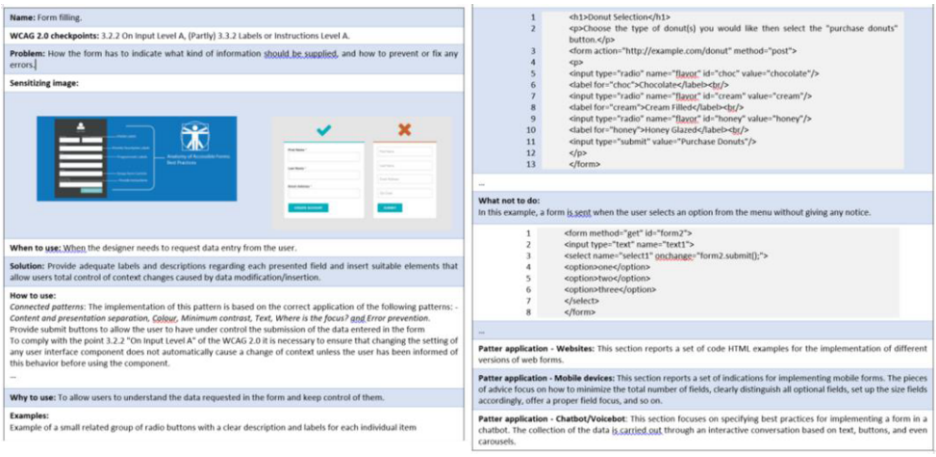

Figure 3. An example of a design pattern: *Form filling*. For space reasons, the schema reports only some indications of the total information that the final pattern has to contain.

5. Conclusion and discussion

This paper aims to present a language of HCI design patterns oriented toward multi-device accessibility. The idea is to allow people both with disabilities and not to take full advantage of the contents provided by websites, mobile applications, and conversational agents such as chatbots or voicebots.

In trying to eliminate the Web Accessibility Divide, or the gap between those who can independently access web resources and those who cannot, this language aims to offer a tool to simplify the work of designers by avoiding applying accessibility criteria after the development of the software product.

The main problem in creating accessible and multi-device patterns is the identification of solutions that can comply with the accessibility requirements of the WCAG. For what concerns the website's design strategies, the checkpoints described in the WCAG 2.1 specifications are sufficient for identifying solutions to be detailed in the patterns.

Instead, for the design of mobile applications and chatbot/voicebot the solutions must be identified using online resources not always created to satisfy accessibility requirements. This involves a long and expensive investigation that affects the definition

of patterns also in consideration of the rapid change in technological solutions that characterizes the design of mobile applications and conversational assistants.

Furthermore, the first draft of WCAG 3.0 has recently been published [19], which aims to make the language as simple as possible, so that even people who are not technology experts can understand it. From the first reading of this draft, WCAG 3.0 will offer many indications for making the web and other digital content (such as videos or mobile apps) more accessible to people. However, there is also no mention of solutions specifically designed for conversational agents.

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Unidirectional Tactile Paving: Circulation for the Visually Impaired

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Abstract. The COVID-19 pandemic heightened inequalities of universal accessibility in the built environment. The visually impaired have been affected by the lack of mobility that resulted from social distancing and physical distancing. Numerous circulation networks, from small retail shops to large-scale public spaces, have been reorganized to limit the spread of COVID-19. By assigning an orientation to each lane, unidirectional circulation networks allow for physical distancing by limiting face-to-face interactions among most pedestrians. These unidirectional networks are communicated visually, by placing flat arrows on the floor, but not through the other senses and are thus inaccessible to the visually impaired. This demonstrates a lack of universally accessible design for unidirectional circulation. We propose two designs (asymmetrical blocks and cobblestone blocks) for a novel unidirectional tactile paving which allows the visually impaired to navigate through unidirectional circulation networks by feeling tiles with their feet and/or canes.

Keywords. Tactile paving, visually impaired, circulation, unidirectional circulation, universal design, physical distancing.

1. Unidirectional pedestrian circulation and the COVID-19 pandemic

The COVID-19 pandemic has changed the way in which pedestrians move through public circulation spaces. Physical distancing, defined as "the practice of staying at least 6 feet away from others to avoid catching a disease such as COVID-19" [1], has become a regular practice in diverse urban contexts. Public spaces such as parks and large pedestrianized streets allow for physical distancing when enough space is available. However, when circulation lanes are less than 6 feet in width, physical distancing is impossible. Such is the case in numerous supermarkets, retail environments, schools, and hospitals, among others. As discussed in [2], unidirectional pedestrian circulation could also be practiced in complex circulation networks, such as the public circulation networks within large informal settlements.

For physical distancing to be possible in these environments, unidirectional pedestrian circulation has become the norm. By limiting circulation in each lane, path or hallway to one direction, face-to-face interactions between pedestrians are limited. Soon after the arrival of COVID-19 to the United States and other countries, diverse preventive measures were imposed on indoor public spaces to limit the spread of the disease. While some of these measures dealt with the implementation of acrylic glass, the extensive use of hand sanitizer and the clearing of surfaces, or designated shopping hours to protect

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the most vulnerable groups of people, several measures dealt directly with pedestrian traffic. Supermarkets and stores controlled their public circulation spaces by implementing one-way aisles, which allowed pedestrians to walk around the entire building while minimizing face-to-face interactions. Kroger, the largest supermarket operator in the country, was already testing one-way aisles at certain stores by early April 2021. Other retail giants such as Walmart also implemented one-way aisles around the same time [3]. The form in which unidirectional circulation has been communicated to pedestrians raises major concerns of inclusivity. Arrows placed on the floor, which indicate the direction of one-way aisles, remain merely a two-dimensional visual means of communication. For these unidirectional circulation networks to be more inclusive, solutions which can be clearly understood by the visually impaired must be found.

Whereas these new measures have changed every pedestrian's circulation habits, people with visual impairments are disproportionately affected by them. According to Dorianne Pollack, a blind person who works at the Disability Resources Department at Northern Arizona University, people with visual impairments cannot adapt to the new COVID-19 rules of governments and business "because they are communicated in a way that is impossible for [them] to observe." [4] One example is that of unidirectional circulation. She states that "in many stores and other places, there are now directional arrows, signage and taped-off measurements to ensure distancing - but you need to be able to see them to know they're there." [4] The consequences of such measures have had profound impact on people who are visually impaired, even resulting in "food insecurity" for those who do not have family or friends to help them get groceries.

The spatial qualities of different architectural layouts might also pose a problem to unidirectional circulation. The existence of dead ends or cul-de-sacs automatically creates unavoidable face-to-face interactions. Therefore, spatial layouts that don't already have a free plan organization or corridors that tie back into the primary circulation network make total unidirectional reordering impossible. Here too, narrow lanes are at a disadvantage since they don't allow for enough width for two people to walk next to each other while practicing physical distancing. Thus, in general, the relative success of different types of programmed spaces (hospitals, airports, restaurants, etc.) in implementing unidirectional circulation depends on their specific, built-in spatial flexibility to accommodate this type of circulation. Although one-way aisles increase the amount of time that users spend in navigating through pathways and potentially raise the exposure to the virus [5], this can be balanced by carefully controlling the occupant capacity limits. Even when such rules are implemented, compliance can be difficult to achieve. In stores and similar environments, installing floor decals or arrows might not be enough to regulate traffic. Multifaceted campaigns are needed to get clients used to these new behaviours. [5]

Even as vaccination campaigns thrive in certain areas of the world, it is likely that unidirectional pedestrian circulation will continue in some urban contexts. According to the Harvard Medical School, "everyone, even those who have recovered from coronavirus infection, and those who have been vaccinated, should continue to (...) practice physical distancing" [6]. Because people infected with COVID-19 behave differently, including those who are asymptomatic or have been re-infected with the disease, it is important to implement general rules of physical distancing, which include unidirectional pedestrian circulation.

In this article, we present a brief overview of tactile paving, a revolutionary navigation aid for the visually impaired (Section 2). Subsequently, we introduce unidirectional tactile paving, a novel type of tactile paving which allows the visually

impaired to navigate through unidirectional circulation networks by feeling the unidirectional tactile blocks with their feet or walking canes (Section 3). Finally, we present opportunities and challenges associated with these designs in the conclusion (Section 4).

2. Tactile paving

Japanese inventor Seiichi Miyake created a revolutionary navigation aid for the blind and the visually impaired. Tactile paving (or Tenji blocks) consists of tactile blocks on pavement which are "intended to alert visually impaired pedestrians of upcoming dangers, like sidewalk curbs and train platform edges" [7]. The textures of the blocks can be felt with the feet or with a cane; they can be perceived by the partially sighted since their colour (usually yellow) contrasts with the pavement around it. A decade after the first implementation of tactile paving near the Okayama School for the Blind, the system was popularized by Japan National Railway, since "every (...) platform was modified to include Miyake's invention" [7]. Today, Japanese law requires certain buildings and public spaces to install tactile paving, and they can be found in most public circulation spaces in major Japanese cities, like Tokyo. Other cities throughout the word have started to implement tactile paving in particular locations such as train stations and airports, as well as certain public spaces.

To create paths of any desired length, tactile blocks can be placed side by side to create paths of any desired length. According to the International Association of Traffic and Safety Sciences, there are "two types of tactile ground surface indicators: warning blocks that indicate the location of hazards or destination facilities (...) and directional blocks that indicate direction of travel." [8] Warning blocks (or warning tiles) have a blister pattern made up of small domes. (See Figure 1, top left.) These blocks usually have 25 or 36 small domes, but different variations exist. Directional blocks (or directional tiles) have long bars that are parallel to the direction of travel. (See Figure 1, top middle.) Most commonly, they have four equally spaced bars.

3. Unidirectional tactile paving

Whereas directional blocks are very functional and effective, they convey direction without conveying orientation (forward or backward). They could be called "bidirectional blocks", since one can walk on them one way or the other. The inexistence of tactile blocks which indicate orientation in addition to direction proposes an avenue for design explorations. In this paper, we propose two designs of unidirectional tactile paving blocks which convey orientation in addition to direction. These are named asymmetrical blocks and cobblestone blocks, described below.

The first design we propose is the **asymmetrical block**. An asymmetrical block has long bars of different widths that are parallel to the direction of travel. An asymmetrical block has two standard long bars parallel to the direction of travel on the right half of the block, and four narrower long bars also parallel to the direction of travel on the left half of the block. (See Figure 1, top right and bottom.) This allows the users to feel a difference between the left and right sides of the tactile paving with their feet and cane. By informing the users that the standard long bars must always be on the right side while walking on a tactile path to respect the assigned direction, the users can internalize this

convention to know which direction to follow. Asymmetrical blocks can be mass produced just like any other tactile paving block and they do not require more material than the standard directional blocks. Moreover, asymmetrical blocks can be used as standard directional blocks when unidirectional circulation is not needed or desired, without having to replace them. (See Figure 2).

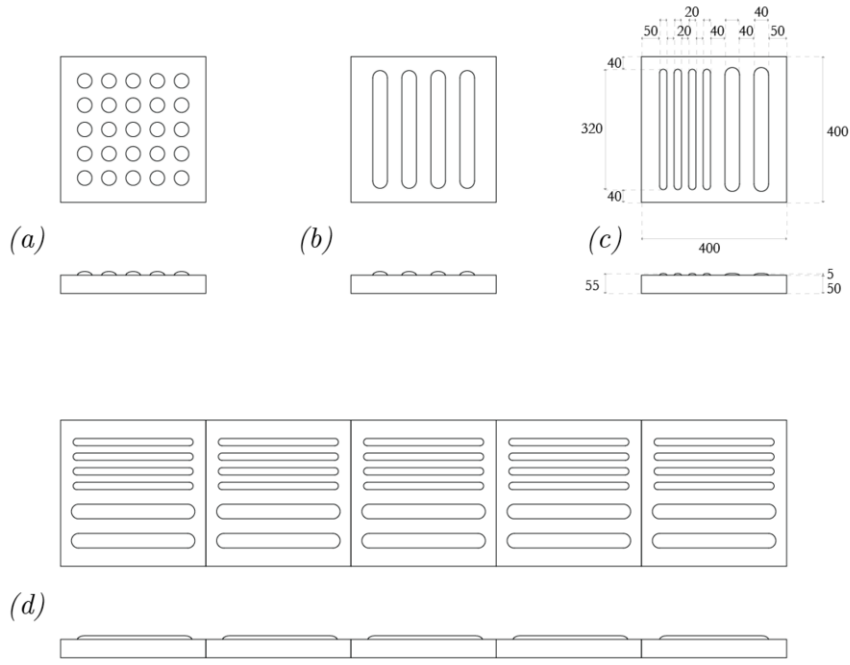

Figure 1. (a) Warning blocks with 25 small domes; top view and elevation. (b) Directional blocks with four long bars; top view and elevation. (c) Asymmetrical blocks with two standard long bars on the right side and four narrow long bars on the left side; top view and elevation. (d) An assembly of five unidirectional blocks; top view and elevation. Dimensions in millimeters.

Variations of the asymmetrical block design could allow for diverse blocks that could convey different information in addition to a sense of direction. Blocks with different arrangements and widths of bars could produce different sounds when a cane is passed over them, transforming the physical information conveyed by the blocks into audible information which could be recognized by the visually impaired pedestrian. For example, a series of long bars of alternating narrow and standard widths could indicate a construction zone.

Figure 2. A linear path made entirely of asymmetrical blocks; elevation (above) and top view (below). Human figure for scale.

The second design we propose is the **cobblestone block**. A cobblestone block has long bars like a standard directional block but, instead of being flat, it consists of two slanted planes with different inclinations sloping in opposite directions. When approaching the block while respecting the assigned direction of unidirectional travel, the pedestrian encounters the less inclined slope; when approaching it from the opposite direction, the pedestrian encounters the more inclined slope. (See Figure 3.) These slopes should be inclined enough to be felt with the feet or with a cane but not too inclined to prevent accidents by tripping somebody. Cobblestone blocks are placed between standard directional blocks at regular intervals (every 25 blocks, for example) as a reminder of the direction to follow. It is possible to place consecutive cobblestone blocks one after the other to provide additional information in addition to the direction. (See Figure 4.)

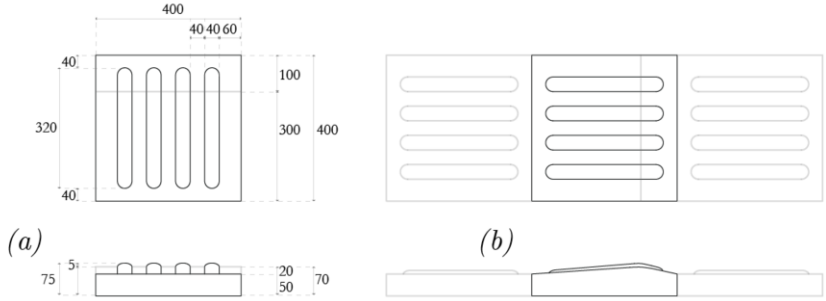

Figure 3. (a) A cobblestone block; top view and elevation. (b) A cobblestone block between two standard directional blocks (lighter lines); top view and elevation. Dimensions in millimeters.

Figure 4. A linear path made of regular directional blocks (shown in grey) and five cobblestone blocks (shown in black); elevation (above) and top view (below). Human figure for scale.

In addition to asymmetrical blocks and cobblestone blocks, other unidirectional tactile blocks could be designed. These should be easy to feel with the feet or with a walking cane and should clearly communicate the orientation of the block. Additionally, they should consider the existing conventions around tactile paving design to minimize confusion among users (such as bars parallel to the direction of travel for directional blocks). Whereas possible designs could communicate resistance while walking against the assigned orientation, they should not be dangerous to the users.

4. Conclusions

In response to the COVID-19 pandemic, our spatial environment has been restructured considerably to limit the spread of the disease. Most of these recent urban interventions respond to the needs of a large part of the urban population but are rarely adapted to those with physical disabilities. The overwhelming visual barrage of new signage systems indicating unidirectional circulation in diverse contexts fails to consider the needs of the visually impaired. Unidirectional tactile paving begins to address these concerns. The designs proposed in this paper allow the visually impaired to navigate through unidirectional circulation networks by feeling the unidirectional tactile blocks with their feet or walking canes. The simplicity and intuitiveness of these designs aim to allow the users to internalize how they work in a relatively short period of time. However, unidirectional tactile paving is only a part of the solution and would benefit from a synergistic integration with other technologies.

Integrating navigation apps within spaces that deploy unidirectional circulation would create a more detailed and inclusive experience while also limiting confusion and accidents. Existing apps already provide great assistance to the visually impaired in moving through both the city and within buildings. For instance, NaviLens (navilens.com) allows its users to scan NaviLens codes placed at strategic locations on the floor and gives them important information about their surroundings. Blindsquare's GPS system (blinsquare.com) guides users to their destinations via advanced third-party tools. BlindWiki (blind.wiki) allows blind or partially sighted users to share location-based findings with others, including difficulties and barriers along paths, but also experiences and stories. Moreover, Be My Eyes (bemyeyes.com) allows volunteers to help the blind and low-vision people through live video calls. Combined with unidirectional tactile paving, these technologies could allow the visually impaired to quickly adapt to updated layouts and decrease the reliance on memorizing complex mental maps of unknown environments.

More affordable alternatives to the preliminary designs presented in this paper could facilitate their installation. Self-adhesive tactile strips can be installed on a variety of flat surfaces and, unlike tactile paving, do not have to be installed simultaneously with the pavement. For an example, see [9]. The designs presented in Section 3 could be adapted to self-adhesive tactile strips. Additionally, people with all types of visual conditions could be served if high-contrast arrows are painted on the tactile strips or blocks. By reordering or reorienting the strips, the assigned directions could be easily rearranged or inverted.

The onslaught of COVID-19 has forced us to reconsider the way in which pedestrians navigate through space and has highlighted the ways in which certain architectural layouts can accelerate a virus epidemic. However, it has also highlighted our visual bias when reshaping our environments while providing opportunities to be more inclusive when thinking of any design solutions. Unidirectional tactile paving could be an inclusive preventive measure for a future outbreak of an airborne disease, such as COVID-19.

Although this paper highlights the usefulness of unidirectional tactile paving with the goal of allowing for physical distancing, asymmetrical blocks and cobblestone blocks can be implemented in non-pandemic contexts too. Regardless of physical distancing, the use of bidirectional tactile paving (the existing type) can lead to collisions between visually impaired pedestrians who walk on it simultaneously in opposite directions. By installing two parallel paths of unidirectional tactile paving, pedestrians can walk both

ways without bumping against each other. (See Figure 5.) This could require the installation of twice as many tactile paving blocks or less, but collisions would be minimized, and the tactile paving would be safer to walk on.

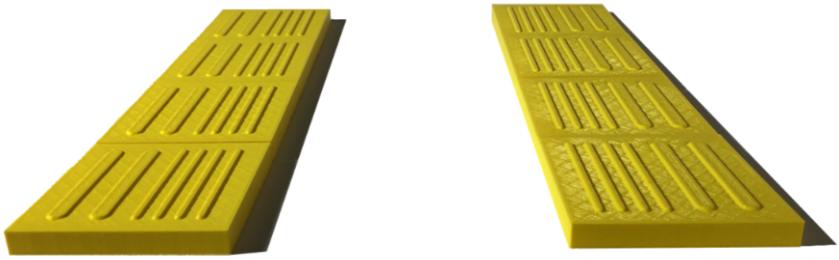

Figure 5. Two parallel paths of unidirectional tactile paving (asymmetrical tiles in this example). Since they go in opposite ways, this would minimize collisions between pedestrians. These tiles were 3D printed at the Harvard Graduate School of Design's Fabrication Lab.

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Toward an Inclusive and Independent Fruition of Architecture: The Use of Scale Models and Augmented Reality

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Abstract. While there are many places in Italy that cater to the population with low vision or who is blind, for example the "Museo Tattile Statale Omero" in Ancona, the remarks made by the Unione Italiana Ciechi e Ipovedenti (U.I.C.I) of Bologna on the issue state that "the issues produced by perceptual barriers, inherent in visual disabilities, do not find adequate answers in the current accessibility regulations". To integrate the accessibility of museums and other cultural services, considered by UNESCO as a fundamental human right that must be granted to people with disabilities (article 30, Convention on the Rights of Persons with Disabilities) the authors present a design, in its early stages, of a system that aims to make the fruition of scale models independent for users with low vision or who are blind. Said system aims to integrate some sort of augmented reality to haptic perception by reproducing sound cues to help users with disabilities navigate a single, or a series of models without any outside aid. The system is based on the deployment of technological plinths to support the scale models. This approach is well fit for retrofitting existing scale models while integrating the navigation system in an effective fashion. The activation of the plinths will be triggered using a smartphone app (either using NFC or Bluetooth) and will reproduce a set routine to guide the user in the haptic exploration of the models. On the outer rim of the plinths a series of triggers and devices will be placed for the user to interact, while leaving some space between the elements to house details at a larger scale or braille plaques. The triggers will be distinguished by their shape, a proud start trigger and a recessed end trigger; the interface is completed by an array of 8 speakers (one each 45°) with the possibility of ulterior sound emitting elements embodied in new models. The current design also defines the properties of the material that will be used in the prototyping phase by excluding rough surfaces that could introduce haptic noise and suggesting the use of thermoplastic polymers or stabilized wood over metals (since a metallic surface could be problematic in exterior installations due to its high thermal conductivity). The concurrent deployment of multiple plinths will consent the independent navigation and queuing of users in a contained exhibit by triggering a positional sound to guide them, while in urban context the app will have to be integrated with systems that implemented detailed voice guidance such as google maps. The paper ends by describing the future prototyping stages the system is expected to go through to fine tune the preliminary design.

Keywords. low-vision, blind, accessibility, architecture, cultural heritage

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1. Introduction

The issue pertaining the accessibility of cultural heritage by people with disabilities is, at its core, a matter of human rights. As stated in "A guide for World Cultural Heritage Information Centers" (Manz K. et al., 2018):

The chance to experience and explore cultural and natural heritage should be afforded to every interested individual. This includes people with various disabilities, be they related to motor skills, sight or hearing, or mental and cognitive faculties [1].

Said remark by UNESCO is elaborating on article 30 of the United Nations Convention on the Rights of Persons with Disabilities (CRPD) stating that people with disabilities should have the right of "Enjoy access to places for cultural performances or services, such as theatres, museums, cinemas, libraries and tourism services, and, as far as possible, enjoy access to monuments and sites of national cultural importance" [2].

In Italy such principles have been included by the MiBACT (Ministero per i Beni e le Attività Culturali e del Turismo) in the guidelines for overcoming architectural barriers in places of cultural interest (P.E.B.A.) in 2018, defining accessibility (of places and objects) as a broad and multidimensional issue that should be solved by the joint effort of universal design and personnel formation.

When restricting the field to people with low vision or who are blind, the main issue is making mainly visual media, such as architecture or paintings, accessible to them. In this sense in Italy one can find a series of structures that specifically cater to them like the "Museo Tattile Statale Omero" in Ancona (housing mainly replicas of sculptures that are geared, when necessary, with elevators to allow the user to feel them at a large scale) or the "Museo Tattile Anteros" in Bologna (housing relief models of paintings); while other museums, such as the Capitoline museum in Rome, have some form of tactile support for people with low vision or who are blind installed while not being a dedicated structure.

The paper addresses said accessibility issues by presenting a system, in its early design stage, that aims to grant the independent fruition of architectural models by people with low vision or who are blind via the interaction with technological elements (plinths) activated by an app.

2. Integrating Haptic Perception with Augmented Reality

Making mainly visual media accessible through haptic perception is an issue vastly studied in literature, the state of art suggests that some cultural expressions are easier to convey with tactile models, since "the all-round copies of sculptures and reproductions of architectures are easier to understand, because the blind person is more familiar with three-dimensional reality"[3], but some aspects are nearly impossible to convey because of some hard limitations, as said by Grassini "for a blind born color is just a name, an abstract word"[4].

While producing tactile models, nowadays, is easier than ever thanks to 3d scanning and rapid prototyping technologies there is still the issue of the scale at which the model can be effective in conveying its features to the user. As stated by Mechini and Sicuranza "the characteristics relevant to 3D reproduction are that it be proportional to the real object, appropriate for the needs of tactile readability, i.e., within arm's reach of the user, capable of being explored with both hands, and small enough to move around it without losing the sense of the whole"[5].

A study conducted in the field of architectural representation conducted by Scianna and Di Filippo experimenting with the reproduction of buildings along the streets of Vucciaria in Palermo found out that, in their sample of people with low vision or who are blind, the preferred scale for architectural prints was 1:50 with scales as small as 1:75 still effective, while the 1:100 scale was considered too small to appreciate the details of the model. This study is concluded with the following statement "It would be interesting to equip the 3Dmodels of sensors capable of giving indications on the architectural parts of the 3D model, so as to make tactile exploration even more accessible." [6]

Integrating haptic representation with sound could be beneficial not only in terms of the accessibility of the single model but also extended to aid people with low vision or who are blind in being independent in their fruition of architecture.

As Tinti et al. highlight in their study, haptic perception allows for only one item to be processed at a time, moreover, "all objects present visual features but do not necessarily, for example, emit sound. Even more importantly, vision allows us to perceive distant, out-of-reach objects, whereas haptic perception does not" [7].

Using a mobile AR system to layer on sound cues to out of reach objects would allow users with disabilities to integrate their experience without outside aid.

3. Navigating Architecture: Triggers and Routines

The independent fruition of architecture by people with low vision or who are blind could be achieved via the coordinated use of a mobile app and a series of technological elements placed in the interested site.

In case of a single model (such as scale model of a building placed nearby the actual structure), a closed loop system would be defined, where the reproduction of an audio guide and the corresponding sound cues would be contained in a limited space.

Scaling up the problem to a wider tour or a museum exhibit an open loop would be needed, where a series of models are connected by a navigational aid to help the user reach each station.

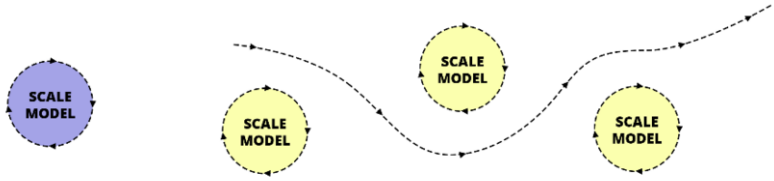

Figure 1. Diagrams of a closed loop (left) and an open loop (right).

In both cases the single model should have a system that, upon request, must be able to start the relative routine to aid the user in experiencing the model. In the case of an open loop a second trigger is needed to start the navigational aid to reach the next model, this should not happen automatically since the user may want to go back and feel again the previous model or could simply want to take a moment of respite before proceeding.

For the triggering of the routines the app could use an NFC (near field communication) or Bluetooth system. The use of NFC could also allow the use of a device other than a smartphone, allowing cultural heritage sites and museums to have cards working effectively as physical tokens. Moreover, NFC makes accidental

triggering more rare, due to an accuracy of about 10 centimeters, and represents a sustainable option for off-grid installation since even the active party in the transaction draws little power and can be left in idle all the time with minimal consumption. [8]

Regarding using Bluetooth to trigger the routines it would surely be of a more agile implementation, especially for standalone models, since the technology is ubiquitous in the smartphone market. The drawback to using this solution is relative to a more taxing power consumption (if confronted with NFC), and a major risk of accidental triggering for the routines, since, even if a high-quality beacon could allow a precision comparable with the activation field of NFC, it is more commonly an order of magnitude higher.[9]

Once triggered, the routine played on the single model is composed by an audio-guide paired with distinctive sound cues directing the user to the described spots, allowing them to navigate even a large model autonomously. At the end of the routine, in the case of an open loop, there will be an option that can be triggered using the app that will direct them to the next model in the tour.

To allow this series of operation around a model the authors theorized the installation of a technological plinth that will support the model at a comfortable height, while hosting the components that will allow the described operations.

4. The Technological Plinth

To house the technological elements driving the system a solution has been designed that uses the, already needed, support to raise the model from the ground. This is crucial in thinking about retrofitting existing models since it would be sufficient to move them on this kind of support and design from them the necessary routines.

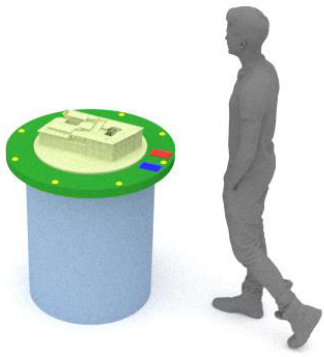

Figure 2. The technological plinth – 3d diagram.

The supports have been designed to take advantage of tactile feedbacks regarding the elements with which the users will have to interact, making significative areas either proud or recessed on a mainly smooth surface.

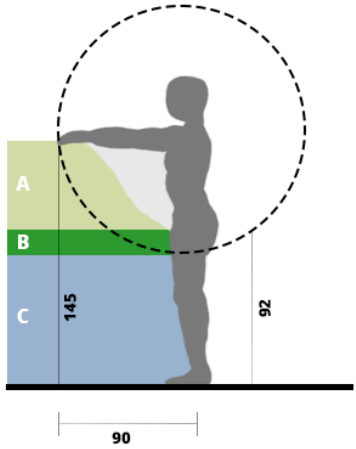

Figure 3. Dimensional diagram, h-zones.

The overall dimensions for the plinth are determined by the average human range of motion. Three height-zones (h-zones) have been identified: h-zone A is between 92 and 145 centimeters from the ground, it allows the comfortable touching of the models, but high elements should be placed further away to allow users to bend; h-zone B is between 95 and 85 centimeters, here will be placed braille inscriptions (when needed), relief of various details, and lastly the triggering interfaces to start the routine; h-zone C represents the interval that could not be reached comfortably by a person standing.

Regarding the dimensions in plan of the plinth, 90 centimeters has been identified as a comfortable overall diameter, with a 15 cm strip housing the elements described in the previous paragraph and a zone for the scale model with a diameter of 60 cm.

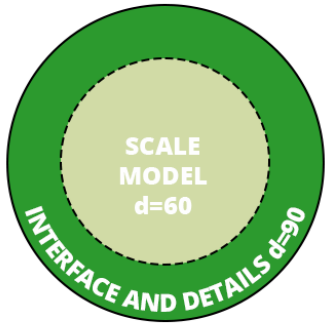

Figure 4. Dimensional diagram, plan.

On the outer rim of the plinth there will be 2 areas, the proud one (depicted in red in the diagram present in figure 5) will be the start trigger, approaching this element with either a phone or an NFC card will start the routine. The sound cues will be produced by an array of 8 speakers (one each 45°, represented in yellow in figure 5) to conduct the user around the model, these speakers could be also integrated by elements placed inside the model and geared to either produce sound or vibrate to guide the hand to a detail in particular. Lastly the recessed area (depicted in blue in figure 5) will be the end trigger

that, upon activation, will signal with an audio cue the next user in line about the availability of the model.

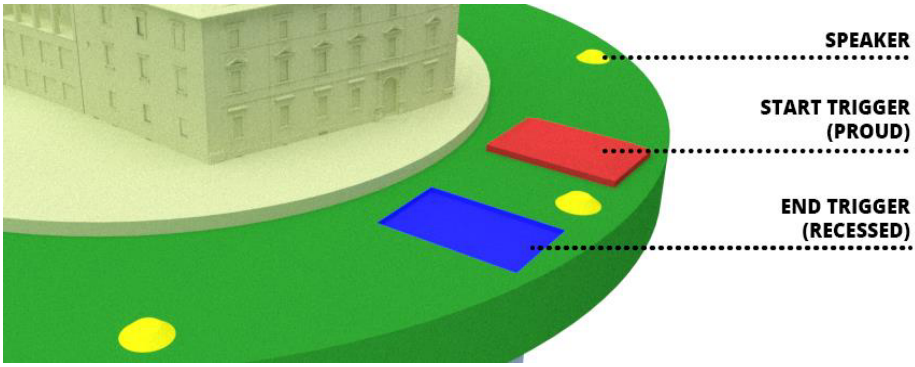

Figure 5. Technological plinth, interface elements.

The materials used to build the plinth should present smooth to the touch, not introducing noise, to avoid interference with elements at a larger scale that could be integrated in the outer rim, these elements could serve as a medium to represent a detail within reach of the user. Another use of the space in-between elements could be relative to the installation of plaques with braille writing allowing a low-tech fruition of the models while building some form of redundancy in case of a malfunction or a power outage.

The choice of materials for the plinth depends on their location, in case of indoor installation they could be realized in stabilized wood or using thermoplastic polymers to grant a uniform and smooth surface. For outdoor use at the time of writing the materials being evaluated are reconstructed stone or concrete so to increase the durability of the plinths when exposed to the weather. In both cases the use of a metallic casing has been considered not adequate, since the high thermal conductivity can hinder the experience of the user in environments that are either too hot or too cold.

The app driving the system will be speech based, its role as key to activate the plinths will be paired with a series of services to grant the independent fruition of architecture by people with low vision or who are blind. In idle, it will warn the user of the availability of a scale model or a dedicated museum nearby, this function is instrumental to the independent discovery of sites while, for example, roaming a city.

It will aid the user in localizing the nearby attraction, by either giving the chance to activate a sound cue from a beacon at the entrance of the museum or making an external installation signal itself. Moreover, in case of an open loop it will conduct them from one model to the next (playing a sound cue from the following plinth), or in case of cities or archeological sites it will rely also on the support of systems such as google maps that implemented detailed voice guidance.

Lastly, in case of an on-site installation (when the model is installed, for example, in a space prospicient the actual building) the system could be integrated with a series of stand-alone beacons that would direct the user toward a specific portion of the actual building to allow the user to feel a particular detail or material on the architecture itself.

5. Conclusions

Granting people with low vision or who are blind an independent fruition of architecture is a matter of rights, rights that could be allowed by an innovative use of existing technologies.

The proposed approach to the issue could make possible for them to both know the position and have a “guided tour” of the models without any outside aid, improving the accessibility of architecture not only on a physical but also on a cultural level. It could be a step in the right direction since, as made clear by the remarks of the Unione Italiana Ciechi e Ipovedenti (U.I.C.I.) of Bologna "the issues produced by perceptual barriers, inherent in visual disabilities, do not find adequate answers in the current accessibility regulations".

On Aisthesis, the audio review of the Museo Tattile Statale Omero, Andrea Sòcrati closed an article about how the development of medias in the history of humanity changed the way we relate to synesthetic perception of things paraphrasing Diderot.

“Three centuries ago Denis Diderot asked the blind man of Puiseaux if he would be happy to have eyes to see; the blind man answered that he would have liked to have longer arms, because the hands would have allowed him to know better than the eyes of seeing peoples what happens on the moon”[10]

The broad implementation of this design could be beneficial in allowing people with low vision or who are blind to go beyond what is at their arm’s reach without little to no outside aid, granting them the long arms the blind man of Puiseaux wished for.

6. Further Developments

The preliminary design described in the paper, at the time of writing, has defined the necessary elements (both on the hardware and the software side) to move on to the prototyping phase.

The first round of prototyping will be conducted to test the interface (using a simple mockup routine) on people with low vision or who are blind. This first phase will be conducted using rapid prototyping technologies (such as FDM 3d printing) to implement the necessary tweaks in a timely fashion. In this phase will be also tested if the use of colors with a stark contrast between them could aid people with low vision in using the interface.

Once the physical interface is tuned further testing will be conducted regarding materials used to grant an adequate level of resistance both to ordinary wear and tear and regarding the exposition of external installations to the elements. External testing will pair the usual issues regarding waterproofing with stress-tests to determine if the noise generated by the superficial degradation of the selected materials can hinder the performance of the system due to an excessive level of tactile noise.

To improve the synesthetic fruition of the models, during this phase, it would be of interest to experiment the use of different material composing the model itself to convey in a better way the material composition of architectures.

Lastly, the development of the app will be conducted to deploy a pilot installation of the system and test the navigation features.

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Transforming our World through Universal Design for Human Development
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Towards eXtended Universal Design

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Abstract. Even though eXtended Reality (XR) technology has been trialed in various projects in primary and secondary education, its lack of universal design hinders further adoption. In this paper, we present the results from focus group interviews with representatives from Norway's private and public sectors, in which we investigated their practical experiences and opinions about the accessibility and usability of XR technology in schools. We summarize practical opportunities and challenges related to the need for universal design of XR technology, both in general terms and in education specifically. Moreover, we compare the results to a previously conducted selective and weighted literature review. Five major future research needs to improve the universal design of XR technology emerge: The need to (1) increase co-creation, (2) identify and understand barriers, (3) develop solutions for said barriers, (4) advance standardization, and (5) develop evaluation methods and tools.

Keywords. eXtended Reality (XR); Primary and Secondary Education; Universal Design; Accessibility; Usability; Digital Learning; Information and Communications Technology (ICT).

1. Introduction

Extended Reality (XR) – an umbrella term for Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR) – has shown promising positive results for primary and secondary education, at the same time as decreasing hardware costs and increasing availability are expected to make XR even more ubiquitous in the future [1, 12, 14].

However, significant barriers in accessibility and usability for people with disabilities and varying abilities and a lack of universal design of XR technology exclude large groups of students and users in general [10, 14]. Especially, the practical implications of missing universal design for students with disabilities have been underrepresented in the literature [14]. Moreover, the lack of standards and evaluation methods has been pointed out as hindering the advanced universal design of XR technology [14].

In this paper, we investigate barriers that students with disabilities and varying abilities can encounter when using XR technology in education. We collected data from the literature and focus group interviews with stakeholders from Norway's private and public sectors. We identify opportunities, and challenges. Moreover, we discuss future research needs to advance the universal design of XR technology in education for all.

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2. Methodology

We organized three focus group interviews with 12 representatives from the private and public sectors: (1) representatives from user organizations for people with sensory (e.g., hearing and seeing), physical, and cognitive (e.g., dyslexia) disabilities, (2) educators from public primary and secondary schools, (3) decision-makers from municipalities, and (4) companies that develop XR applications for education in Norway. The goal of these interviews was to investigate the representatives' experiences with and opinions about ongoing, previous, and planned XR projects in Norwegian schools. Each focus group consisted of 2 to 5 participants. We asked the participants to share observed advantages, disadvantages, universal design, barriers, and solutions to said barriers, as well as the participants' opinions about future research needs of XR technology. Then, we summarized the opportunities that XR technology can offer for students with disabilities in primary and secondary education, as well as experienced barriers for people with different degrees of sensory, physical, and cognitive abilities (cf. 3. Results). We compared our findings with the results of a selective and weighted literature review that we conducted during the preparation of the focus group interviews [14] and defined future research needs to make XR technology more universally designed (cf. 4. Discussion).

3. Results

3.1. Opportunities

There are numerous opportunities for use of XR technology in primary and secondary education. General pedagogical opportunities have been reviewed elsewhere [13]: XR is first and foremost technology for mediating experiential learning. XR can bring abstract topics into a more practical learning context. XR can stimulate social interaction and collaboration and can help improve digital skills in students. XR can both challenge standard learning and invite alternative learning processes, both in students and educators. XR technology is likely to be increasingly present in future classrooms.

Moreover, XR can support weak students with learning disabilities or other challenges. XR is well-suited to support students who have difficulty concentrating or other cognitive challenges. One participant, for example, recounted their experience with adolescent boys who found it difficult to sit still and concentrate on the topic at hand. The participant explained that these teenage boys benefitted from being immersed in a digital environment, as digital interaction captured their attention and kept them busy in a different way than in the physical world. The children's visits to the virtual world are described as allowing them to be in their own bubble, being shielded from external distractions. Similar positive responses to XR technology have been observed by other participants working with children with various cognitive disabilities like Down syndrome, ADHD, autism, or social anxiety. One participant shared their experience of how XR technology motivated children with cognitive and physical disabilities to be more engaged and physically active. The participant recalled one project involving a child with Down syndrome that gained a different motivation for moving around while in a virtual world. They remembered the kid's mother saying: "I have seldom seen my kid so active and engaged as when in virtual reality!"

3.2. Challenges

XR technology can become yet another area for exclusion in education if its universal design is not addressed and its accessibility and usability are not increased sufficiently. XR technology lacks universal design, which often leads to the exclusion of students with disabilities, varying abilities, and other needs. Specifically, students with sensory (e.g., visual, and auditory), physical and cognitive disabilities or varying abilities encounter significant barriers preventing them from using XR technology for any length of time. Some of the participants voiced their concern about relying too much on XR technology in education when the technology lacks universal design. The barriers described below, likely exclude students with disabilities from using XR technology, either partially or completely. If schools decided to rely too much on XR technology for any given topic or subject, there would be an imminent risk of excluding students with disabilities and varying degrees of sensory abilities. Even students with common conditions like wearing eyeglasses could be excluded. One participant said: "We are afraid that the virtual world becomes just another area where people with disabilities are left out."

Students with disabilities or common ability variations can encounter barriers connected to headsets and other physical barriers. Especially, head-mounted devices (HMD) for VR and MR are associated with significant barriers. HMDs can be challenging for students who need to wear eyeglasses, have a smaller head, or have a narrower interpupillary distance (IPD) than the average adult white male [3]. This makes the HMD uncomfortable to wear and use and is also a reason why many experience motion sickness. Other issues that give rise to discomfort that either reduce the time an individual can use MR/VR or they experience motion sickness are related to common vision problems such as no or poorer ability to perceive 3D visual content, differential sensitivity to depth, and/or motion cues [3,6,11]. As many as 5% of the population do not have the ability to perceive 3D, and 10–20% of the population have poor ability to perceive 3D in the physical, mixed, or virtual world [4,5]. Moreover, the physical setup of XR equipment can impose inconvenient, impractical, and even dangerous challenges for people with disabilities or different degrees of sensory ability. Managing cables for HMDs can interfere with assistive devices like headphones or wheelchairs. Setting up and interacting with XR devices can be particularly challenging for students with sensory, physical, or cognitive disabilities. One participant reported that one student in a wheelchair became so engaged and excited by the virtual world that they fell off their wheelchair.

Students with visual impairments face considerable barriers when using XR due to lack of multimodality, lack of accessibility of the (graphical) user interface, and potential incompatibility with assistive technology. Virtual worlds to date heavily focus on the visual experience, while often neglecting equivalent auditory immersion. One participant with low vision reported that they were missing a virtual sound landscape in which sounds have detail, create an atmosphere, and can be located. Moreover, there is a lack of auditory descriptions of visual objects and events. Users who have low vision or who are blind desire the option of enabling alternative modalities for visual events, scenes, or actions. This could, for example, be in the form of descriptive narration, or as alternative texts that are readable by a screen reader typically used by people with visual impairments. Likewise, (graphical) user interfaces are often inaccessible, especially when users rely on assistive devices like screen readers or magnifiers. Our focus group participants mentioned typical barriers like font sizes that were too small, contrasts that were not large enough or a busy and distracting background. One participant reported that it was sometimes not even obvious where to find the start button to initiate the game.

Students with physical and sensory impairments can encounter barriers related to incompatibility with assistive devices. Many XR devices and applications are incompatible with assistive technology like screen readers or hearing aids that are typically used by people that are hard of hearing. One participant mentioned that some devices could not be used in combination with headphones that would improve the auditory experience for people with hearing impairments. Especially, assistive technology connected through Bluetooth can raise significant complications because some XR equipment does not support additional external devices.

XR developers might repeat barriers that are well-known from other ICT areas, at the same time as they overlook simple solutions that could benefit multiple user groups simultaneously. Students with reading difficulties in the real world may also have difficulty reading text presented in the digital world. Barriers in the (graphical) user interface for people with visual disabilities, or missing subtitles are well known in other ICT areas like websites or movie clips. One participant who had experience working with dyslectic students emphasized that XR technology mirrored many of the barriers that they encountered from other ICT areas like websites, games, and digital media in general. For children with reading difficulties, texts are often too long, and the language is too complicated because designers and developers are trying to appear excessively sophisticated. Thus, our participants suggested reusing relevant guidelines from these ICT areas for XR technology. They mentioned, for example, the Web Accessibility Guidelines (WCAG) which offered best-practice examples for increased accessibility and usability of websites [16]. The participant emphasized that basic recommendations like "keep it simple!" – e.g., the use of simple understandable vocabulary or enabling the option of reading all dialog and text aloud – could increase accessibility and usability of XR technology significantly. Moreover, the participants pointed out that solutions targeted at one group often benefited other user groups as well. This is referred to as the curb-cut effect in universal design research [7]. Having text and dialog read-aloud, for example, will not only benefit students with visual disabilities but students with dyslexia as well. Likewise, blurring the background will not only increase readability for students with low vision but will also help the concentration of students with cognitive challenges.

More research on barriers for students with disabilities and varying abilities, and solutions to mitigate said barriers is needed. Most companies in our focus group interview expressed their commitment to helping students with disabilities and wished to produce universally designed XR technology. One company reported that they conducted a small study including people with cognitive disabilities financed by Norwegian authorities. At the same time, representatives from user organizations called for extended research on the practical barriers of XR technology for students with disabilities, as well as the implications of these barriers on education. Further research about universal design and its funding was desired by most participants of our focus group participants.

Narrow profit margins and high press from investors can discourage companies to focus more on the universal design of XR technology. Many XR content creators in Norway are small start-up companies with only a few developers and limited budgets and are often faced with tough financial decisions. Thus, they need to prioritize where and how to focus their efforts and resources. Some XR companies claim that they are advised by investors to prioritize content creation targeted at what they term the majority population of students (those without disabilities) first. They consider the group of students without disabilities to constitute the largest percentage of customers, and, therefore, the most profitable. When they do so, however, they also exclude those with common eye problems and those with visual impairments. Thus, they cater to just about half

the population. In contrast, focusing on people with disabilities during development could lead to unexpected beneficial synergies. At the same time, companies need to weigh production costs against legal obligations that the lawmaker has put in place for digital learning aids as we will discuss in the next paragraph. The companies that we talked to confirmed that the universal design of their products was of high importance, but they lacked knowledge on how to achieve this.

As XR technology becomes more ubiquitous, legal requirements targeting the increased accessibility and usability of devices and applications, especially in education, become more likely. There are national and international laws requiring all digital teaching tools to be universally designed, like the Norwegian Anti-Discrimination Act or the Regulation on Universal Design of ICT Solutions covering among others websites and digital teaching aids [8, 9]. Even though the Norwegian law does not explicitly mention XR technology, representatives from user organizations argued that XR technology qualified as digital teaching aid sanctioned by the law when used as a teaching aid in the classroom. Moreover, the participants pointed out that it could be beneficial to invest in universal design early in the production process. One participant quoted experiences from the time when the ICT Regulation Solutions had first been enacted: Many companies and organizations had to remodel their websites to comply with WCAG as required in the regulation. This remodeling caused costs for the companies and organizations by additional time, effort, and resources that could have been avoided if they had incorporated compliance with the guidelines early in the design and development process. Some participants emphasized that making universal design an integral part of the design and development process could, thus, be more cost-effective in the long run.

There is a lack of guidelines, standards, and best-practice examples to support increased accessibility and usability during the design and development of XR devices and applications. Representatives from XR companies made clear that the general lack of practical guidelines and concrete best-practice examples was one of the main reasons why developers overlooked the universal design of XR devices and applications. As mentioned above, many XR software companies for the education sector are rather small and have limited resources. They claimed that they did not have enough leeway for experimentation because they must create content with a limited amount of people on a tight schedule. The companies we talked to complained that there was simply no time for investigations into which solutions worked best for students with disabilities or how viable solutions could be implemented. A standard of or even a set of clear guidelines and best-practice examples would mitigate the burden of finding effective solutions and their implementation. A standard would facilitate the integration of accessible and usable solutions by providing a clear roadmap or manual to manifest accessibility and usability for all into the agile design and development routines of XR devices and content creators.

4. Discussion

4.1. Comparison between the literature and the interviews

In our focus group interviews, we noted many common barriers for students with disability and varying abilities with what we found during a selective and weighted literature review [14]: For example, XR technology can offer opportunities for virtual access and

inclusion, compensation for disabilities, safe spaces, personalization, assistive technologies, and rehabilitation [14]. In contrast, general challenges are mostly related to the lack of multimodality, practical issues when setting up or using devices, incompatibility with assistive technology, financial costs, health issues, overreliance on gamification, and ethical considerations [14]. Moreover, we reviewed common barriers for people with cognitive, sensory, and physical disabilities [14]. General opportunities in the classroom and systemic challenges of XR technology have been reviewed elsewhere [13].

Our focus group participants highlighted the general lack of universal design of XR technology for students with disabilities as one of the main inhibitors to implementing XR technology in education. This lack seemed to outweigh the few positive aspects that they reported for students with disabilities. In contrast, they mirrored many practical barriers related to inaccessible hardware as well as inaccessible navigation and interaction methods, and incompatibility with assistive technology. Similarly, content-related barriers like the lack of multi-modality and inaccessible (graphical) user interfaces have been reported by both the literature and our participants. Thus, our findings reflected and confirmed several of the barriers described in international literature and added some more practical examples for education. Moreover, our focus group participants underlined the importance of focusing future research on the universal design of XR technology. Representatives from user organizations for people with disabilities stressed that XR technology must become more accessible and usable before wider deployment in schools can be achieved. They especially pointed out the need to ensure that students with disabilities and varying degrees of ability were not excluded from this emerging technology. They gave an emphasis to education that was universally accessible by all students.

4.2. Need for future research

Even though our focus group interviews investigated XR technology in education, the discussed accessibility and usability challenges are rooted in a general lack of universal design of XR technology. Thus, we will discuss future research needs to improve accessibility and usability of XR technology on a more general level in the following discussion. More precisely, the universal design of XR technology needs to be improved by breaking down barriers for students and users in general with disabilities to make XR technology more accessible and usable for all. Future research should focus on co-creation and user involvement, barriers and their solutions, guidelines and best-practice examples, and evaluation of the degree of universal design and effects. This research should contribute toward the general standardization of the universal design of XR technology. Moreover, future research needs connected to pedagogical integration, digital skills, digital infrastructure, and funding are also necessary [13].

There is a need to strengthen co-creation involving XR software companies and device manufacturers, students and educators, and user organizations representing people with disabilities. User involvement during the design, development, and testing of XR technology is the key principle of inclusive design approaches (IDA) and proved to be necessary to increase the universal design of a product or service in general [2]. Relevant methods during such co-creation processes are user tests, focus groups, and surveys. Recruitment of students and users with disabilities can be done through user organizations, co-operations with special ed schools, or by addressing students directly through social media.

There is a need to identify the barriers that users with disabilities encounter when using XR devices and applications, both generally and in education specifically. Some studies have started with the identification of such barriers [15, 17]. However, there is a need for further investigation of barriers for different user groups in general and students with disabilities in specific. This investigation should also highlight the challenges of XR technology, specifically in the classroom. The focus should be on students with cognitive, sensory (e.g., visual, and auditory), and physical disabilities as these categories represent the most prominent disability groups among students and as XR technology is a predominantly visual medium. Moreover, there should be an assessment of the limitations of XR technology, including an evaluation of where and when XR as a tool for mediating learning in schools is beneficial.

We need to advance the development of solutions or strategies to mitigate the investigated barriers through co-creation. Few solutions for barriers have already been proposed [14]. With co-creation, students with disabilities and varying abilities can decide and influence which solution fits best for satisfying their needs and preferences. Moreover, students with disabilities can help to test solutions with assistive technology like wheelchairs, screen readers, or hearing aids. Synergies and other unexpected benefits (e.g. the curb-cut effect), as well as the avoidance of costs for remodeling the XR devices and applications once universal design becomes a legal obligation will make up for the additional co-creation costs in the long run.

The standardization process of the universal design of XR technology should be addressed. Namely, guidelines and best-case examples that designers and developers can use to create accessible and usable devices and applications need to be developed and compiled. These guidelines should include examples with specific implementations and source code. Moreover, user organizations, schools, municipalities, and authorities can use these guidelines to evaluate the level of universal design of XR alternatives during procurement. Likewise, the legislator can use the guidelines as a reference to define minimum requirements for developers and manufacturers.

There is a need to develop evaluation methods and tools to measure the degree of accessibility and usability of XR devices and applications. Such methods should indicate how well universally designed a specific device or application is compared to other equivalent candidates. These evaluation methods and tools would support user organizations, schools, municipalities, and public agencies during procurement processes by identifying the most universally designed competitor. Moreover, these methods and tools could assist XR developers and manufacturers during design, development, and testing. Evaluation methods and tools should be easily integrable into an agile development process, and most likely be automatable to some degree. Finally, evaluation methods and tools can compare and evaluate the effects of universal design against their level of conformity with the previously discussed standards. Evaluating effects could highlight gains and weaknesses, make them visible and uncover synergies and unexpected benefits in areas that might not have been originally targeted by an investigated solution. By improving the audio experience in the virtual world for students with vision disabilities, for example, one might improve the experience of students in general.

5. Conclusion

Even though XR technology in education offers a variety of advantages, especially for students with learning difficulties, the technology has a significant lack of universal design and a low degree of accessibility and usability for students with disabilities and varying abilities. Our findings from focus group interviews with representatives of XR companies, educators in schools, decision-makers in municipalities, and user organizations confirm many of the barriers that we have uncovered from a previously conducted selective and weighted literature search. Specifically, students with different degrees of sensory abilities, e.g., hearing and seeing, encounter barriers related to the lack of multimodality, lack of accessibility of the (graphical) user interface, and incompatibility with assistive technology. Likewise, physical barriers and limitations of the headsets can hinder students with physical disabilities and common conditions like wearing eyeglasses alike. We show that financial requirements from investors and missing guidelines likely hinder the implementation of solutions to mitigate barriers. Finally, we define five future research needs to facilitate the use of XR technology in education related to (1) *increased co-creation in the development of XR applications and devices*, (2) *identification of barriers for students with disabilities, as well as the (3) the development of solutions for said barriers*, (4) *the advancement of standards, guidelines and best-practice examples for increased universal design of XR technology in general*, and (5) the development of *evaluation methods and tools to measure the degree of accessibility and usability of XR devices and applications*.

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Technology Use and Familiarity as an Indicator of Its Adoption in Museum by People with Intellectual Disabilities

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Abstract. This paper describes the process of co-design of technological products to increase museum accessibility and engagement in visitors with mild or moderate intellectual disabilities (IDs). By using an Inclusive Research approach, a multidisciplinary team of experts, including researchers in Users Experience (UX), psychology, and education, museum curators and a group of participants with IDs (n=9) have participated as the research team. Participants with IDs were involved in two rounds of interviews. The first-round interview aimed to explore participants' use and familiarity with technologies and to understand their interest in using technological tools in different contexts. The second-round interview aimed at exploring participants' spontaneous choice between different tools classified as low (easy-to-read vs Augmentative and Alternative Communication) or high-tech (Augmented Reality) aids for acquiring new knowledge within a museum space. The analysis of the interviews revealed that there was a general consistency between previous technology use/experience/interest and the choice of ICT-based products by participants with IDs. These results highlight the importance of emphasizing a multidisciplinary dialogue and the active participation of IDs users to outline methodologies, programs, procedures, and international standards to foster inclusive access to cultural heritage.

Keywords. Accessibility, Intellectual Disabilities, Experts, Co-design, Inclusion.

1. Introduction

In the last few years, a growing interest in understanding how to promote the access to knowledge for people with Intellectual Disabilities (IDs) and in general for people with Special Educational Needs (SEN), has been fueled by increased legislative priorities and societal expectations for individuals in this population. The Convention on the Rights of People with Disabilities [1] promotes the application of Universal Design principles to avoid any form of discrimination (art. 2) stating that products, environments, programs

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should be accessible and usable by all people without the need for adaptation or specialized design.

In today's information and knowledge society, people with SEN seem to benefit from the use of Information and Communication Technologies (ICTs) [2]. ICTs encourage a flexibility in identifying multiple ways of understanding, processing and elaborating knowledge thereby removing cognitive and communication barriers within formal and informal education contexts (i.e. museums). However, ICTs could become a barrier or obstacle to knowledge for people with IDs if they don't respond to people's needs. What complicates the relationship between disability and technologies is what is called *digital divide*, i.e., the difficulty for people with disabilities not only to access but also to use technological resources [3].

As highlighted by Pinelli & Fiorucci [4], the possibility of accessing the digital world *(Digital Inclusion*) implies the intersection between elements related to the access and use of ICTs. As for the use of ICTs, the authors distinguish between *Digital Skills* and *Digital Competences*. This distinction reflects the inevitable digital gap that may exist between the use of technological resources in terms of the required skills (i.e. capacity to use a technological device) and the required competences (i.e. the actual use of a technological tool and the interest in using it for pursing learning goals and learning activities).

In the present paper we discuss on how digital skills and competences of people with IDs need to be considered when designing and introducing ICTs within social and cultural contexts (i.e. museums). By using a new methodological approach based on *Inclusive Research* [5,6], we investigated how previous technology use/experience/interest may influence the choice and use of ICT-based products by participants with IDs. Our goal is to reflect on the co-design of technological spaces/products to increase accessibility and engagement in museum visitors giving importance to the process of applicability, usability and effectiveness of ICT tools in meeting people's needs and desires.

2. Method

2.1. Context

The Museum of Natural Science (Trieste) is the context of this research. For several years now, the museum has been giving attention to the renewal of communicative spaces in an inclusive perspective. The museum expressed a particular interest in introducing innovative technological solutions to enhance accessibility, usability, and the overall quality of the interaction with contents available to museum visitors.

2.2. Participants

A multidisciplinary team of experts, including researchers in Users Experience (UX), psychology, education, and museum curators have been working together in several research projects aimed at making social and cultural contexts accessible for people with IDs. Across all the studies, crucial members of the research team were a group of people with mild or moderate IDs part of the Cooperativa Sociale Trieste Integrazione a m. Anffas Onlus (Trieste). The participants with IDs have been working with experts in education over the years and have an established emotional relationship with them. In

this article we report the results of one of the studies carried out, which saw the involvement of a small group of people with mild or moderate IDs (n=9) with a similar level of schooling (i.e. completion of compulsory schools) and a similar level of reading, writing and textual comprehension abilities.

2.3. Procedure

The research paradigm was that of *Inclusive Research* [5,6] which is based on a participatory approach allowing an accurate analysis of participants' thoughts, needs and desires [7,8]. Our goal was to reflect on the co-design of technological spaces/products to increase accessibility and engagement in museum visitors giving importance to the process of applicability, usability and effectiveness of ICT tools in meeting people's needs and desires.

For this purpose, qualitative data have been collected to explore thoughts and ideas of people with IDs while interacting with ICT-based products within the museum space. Two sets of interviews have been conducted to investigate how previous technology use/experience/interest may influences the choice and use of ICT-based products by participants with IDs.

The first-round interview aimed to explore participants' experience with technologies and understand their interest in using technological tools in different contexts. The interview consisted of 7 questions (Figure 1), was conducted at the Anffas, was video-recorded and entirely transcribed and analyzed by the authors of this work.

Do you use any type of technology (cell phone, tablet, computer, etc.)?
Do you use these technologies yourself?
If not, do you ask someone for help with anything specific?
What do you use the technologies to do?
What do you like about using technology?
What do you dislike about using technology?
What is your biggest difficulty when using technology?

Figure 1. Interview to explore participant's skills/competence/interest in using technology in their daily-life.

The second-round interview was conducted within the museum and aimed at exploring participants' spontaneous choice between different tools for acquiring new knowledge. The tools presented belonged to two different categories: (i) Low-tech aids consisted of a simplified written text (Easy-to-read, EtR) and a text with pictograms - AAC (Augmented and Alternative Communication); (ii) High-tech aid consisted of an Augmented Reality (AR) tool.

The easy-to-read and the ACC texts (Figure 2 and 3, respectively) were created by a social worker expert in these strategies with the active contribution of the participants with IDs. The current contents of the EtR and AAC text were produced in Italian, the native language of our participants. The contents referred to an exhibit that had aroused particular interest and attention in our participants during a previous visit to the museum. The creation of the two low-tech aids took place through 10 meetings conducted before the present data collection. During these meetings the participants had become familiar with the two low-tech aids they had produced.

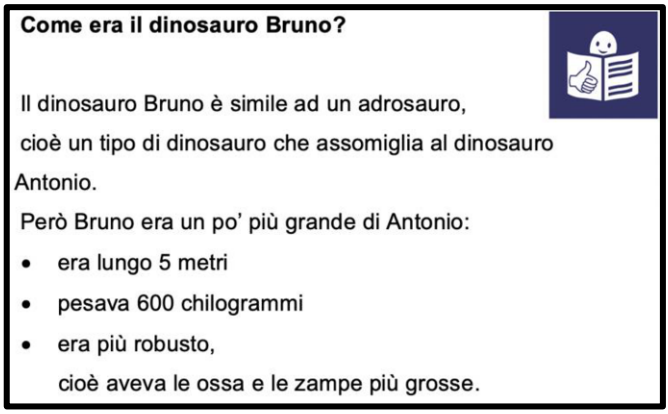

Figure 2. Low-tech aid consisting of an easy-to-read text. The figure represents an extract from the written text.

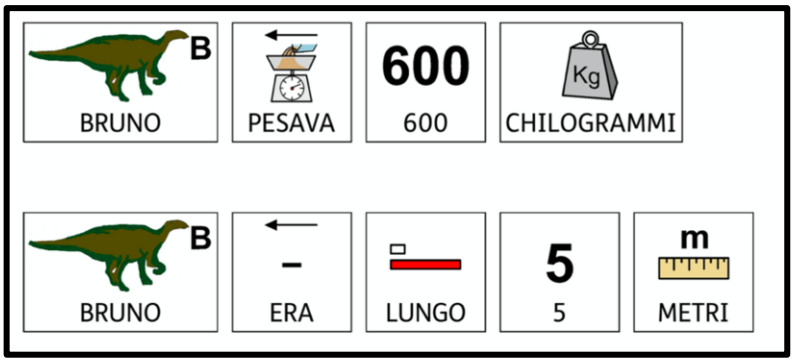

Figure 3. Low-tech aid consisting of a text with pictograms. The figure represents an extract from the AAC text.

The AR tool was designed by the two authors from the Università della Svizzera Italiana based on experience with a similar target group. In order to co-design new solutions, the authors needed to use prototypes already developed [9]. This would allow changes to increase the accessibility, compensate for the lack of abstraction ability, and then achieve the goal of co-designing ICTs.

Participants' familiarization with the AR tool took place within the Anffas association and was mediated by the social worker, the UX-design experts and the psychologists/educators. Figure 4 shows the familiarization phase occurred according to the following steps: (i) participants were shown the QR code and provided with a smartphone with the camera on; (ii) they were asked to frame the QR code as they preferred and to ask for help if they had some difficulties (iii) they were asked to tell what they saw and to zoom in on some details.

We explored participant's spontaneous reaction during their first interaction with the AR tool by applying a coding scheme that allowed the detailed analysis of verbal and non-verbal communication components (i.e. facial expressions and exclamations that express emotions of surprise, fear, indifference etc.).

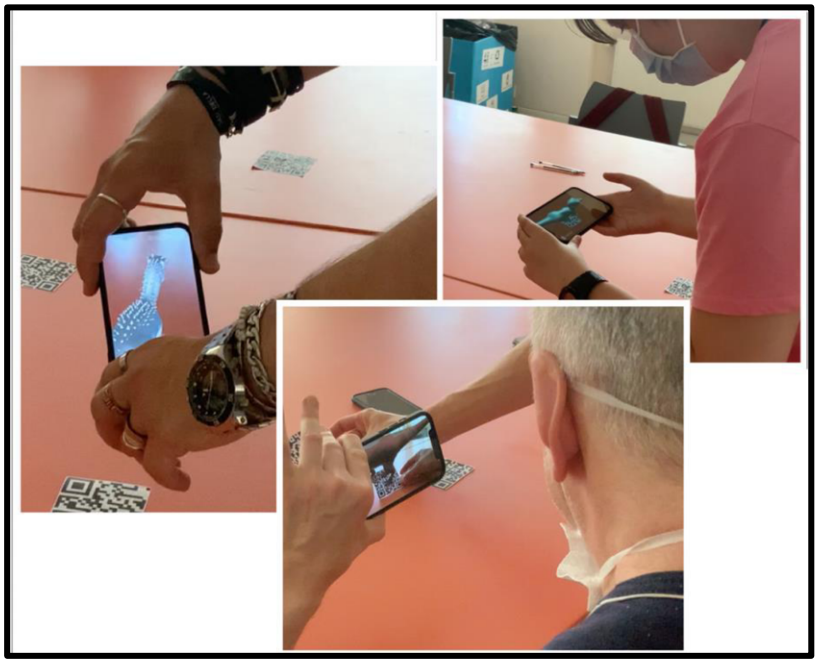

Figure 4. Familiarization with the high-tech aid consisting of an Augmented Reality (AR) tool.

The day after the familiarization took place, participants with IDs and the rest of the research team where involved in a tour at the museum. The second-round interview consisted of presenting to our participants, individually, the three aids (EtR text, AAC text, AR tool) positioned right in front of the related exhibit. Participants were asked to choose one of the three aids to acquire new knowledge on the exhibit. The researchers recorded participant's choice.

3. Results

The analysis of the two-round interviews revealed that there was a general consistency between previous technology use/experience/interest and the choice of ICT-based products by participants with IDs.

In Table 1 we reported a synthesis of the answers to the first-round interview questions.

Table 1. Results from the first-round interview aimed at exploring participants' experience with technologies and understand their interest in using technological tools.

	B.	**S.**	**E.**	**H.**	**M.**	**M.**	**A.**
1	Tablet PC	Mp3 I had a Tablet that broke	Tablet PC Smartphone	Smartphone Interactive whiteboard	3 tablets 2 radio TV PC Wii Smartphone	Tablet Smartphone	PC Smartphone
2	Yes	Yes	Yes	Yes	No	Yes	No
3	I once asked my mom for help to turn	To turn on the mp3	My sister helps me to	I once asked for help to charge my cell phone	No	I ask for help to recharge	Mom helps me, e.g. to take a

	on the PC, after that I learned	and to use it	turn on the pc			my cell phone credit	picture my mom holds the phone and I press the button
4	To send messages, to play games	To listen music and play games	I use the Tablet to play games, my computer to write poems and my cell phone to take pictures	I use my cell phone to make calls, my media board to draw, to look at pictures	I used to use the Wii for exercising now I don't use it anymore. The cell phone for texting, watching videos and surfing the Internet. The Tablet I use to send messages on WhatsApp to friends, listen to music and play games	I use the Tablet to play games while the cell phone to answer calls and send Emoji	I use my computer to write children's stories and my phone to send messages with WhatsApp and to go on Facebook and Instagram
5	I like to use it	I like to use it	NA	Drawing and looking at photos	NA	NA	NA
6	NA	I don't know	NA	I don't like games on the multimedia board	NA	NA	NA
7	NA	I don't know	NA	I don't know	NA	NA	NA

Legend:
1. Do you use any type of technology?
2. Do you use these technologies yourself?
3. If not, do you ask someone for help with anything specific?
4. What do you use the technologies to do?
5. What do you like about using technology?
6. What do you dislike about using technology?
7. What is your biggest difficulty when using technology?

NA: Not Available

The second-round interview consisted of presenting to our participants, one at a time, the three aids (EtR text, AAC text, AR tool) within the museum space. Participants were asked which one they wanted to use in order to acquire new knowledge. Results showed that the 80% of participants have chosen the AR technology. Participants who made this choice were those showing a more mature experience with technology in terms of skills and competence. These results indicated that participants that manifested an already established experience with and/or an interest in technologies also showed a preferential choice of the AR technology.

The analysis of our participants' verbal and non-verbal communication components in their interaction with the AR tools showed some relevant behaviors. For example, some participants manifested the *"wow-effect"* during the hands-on session, and/or a dissociation between real *vs.* realistic aspects (i.e. M. said *"It is the dinosaur Antonio!"*). This analysis allowed us to extract related user requirements to guide the design of AR tools and increase accessibility and engagement in museum visitors.

4. Conclusions

These results highlight the importance of emphasizing a multidisciplinary dialogue and the active participation of IDs users to outline methodologies, programs, procedures, and international standards to foster inclusive access to cultural heritage.

Museums are increasingly interested in adopting ICTs solutions that meet the needs of different visitors. Given the advent of new technologies for the promotion and enhancement of cultural heritage [10,11,12,13] it is important to activate a multidisciplinary debate by involving experts from different backgrounds in understanding which might be the role of new technologies in removing barriers to knowledge [14].

The active involvement of people with IDs in this process allow the comprehension of their ideas/perceptions and obstacles to accessing knowledge. By using an inclusive research approach, Mastrogiuseppe et al. [15] involved a group of people with IDs to design a tool aimed at understanding the readability and comprehensibility of textual resources within museums. A recent work by Soares Guedes and collaborator [16] described a cycle from ideation to testing and redesign of an accessible application to navigate through museum content focusing on thoughts, expectations, and ideas of people with ID.

By using a participatory design approach, the present paper allows to reflect on the importance of considering digital skills and competences of people with IDs when designing and introducing ICTs within museum contexts. Previous technology use/experience/interest showed to be an indicator of the choice and use of ICT-based products (AR technology) in museum by participants with IDs.

Results of the present study allow us to reflect on two main points. The first has to do with the fact that it is important to use a Universal Design perspective when designing procedures and tools within social and cultural spaces. Cultural sites should provide multiple ways of understanding, processing and elaborating knowledge in order to avoid any form of discrimination. The second one has to do with the fact that, in our today's information and knowledge society, the right of accessing the digital world should be extended to everyone. To reduce the digital divide and promote a digital inclusion all the people, especially the most vulnerable, should be given the opportunity not only to access but also to use ICTs. Based on their own abilities and interest, all people should be provided with the adequate digital skills and competences to meet the challenges of our society and to actively participate in it.

In future studies, our goal will be to involve both the users with IDs and the stakeholders in some brainstorming sessions to create an affinity diagram on the relevant themes (clusters) emerged from the interviews. Further, we can extract related user requirements to guide the design of new tools to increase accessibility and engagement in museum visitors. From a Universal Design perspective, we believe that the tools and actions we are developing through the active involvement of people with ID could be functional and prove valuable to other populations (e.g., children, the elderly).

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A Multisensorial Storytelling Design Strategy to Build Empathy and a Culture of Inclusion

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Abstract. The Wondrous Goggles project is a multisensorial storytelling design strategy to explore the experiential world of people who are blind or have low vision, with the aim of raising awareness about inclusive places for work and play. The need for this exploratory storytelling design strategy is predominantly educational, as a tool to inform designers, policy makers, and technology developers of how people with blindness or low vision experience public spaces. The Wondrous Googles are specifically designed to facilitate an understanding of the navigational and spatial perception of people with low vision. During use, the Wondrous Goggles enable the user to gain a sense of limited vision and provide a vehicle for the wearer to embark upon a process of feeling, sensing, and reflecting while listening to the narration of someone who has navigated the space with low vision. Unlike other technologies that create virtual reality, or an augmented reality based on vision alone, the Wondrous Goggles create a multisensorial storytelling experience through the lived experience of a person with low vision, to gain an understanding of people's lived experiences in navigating public spaces, in order to create cultures of inclusion.

Keywords. Design, multisensorial, storytelling, immersive, inclusion, empathy, public space, disability

1. Introduction

Our relationships to the world and each other have drastically changed over the last three years and the ever-fast pace of new technologies are shaping our everyday experiences, assisting or transforming our work and play activities to either enable or disable our interactions with the world. The *Wondrous Goggles* project focuses on pushing the boundaries of simulation through the exploratory design of a portable immersive technology to represent the experiential world of people who are blind or have low vision and to provide a multisensorial storytelling experience for users. The need for this exploratory design is predominantly educational, as a tool to inform designers, policy makers, and governments of how public spaces are experienced by someone with low vision, and to enable informed decision-making about modifications to the built environment and other activities to enhance design for all. More importantly, Wondrous

Goggles was developed as a strategic tool to empower people with disabilities to share their lived experience and personal stories about access and inclusion in work, play and their everyday lives. The research project focused on developing Wondrous Goggles as a research tool to engage stakeholders in a design-led process of creating a culture of inclusion. Creating a culture of inclusion is less about designing for empathy, charity, or diversity and more about "designing places that all people can use" [1]. As early as 1994,

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Coleman argued that "fresh approaches…are needed to bridge the present gulf between mainstream design and design for the elderly, especially with regard to the scale of demographic change. The concept of Inclusive Design coupled with storytelling and scenario building techniques can turn what is often considered as a branch of design for disability into an exciting gateway to product innovation and a more user-friendly future for all" [2]. Storytelling has the ability to share the lived experiences of people with disabilities beyond codes, guidelines and checklists [3]. Multisensorial storytelling has the ability to take this even further by emphasising how people of all abilities experience environments through all their senses and not just vision alone [4-5]. By utilising people's narratives of their lived experiences of public spaces, this design strategy offers a medium to explore beyond the often-tokenistic aspects of simulation exercises. As disability scholars and inclusive designers, we need to rethink what immersive simulation through multisensorial storytelling might offer to the field of inclusive design, its practitioners, and in turn people with disabilities.

Aiming to explore immersive storytelling for empathy, we developed Wondrous Goggles. It is a lightweight head-mounted device comprising of headphones, a goggle, and a three-functionality device: (i) audio stream prompting experiences narrated by someone who is blind or has vision loss, (ii) simulation of a visual impairment condition, and (ii) voice memo recording. During use, the Wondrous Goggles provide a tool for the user to gain a sense of limited vision and provides a vehicle for the wearer to embark upon a process of feeling, sensing, and reflecting while listening to the narration of someone who has navigated the space with low vision. The iterative process of feeling, sensing, and reflecting engages the wearer to create a new experience and is conducive to the building of empathy. Empathy in this context is the result of a process that is lived differently every time a person wears the device—a process that augments a person's perception of diverse views.

Figure 1. Prototype of Wondrous Goggles.

Through listening to the pre-recorded narrative and journeying with the person with a disability as navigator, the wearer embarks on the navigation experience of someone

with a visual impairment who has navigated the same space (in this case an art museum). Unlike other technologies that create virtual reality, or an augmented reality based on vision simulation alone, Wondrous Goggles creates a multisensorial experience through and by the lived experience of a person with a visual impairment.

2. Literature Review

Research has evidenced how some use of simulation devices may not be effective because people would only be 'experiencing' the disability for a short amount of time—they do not replicate the life-long experience of someone with disabilities and their struggles, memories, and methods of adapting [6]. Therefore, simulation devices risk reinforcing stereotypes already ingrained in the users' minds. However, the studies conducted by Stanford show that the more immersive the experience is, the more likely it is for users to take action to support individuals whose real-life experiences were being simulated [6]. The Stanford research undertook comprehensive studies through two experiments using simulation technologies like Virtual Reality (VR) and its ability to impact upon the levels of people's empathy in contrast to traditional text-based media and 2-dimensional graphic media. The findings from this research found that VR and other IVE's (immersive virtual environments) had a significant improvement on traditional media in generating higher levels of empathy through a more immersive perspective taking experience, while less immersive experiences instead reinforce stereotypes. Many studies view immersive technologies as the "ultimate empathy machine" that can assist people in relating to each other better than novels, TV shows, or films can [7]. Stanford's Jamil Zaki argues that "empathy isn't just a trait. It's something you can work on and turn up or turn down in different situations." [7] Studies and projects on building empathy to increase people's understanding of one another to primarily motivate positive behaviours, such as donating or volunteering, are problematic, as they align with the charity model of disability. Our research intentionally pushes against this staid model of disability, towards an embodied empathy through multisensorial storytelling, and a criticality of that embodiment. "Real human empathy relies on the transmission of perception of a range of subtle visual and audible cues that work with varying degrees of conscious awareness on the part of either transmitter or observer" [8]. Rouse critiques the instrumentalization of empathy and argues that seeking quick, easy, and painless methods using technology to unlearn prejudice fall short of actual change [9]. Our work is also critical of this and highlights that marginalised or misrepresented communities should be included in the design and development of tools or interventions; and that the tools are not the ultimate solution but should be seen as a way for enabling and facilitating conversations and a sharing of stories and experiences.

3. Research Design

Drawing upon critical access theories and research through design, this study sought to create a way for people with disabilities to share their first-hand lived experience of a space with multiple stakeholders. This was created through the designing of the Wondrous Goggles as a multisensorial storytelling tool. The Wondrous Goggles are specifically designed to enable an understanding of the navigational and spatial perception of people with low vision. The Wondrous Goggles are a lightweight head-

mounted device comprised of headphones, a visor, and a three-functionality device: audio stream prompting experiences narrated by someone who is blind or has vision loss; simulation of a low vision condition; and voice memo recording. The Wondrous Goggles' visor simulates a low vision condition, while the headphones deliver an audio narrative of navigating a particular place from the perspective of a person with low vision. The memo recording functionality allows the user to record ideas and reflections while navigating the space with the goggles [10]. The goal of this research was to develop Wondrous Goggles as a research tool to engage stakeholders in the creation of a culture of inclusion. The participants for this study were diverse stakeholders (designers, educators and curators) and they were asked to participate in a navigational task (in an indoor environment wearing the simulation goggle), an interview and a focus group. The goggle included a visor that simulated a visual impairment, like diabetic retinopathy and retinitis pigmentosa. The goggle also included an audio recording of the lived experience of someone with low vision navigating the environment, that was played back to the participant as they navigated the same environment. Data collection included:

- Audio recordings from Interviews
- Audio recordings from Focus Groups
- Transcriptions from Interviews
- Audio recorded memos from the Navigational Task
- Observations/Field Notes from the researchers
- Audio recordings from walk-throughs with low vision experts

As part of the design and research, we engaged low vision experts who recorded their firsthand experience of visiting a public space. The audio recording was completely unscripted. This site-specific recording then became the narrative for the Wondrous Goggles and acts as a guidance for participants, as they move through the same space being guided by someone who has low vision. The recordings and navigational exercises are around 8-10 mins in length. Our project partner was QUT Art Museum in Brisbane, Australia, providing the public space for our navigation exploration with the Googles and lending the expertise of their curators and educators as stakeholders in the research.

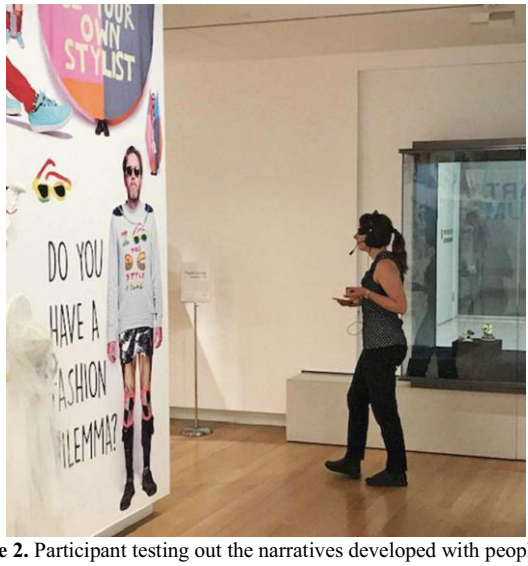

Figure 2. Participant testing out the narratives developed with people with disabilities at the QUT Art Museum.

Participants were recruited from the QUT Art Museum staff and their participation involved undertaking a navigational task and audio recorded interview; altogether task and interview took approximately 45 – 60 minutes. During the navigational task in an indoor public space (QUT Art Museum) the participants were asked to wear a simulation goggle (see Figure 2). The goggle had a visor which simulates a particular visual impairment like diabetic retinopathy. The goggle also has a headset that included audio. This audio played while the participants were navigating the environment with the researchers. The audio is a narration of the lived experience of a person with that particular visual impairment describing what they see in the same environment that you are navigating. So, for instance, the visor can be switched out to align with the narrator's specific vision impairment like retinitis pigmentosa. The user is also prompted with questions or messages from the narrator with a disability about how a person with visual impairments would sense the environment they are navigating. This experience went beyond vision and was multisensorial, for instance the museum had recently been painted and so our blind expert commented on their audio recording that they could smell fresh paint down one of the corridors and therefore could use smell as a navigational aid. This in turn heightened the users' senses and understanding of other senses like smell as a useful navigational aid. The Wondrous Goggles are also designed to have a memoing recorder in them so that while the users are navigating the space with the narration, they can record their immediate thoughts, design insights, fears, emotions, or other reflections. While wearing the device, users were encouraged to talk about their thoughts and experiences into the microphone. The audio memo was saved in the device so that it would be available for playback and analysis later.

After the navigational task, we conducted short interviews with the participants, where we played back their recorded memos, so that the researchers could ask the reasons behind their responses and gain an understanding of the user's experiences. Finally, there was a follow up audio-recorded Focus Group of about 20 mins, approximately 2 weeks after the interview with the participants who also completed these tasks in the same environment to understand their experience weeks after the original tasks, in order to give time for empathy building and reflection on the experience. This research provided insight on how multisensorial storytelling tools might help stakeholders experience a space from another person's abilities and perspective. The literature review suggests that experiencing a space through someone else's point of view and narratives might aid stakeholders in building empathy, in being reflective of their own embodiment, and in making changes in their environments, programs, and services from reflecting on their use of the Wondrous Goggles.

4. Findings & Discussion

During use, the Wondrous Goggles provide a tool for the user to gain a sense of limited vision and provides a vehicle for the wearer to embark upon a process of sensing environments differently and reflecting while listening to the narration of someone who has navigated the space with low vision. From this pilot study with the QUT Art Museum, the stakeholders who had worked in this environment for years reported that through the walkthrough with the Goggles many obstacles existed that they had never realised or seen before. These obstacles and other issues were pointed out through the unscripted audio narratives of the people with low vision that co-created the goggles. Additionally, this study led the QUT Art Museum to act upon this new understanding of their

environment and its barriers and obstacles, to add new inclusive design features and services like tactile indicators to denote a downward path of travel, audio descriptions for their visual works, tactile models, sensory maps, and multisensorial touch tours to be inclusive of all visitors.

Our aim with this research was to explore how to create inclusion by providing a multisensorial storytelling tool for stakeholders to assess their public environments from a new and diverse perspective through the lived experience of a person with low vision. This is to encourage design for all, and why we chose to conduct this pilot study in an art museum, because galleries and museums are often exclusionary public spaces, not only in terms of their exhibitions and environments, but also through their public programming and activities. This project highlighted the value of co-created immersive tools designed with people with disabilities to support social participation and equal access. The project's outcomes are applicable to:

1. Development of Post Occupancy Evaluation (POE) strategies to be inclusive of people with disabilities
2. Informing Accessibility Policy, Services, and Regulations
3. Widening participation
4. Creating inclusive employment opportunities for people with disabilities (either as staff or as access consultants)
5. Delivery of education and training for empathy building and design for all for most sectors and practitioners.

The use of storytelling through technology as a tool for stakeholders to understand how provisions and accessibility regulations apply (at minimum or not at all) in public environments (such as workplaces or an art museum in this case), is an area that has not been addressed for the purpose of stakeholders conducting accessibility evaluations of public spaces. Auditors of access still primarily rely on tick and flick checklists, and these are most often devoid of input from and of the lived experience of people with disabilities [3].

This study will serve to advance knowledge in the field of co-creating multisensorial storytelling tools for creating inclusive cultures, an area which currently has minimal academic research undertaken. Extant literature in the topic of creating inclusion comes from management theory and business practice [11] discussing definitions and processes in the workplace, or it comes from human resources and policy [12, 13] that touches on redefinition of accessible work environments and organizational culture around equity, diversity and bias. These approaches to creating cultures of inclusion do not include the lived experience of people with disabilities, nor have they employed multisensorial storytelling as a method for empathy building. In Braunsteiner and Mariano-Lapidus [14] perspectives of inclusion and challenges for the future, they call for a cultural shift in how we conceptualise inclusion, shifting from a deficit view to a success view based on diversity. Our research project on Wondrous Goggles is very much aligned with this perspective, utilizing technology and a multisensorial approach to emphasise abilities and not limitations, and in this way to create new experiences that would further stakeholders' capability to understand the spaces they design, curate and manage from a different perspective.

This research also served to expand upon our research conducted in 2018 with the Queensland State Government (Australia) with a large workforce of 250,000 employees [15]. From data collected through document and policy analysis, surveys, and workshops with Queensland Government stakeholders, one of the key outcomes from this research was to use storytelling rather than disability disclosure on employee surveys. This

understanding of first-person storytelling by people with disabilities, and its ability to empower people with disabilities but also create empathy, reinforced our need to incorporate first-person narratives and storytelling in our immersive technology. This research also reinforces the need to move beyond tick-and-flick processes, codes, and other checklists. People with disabilities felt more comfortable sharing their story rather than choosing to identify their disability from a list on surveys. Participants responded that they would not feel comfortable choosing from a list to identify if they have an impairment or disability, but would rather share and create their own narrative as self-identification [15].

Aligning with the socio-cultural model of disability, and using person-centered narrative techniques, our research highlights how multisensorial storytelling could be integrated into research design with people with disability. By asking thoughtful questions about people with disabilities' daily lived experience, these questions could also be used as prompts for the audio narratives in the Wondrous Goggles. Questions like: *Did you experience any barriers getting here today? Please share what these were.* This allows for the person with a disability to choose what they want to share about the personal issues and barriers that they experience, rather than ticking a box labelled *I have a physical disability*. This storytelling process also pushes against someone (often an architect, interior designer, facility manager or access consultant) using an access checklist and ticking a box that there is an 'accessible' toilet. Ticking boxes and filling out checklists do not empower people with disabilities, create empathy, include multisensorial and embodied knowledge or highlight the nuances of people's lived experiences. Storytelling techniques like these we have presented through our research projects will allow for disabilities and barriers to be revealed and for empathy-building through multisensorial and embodied experiences. By developing tools, strategies, and technologies to create a culture of inclusion across all sectors, it is expected that stakeholders, managers, and all users will embrace best practice models of storytelling, minimise stigma associated with self-disclosure of a disability, be able to reduce the increasing percentage drop of people with disabilities from workforces globally, and address the lack of access to cultural activities and full participation of people with disabilities.

5. Conclusion

Most of the public spaces and public indoor environments that we encounter on a daily basis have barriers for inclusion, whether they are physical barriers or socio-cultural barriers [1,3,4]. Through designing a tool to enable multisensorial storytelling experiences to help build empathy about the navigation challenges of people with disabilities, we can begin to understand the perceptions and experiences of diverse users and try to eliminate these barriers in order to create inclusive environments. Unlike other technologies that create virtual reality, or an augmented reality simulation based on vision alone, the Wondrous Goggles offer a multisensorial experience through the lived experience of a person with low vision and their first-person narrative. By also including the user's ability to record their own reflections at the point of experience, this approach pushes against taken-for-granted simulation exercises with imagined users and opens up opportunities for new co-designed empathic experiences to create cultures of inclusion for all. Future research will focus on expanding tools and strategies to help stakeholders

support the building of cultures of inclusion, in the workplace and in public spaces, to enable everyone's full access and participation in society.

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Section 7

Universal Design and Cultural Heritage

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Does Pure Contemplation Belong to Architecture? The Denied Ramps at the Church of San Salvatore in the Santa Giulia Museum in Brescia

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Abstract. This paper addresses the issue of balancing the two values underlying the accessibility and conservation of cultural heritage: its use and its protection. These values are often, wrongly, regarded as opposites, or as incompatible. The reason for this contrast originates in the way of understanding ancient architecture and in the value of the relationship between architecture and people.
This issue is considered by presenting a recent case concerning the Museum of Santa Giulia in Brescia, a multi-layered complex that preserves evidence ranging from the prehistoric to the contemporary age, housed in a monastic complex of Longobard origin.
The recent failure to build some ramps proposed for increasing accessibility to the church of San Salvatore, an integral part of the museum's itinerary, offers an opportunity to reflect on the need for better integration between different, and only apparently opposed, instances.
The topic is dealt with by referring to the most recent disciplinary reflections in the field of conservation carried out in Italy with respect to the issue of accessibility to the cultural heritage, without neglecting juridical-normative aspects and international documents, such as the Faro Convention.
This multidisciplinary reading aims to highlight the main significance of accessing cultural heritage, with reference also to the objectives of sustainable development and the human development of the individual and the reference community.

Keywords. Accessibility, Conservation, Santa Giulia Museum in Brescia, Faro Convention, Individual and Community Rights

1. Introduction

Among the most recent European documents on accessibility is Bogdan Andrzej Zdrojewski's *Report on structural and financial barriers in the access to culture* [1].

This is the first comprehensive report of the Committee on Culture and Education presented as a motion for a resolution to the European Parliament. The document – recalling the importance of an active and accessible cultural sector for the development

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of an inclusive democratic society – stresses the need for "the promotion and achievement of inclusive and meaningful access to culture as one of the priorities on the political agenda".

Although a relatively recent topic in Italy [2, 3], accessibility to culture is not primarily a technical issue ('*how* to make culture accessible?'), but a response to the question '*why* make it accessible?'. The answers are manifold and can be found on several levels. The Universal Declaration of Human Rights (1948) states in Article 27 that: "Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits" [4].

Moreover, Italian legislation on the protection of cultural heritage and landscape (2004) also includes in the objectives of 'enhancement' those activities aimed at "ensuring the best conditions for public use and enjoyment of the [cultural] heritage, including by people with disabilities, in order to promote the development of culture" (Article 6) [5].

In 2005 the Faro Convention introduced the definition of 'heritage community' as a group of "people who value specific aspects of cultural heritage which they wish, within the framework of public action, to sustain and transmit to future generations", and emphasised its collective profile in the right to benefit from and respect the common European cultural heritage (Articles 2b and 4) [6].

A careful reading of the Faro Convention reveals an important legal significance, in that the focus has shifted from the rights of the individual to those of the community in which individuals live. We are, therefore, talking about a collective right whereby the community takes responsibility for all its members so that no one is left out, thus strengthening the right of the individual under the 'umbrella' of the community.

Furthermore, considering the issue of tangible and intangible barriers to culture, it should be remembered that:

1. barriers prevent the full participation of communities in cultural processes and cultural ecosystems, thus automatically inhibiting their potential development;
2. any form of barrier introduces inertia into the business ecosystems that could result from cultural and creative industries;
3. any form of (direct or indirect) access limitation introduces resistance to the pursuit of an inclusive society and an inclusive growth process;
4. barriers represent an overall degradation of the cultural ecosystem, excluding the potential value of implementing cultural and creative industries.

Promoting the development of culture is therefore an operation that acquires social, anthropological and identity connotations that no one can or should renounce. This is an assumption that has direct repercussions for the project of the reuse and accessibility of the built heritage, and that has long been accepted in the most advanced circles of debate within the discipline of architectural restoration. In fact, as early as 1998, Amedeo Bellini wrote: "We have […] insurmountable difficulties imagining a monument that has not been produced for people, that is protected and preserved in itself, as an abstraction, and not to be enjoyed; […] it appears to us as something that bears witness in a more complex way to qualities that belong to all experiences, and therefore to all" [7].

More recently, the role of culture and cultural heritage is also present in the Sustainable Development Goals (SDG) of the 2030 Agenda. In particular, the term 'culture' appears explicitly in SDG 4, target 4.7; SDG 8, target 8.9; and SDG 12, target 12.b and the term 'cultural heritage' appears in SDG 11, target 11.4, and in many other SDGs culture and cultural heritage are underlying themes [8].

This means that culture and cultural heritage impact on several areas such as law, heritage studies, education, urban planning and tourism that are drivers for the development of a society that connects inclusion and sustainability, based on a conception of accessibility to heritage communities as cultural law. There can be no real sustainable development without strengthening the conditions of inclusion and the active participation of the entire local community. In turn, an inclusive community will generate a sustainable growth effect compared with the social impact of the above-mentioned areas.

From this perspective, three main themes can be considered as "cross-cutting issues: cultural transformation and adaptation (1), access (2) and participation and governance (3)" [9].

The three cross-cutting issues can be considered the keywords present in the proposed definition of museum by ICOM in 2019 [10]. They recall the Faro Convention that redefined accessibility as a collective right, making the role of social memory fundamental, and finding their practical and modern application in the principles of Universal Design.

2. The case of the Church of San Salvatore in the Santa Giulia Museum in Brescia

The case under examination concerns a recent event of 'denied accessibility' involving the monastic complex of San Salvatore and Santa Giulia in Brescia that houses the City Museum and which – with the Roman Archaeological Park – has been included in the UNESCO World Heritage List in the serial site "The Longobards in Italy. The Places of Power (568–774 CE)" since 2011.

The Santa Giulia Museum not only houses important permanent collections of historical and artistic evidence that tell the story of the city, but is itself the result of centuries of stratification in which there are Roman domus; the Longobard basilica of San Salvatore with its crypt; the Romanesque oratory of Santa Maria in Solario; and the Renaissance Nun's Choir.

A sufficient accessibility degree is guaranteed for almost all the spaces of the complex of the Santa Giulia Museum – considering its wide extension. Exceptions are the crypt, the side chapels and the sacristy of the Church of San Salvatore, and the lower sacellum of Santa Maria in Solario. Obviously, in such a complex of historical buildings, accessibility does not always meet the standards for independent use of the spaces. In some cases, in fact, users have to cover complex and long stretches leaving the 'natural' museum paths. The museum's accessibility, however, is mainly aimed at people with limited mobility (especially wheelchair users), and only in recent years have pilot projects been initiated that include sensory accessibility.

In addition to the permanent collections of the City Museum, the monastic complex also hosts temporary exhibitions of international standing, which are usually held on the top floor of the museum building in spaces specially equipped for this type of event. However, some temporary exhibitions have been specifically hosted in the most significant and fragile places of the ancient complex, with the intention of establishing a comparison and dialogue between the historical context and the objects on display. For example, Juan Navarro Baldeweg's recent exhibition (September 2020-April 2021) was set up, at the explicit request of the architect, in the spaces of the Renaissance Nun's Choir and the Church of San Salvatore, including its side chapels, the sacristy and the

crypt. The latter three are among the few spaces in the entire complex that are not accessible, especially to wheelchair users.

However, the exhibition gave rise to much discussion about the appropriateness of using such a fragile and partially inaccessible site as an exhibition space, preventing a wider public from fully enjoying it. Shortly after the opening of the exhibition, in fact, the question of accessibility was highlighted with some clamour – especially in the local press – while the sensitivity of the location as an exhibition space remained in the background.

The controversy stimulated the museum's management to find solutions to make Baldeweg's exhibition fully accessible, either by making videos of the objects on display and using augmentative reality (in the case of the crypt, which is physically impossible to reach for those with limited mobility, especially wheelchair users), or by building two reversible ramps to make the side chapels and the sacristy of the church of San Salvatore accessible.

These interventions, of course, went beyond the contingency of the show, and were intended as an investment in full accessibility for the future. It is precisely in this context that we are interested in contributing to the debate on improving the future usability of the City Museum.

Considering that making certain parts of the monastic complex physically accessible (the crypt of San Salvatore and the lower sacellum of Santa Maria in Solario) would imply heavy and unacceptable changes from a conservation point of view, we are interested here in discussing the project for the accessibility of the side chapels and the sacristy of San Salvatore.

At present, these richly decorated spaces are already included in the permanent museum itinerary, housing some exhibition showcases. However, in order to reach them, one has to climb a 17-centimetre-high step, which makes them effectively inaccessible to people with impaired mobility.

For the Baldeweg exhibition, where the northern chapels and sacristy housed some works, permanent but removable ramps were proposed to overcome the height difference: two 'mirrored' ramps for the chapels and one 'isolated' ramp for the sacristy.

Both ramps had 8 percent slopes and were made of high-density polystyrene, with the walking surface and sides in phenolic plywood, their colours recalling those used in the design of the museum. In particular, the floor was designed in so-called 'Santa Giulia blue' and the sides in light grey (Sarnico stone colour). The ramps' small dimensions and their integration with existing elements of the permanent installation, guarantee minimum impact in terms of the perception of the church's space. With steel bars inserted into the polystyrene, the ramps would not be fixed to ancient elements, but to existing elements of the exhibition design: to the metal grids of the chapels' floors and to the balustrade in the sacristy.

This type of installation would, therefore, have ensured a conservative intervention that respected the material integrity of the ancient architectural elements. Moreover, being a particularly light material, polystyrene ensures that it does not put too much weight on the original stone paving and that it can be easily handled to remove ramps when necessary, restoring the existing situation (Figures 1-2).

Figure 1. The side chapels: the current situation (top) and the project with a photo-insertion of the ramps (bottom).

Figure 2. The sacristy: the current situation (left) and the project with a photo-insertion of the ramp (right).

For the reasons stated above, in our opinion the proposed solution represented a good compromise both formally and functionally between the requirements of protecting the ancient monument, of usability extended to as many people as possible in view of Universal Design, and of managing the operations of setting up and maintaining the museum spaces. Moreover, the elements could have been retained not only for the temporary exhibition, but permanently.

Since the complex is a listed building under Italian law, any intervention must be authorised by the competent Superintendence of Archaeology, Fine Arts and Landscape, to which the ramps project was submitted in November 2020.

The analysis of the Superintendence's opinion – which arrived a few days before the closure of the temporary exhibition – offers interesting food for thought on the delicate balance between the need for conservation and the need for inclusion in such a fragile context as this UNESCO site.

From the point of view of protection, the Superintendence emphasises its utmost interest in guaranteeing the full enjoyment of the historical, archaeological, architectural and artistic values of the church of San Salvatore, without it being debased by exhibitions that have nothing to do with its thousand-year history. It recalls, moreover, that the entire monastery complex is already equipped with numerous other more suitable spaces for this purpose, which it would be a contradiction not to use. On this basis, the Superintendence authorised the construction of the ramps and their permanence only for the duration of the Baldeweg retrospective (i.e., for a few days), reserving the right to decide whether or not to authorise any future temporary exhibitions in San Salvatore, in order to protect the monument's decorum. Only if permission is granted can ramps be put in, and then only for the duration of the event. The issue was then reduced to the need

for only temporary accessibility, which led to the acceptance of the ramps as long as they were removed as soon as possible.

In our opinion, the main issue has not been addressed, namely that these spaces are already included in the permanent exhibition itinerary of the museum, as evidenced by the presence of the display cases.

While it is true that in some cases it may not be possible to achieve the accessibility of cultural heritage unless unacceptable transformations are made to ancient buildings (as in the case of the crypt of San Salvatore), we believe that this is not the case in the example under consideration. In most cases, in fact, careful and conscious design can achieve the objectives of protection and enhancement, and of accessibility, through acceptable or even qualifying solutions. Of course, balancing different needs is not always easy, but it cannot be *a priori* considered impossible.

In the case of the Church of San Salvatore, it is a matter of overcoming a difference in height of a few centimetres to reach the side spaces. This would make it possible not only for everyone to fully enjoy the permanent museum itinerary but also allow for complete immersion in the spatiality of the church, fully perceiving its historical and architectural values.

In the context of projects for the reuse of ancient buildings, some Italian scholars have proposed adopting a multi-criteria grid as a tool to balance various needs from the very beginning of the design phase [11, 12]. These include the need to maximise the conservation of the building's ancient material; structural consolidation; the usability and accessibility of spaces in relation to the planned routes; thermo-hygrometric and lighting issues and those related to safety management; maintenance during operation; and so on. These needs all have to be combined into an architectural project of great formal quality.

This way of organising the reuse project avoids dealing with issues that were not taken into consideration when the work was completed, and which are often necessarily resolved *a posteriori* using less than optimal solutions.

The case under consideration is a testimony to the fact that the issue full use of the Church of San Salvatore was left out of the initial project. However, the solution now proposed for overcoming the step – integrating into the existing layout with minimal impact on the perception of the ancient spatiality – is presumably the optimal one that could have been chosen from the outset.

Therefore, we believe that, in situations of this kind, an effort should be made to overcome the overly abstract concept of protection, in order to favour greater inclusiveness.

3. Conclusions

The case of 'denied accessibility' in the Church of San Salvatore in the Santa Giulia Museum in Brescia is instructive from several points of view. Firstly, it is evident that if the requirement of accessibility is not solved from the beginning, an *a posteriori* solution can become a real problem from the point of view of design and function, in relationship to managing the paths for visits, and attaining permission from the competent bodies.

Secondly, as is more evident when considering a multi-criteria grid in the reuse project of historical sites, none of the various issues involved can assume such a weight that all the others are not satisfied.

Finally, today's national and international documents confront the topic of accessibility not so much as the fulfilment of the right of the individual person (with

disabilities), but – more correctly – as a way of affirming the value of culture as an expression of the memory and identity of communities to be passed on to future generations. From this perspective, accessibility to culture and cultural heritage is to be understood as synonymous with democracy and sustainability.

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World Heritage-Universal Heritage. The Commitment of Brescia Museums Foundation and Brescia Council to Enhance Museums and Public Archaeological Areas

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Abstract. Brescia's museums network has adopted and developed in the last years a wide number of ways to make its heritage inclusive and accessible to everyone. Via the creation of different tools and initiatives, Brescia Museums Foundation, that manages the network, is at constant work to ensure the possibility to all members of the public to fully experience the cultural heritage.

Keywords. Heritage, Accessibility, Universal values, Inclusion, Cultural dissemination, ICT

1. Introduction

Brescia's museums comprise a heterogeneous heritage which extends from the third millennium BC to contemporary art, housed in historic buildings that distinguish the city's urban centre and cultural life.

The museum network contains an archaeological area, with monumental buildings of primary importance for northern Italy including the 1st century BC sanctuary, 1st century AD *Capitolium* temple (Figure 1), Roman theatre (1st – 3rd century AD) and additional Roman furnishings and statues. An 8th – 15th century AD monastic complex covering more than 11,000 m^2 (Figure 2) houses the City Museum, which exhibits thousands of objects and artworks in the historic monastery premises; the Tosio Martinengo Gallery features an art collection on display in an aristocratic residence, and Brescia Castle is also home to the Arms Museum and Risorgimento Museum.

One of the main objectives of Brescia Museums Foundation's mission, also on behalf of Brescia Council, is the widest possible public accessibility to this heritage – a large part of which was listed as a UNESCO World Heritage Site in 2011. This commitment began in Brescia in the early 18th century and the tradition continues today, sharing projects and achievements with local inhabitants and the wider public.

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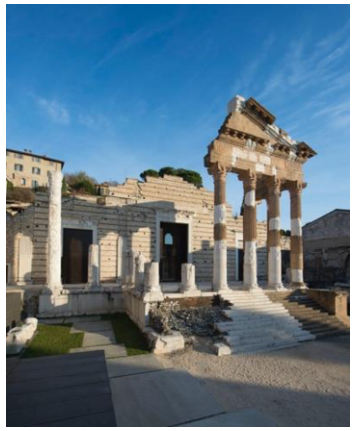

Figure 1. Capitoline temple (I century AD)

Figure 2. Santa Giulia Monastery, aerial view

2. The Path to the Culture of Accessibility

The approach to inclusiveness developed over the years in Brescia has undergone progressive evolution, determined by various factors including a nationwide increase in awareness regarding this question, the specialized training of staff involved in museum heritage management and activity planning, and the increasing availability of inclusive tools and strategies applicable to cultural matters.

Projects and activities have been aimed in many different directions, reflecting the diverse characteristics of the heritage, the museums, and the needs of inhabitants and tourists, as well as particular difficulties that might impede a correct and guaranteed availability to everyone.

A considerable driving force for the development of inclusive projects was also provided by the membership of certain Brescian museums of thematic networks which share common objectives and operating methods and have encouraged the spread of good practices and greater sustainability – in particular the network of Lombard sites, listed as UNESCO World Heritage in 2011, which focuses most of its projects on accessibility issues, also stimulating local projects [1].

The projects carried out by Brescia Museums Foundation have thus evolved successively, from the adoption of relatively ordinary paths and tools that guarantee various degrees of access to all members of the public, to the design and implementation

of inclusive strategies, avoiding distinct itineraries and experiences in line with the basic principles of Universal Design.

2.1. Accessibility and Physical Barriers

Although Brescia's heritage consists of outstanding monumental structures, historic buildings and museums, over the years it has proved possible to successfully overcome the architectural barriers posed by these historic constructions that range in date from the 1st century BC to the 18th AD (Figure 3).

Thanks to specialist advice and operations carefully designed with great sensitivity, in collaboration with the government departments responsible for conservation, over time numerous barriers have been overcome. At first, specific devices were installed in pre-existing visitors' itineraries in order to remedy certain shortcomings they presented. Subsequently, starting from at least 2013 in the archaeological area, single routes were designed to be shared by all visitors, with excellent results that have been described in previous publications [2].

Figure 3. Accessibility in the republican sanctuary (I century BC).

Visual impairment was first tackled in isolation, on the occasion of a proposal external to the museum, which resulted in the creation of a concise itinerary (*Ariadne's string*) based on the choice of two themes and featuring high-definition replicas of four works, made of the same material as the originals (marble and bronze) and placed right next to them. Close collaboration with the Brescia section of the Italian Union of the Blind and Visually Impaired and special staff training at the Homer National Tactile Museum in Ancona made it possible to focus on the main possibilities and potential of an inclusive approach, by developing itineraries for heterogeneous groups of visitors – sighted, blind and partially sighted – who today undertake shared tactile paths that have become permanent parts of the museum's educational and cultural facilities.

The archaeological section of the Santa Giulia Museum, established in 1998, is currently being refurbished and it has been decided to allow the tactile exploration of all the original works – mainly in stone – not kept inside display cases, as well as making audioguides available for all visitors.

The museum participated in the creation of a tactile exhibition on the monuments of exceptional universal value registered in the World Heritage Serial Site “The Longobards in Italy. Places of Power (568-774 AD)” (Figure 4). This is called “Getting in touch with the Ancient Lombards” (Brescia, Santa Giulia, March-May 2022) and features models of Lombard buildings and the surrounding areas; an audioguide connected to each one

accompanies visitors on their tactile exploration, providing cultural information – which is also translated into Italian sign language (LIS) and accompanied by videos.

In addition, members of the educational services staff able to interpret LIS can accompany deaf visitors on thematic itineraries which may be adapted according to needs and requests.

Figure 4. Temporary exhibition "Getting in touch with the Ancient Lombards"

2.2. Information and Communications Technology Devices

In 2013 Brescia Museums Foundation began experimenting with new technologies to carefully evaluate their effectiveness for communicating and making accessible items permanently on show and temporary exhibitions, involving both experts and stakeholders in these evaluations. These tools undoubtedly have an important role, but their effectiveness is often undermined by indiscriminate use that is not calibrated to actual situations and concrete requirements.

The application of these technologies has focused in particular on the objectives of information availability and physical access to places.

Wearable devices that offer augmented reality (*ArtGlasses*) were first introduced in the archaeological area, then in the Santa Giulia Museum complex; shortly they will also be available for the Arms Museum in the Castle. These are GPS-positioned glasses with transparent lenses connected to a multilingual audioguide and may be worn during the visit; visitors are guided to and through the most significant places and items with audio cultural information, and augmented reality images are available at numerous points on the itinerary. This added facility can illustrate changes over time (for example showing what something was like before restoration or reconstruction work), artist's reconstructions, especially useful for archaeological heritage (e.g. 3D reconstructions that portray how an area or monument is thought to have looked in antiquity), or videos and interviews with specialists. The devices are user-friendly; on request, subtitles can also be activated for those with hearing difficulties [3] [4].

A further use of technological tools has enabled virtual, immersive visits to the only two places in the Santa Giulia monastic complex which – despite numerous joint assessments by experts and protection bodies – cannot be entered by visitors with limited walking capacity or confined to a wheelchair. These are the crypt of the Lombard church of San Salvatore, an area of great architectural importance where holy relics were kept and worshipped within the monastery, and the lower chamber of the Romanesque church of Santa Maria in Solario, where the monastery treasure was conserved. These two places are important monumental contexts where it would be inappropriate to perform

architectural alterations or install special devices to overcome the architectural barriers they present due to their very nature and conformation.

It was therefore decided to create 360° immersive videos to permit anyone who wants to experience a virtual visit to these two highly significant locations in the monastery, guided by an expert archaeologist who illustrates them and their special features.

The videos are available from the Brescia Museums Foundation website, and may be employed for remote use (and visits). For visitors in wheelchairs, special holders have been prepared in which personal smartphones can be inserted, guaranteeing direct vision of the videos at the entrances to each of the two inaccessible zones; these are freely available at the museum entrance.

As has become particularly evident during the recent pandemic period, the use of technologies can greatly facilitate art and culture's role as shared heritage, allowing items of special interest to be truly accessible to all. Their proximity to users means that visits can be accompanied by relevant information and active interactions can be established with all visitors – in this case via the museum curator who becomes an exclusive guide, with a particular attention to providing accurate information and interesting details.

2.3. Cultural Information Access and Audience Awareness

As part of the work aimed at eliminating all types of barriers to the museum and within the museum itself, we devised and implemented initiatives designed to create inclusive hospitality, also targeting potential audiences who might feel distant from museums for reasons of presumed inadequacy. Brescia's museums are trying to develop an environment based on active participation, to foster social exchange and propose museums as places based on differences – beyond any educational, cultural or socioeconomic barriers – where comparison between different viewpoints and cultures and otherness are constantly stimulated, not in order to defend or justify any in particular but rather to encourage open-mindedness.

Brescia Museums Foundation has adopted *Easyguide*, a simple multimedia guide that can be used directly from a smartphone. Access to content is immediate and is implemented by scanning a QR code which is given to visitors when they purchase their tickets. The texts, images, videos and other multimedia contents available in Italian and English remain usable throughout visits to the individual museums. The web app can also be used by the deaf thanks to the presence of written text as well as audio.

Easyguide, developed by MuseumMate, is a genuine visitors' mentor, which everyone can take with them and use when they wish.

Each guide includes various different itineraries, including a "guided tour" to the most important exhibits. The presentation of certain items is further enriched by multimedia features such as short videos with explanations by the curators of the collections and other specialists.

An "At your own pace" trip is also available, designed for those who prefer to build their own itineraries by selecting the items they wish to explore each time, using the numbers indicated on the museum labels. In all the museums there is always a "Children's visit" designed for children (6 years plus) who – like little detectives starting from the details – have to search the rooms for certain objects and listen to their fascinating stories.

Lastly, the “Activities” section is dedicated to initiatives that are available permanently or for a long period in the individual museums. This tool's flexibility permits its progressive expansion with constantly updated contents and facilities.

For the youngest visitors and their families, from 2022 *Geronimo Stilton. Brescia Musei Adventures* is active. This is a museum app-game for children; guided by the well-loved journalist mouse, they can take part in three exciting adventures in Brescia's museums. Between amulets, amphorae, paintings and armour, Geronimo guides his young adventure companions to discover the museums' history and their heritage with the help of augmented reality that transforms some museum pieces into 3D images which can be examined, manipulated and enlarged – so that even the smallest details may be appreciated and familiarity with heritage is enabled via different channels for maximum accessibility (Figure 5).

2.4. Well-being and Culture

It has been amply demonstrated by contemporary neuroscience [5] that art and beauty nurture and caress the brain. This places museums on the front line in the promotion of psychological well-being, and the prevention and cure of numerous pathologies.

Brescia's museums are proposed as places where – through specific activities and with proper guidance – it is possible to develop awareness of how important it is for our mental health and psycho-physical balance to be in contact with beauty and to be able to enjoy it. And at the same time the museum thus sheds its mysterious historical aura and ventures into unusual domains, meeting special visitors.

For a number of years Brescia Museums Foundation has been engaged in significant activities together with social and health organizations and institutions operating in the town.

Twentieth-century Protagonists is the title given to activities dedicated to aged persons who live in nursing homes. Encounters with history, art and culture have proved to bring about profound and regenerative well-being; meetings are thus organized in which works of art and film projections awaken personal memories and stories that, intertwining together, give life to moving memories.

In recent years we have collaborated with the Residenza Vittoria di Korian Italia e RSA Casa Industria; since 2018 annual meetings have been held for residents, operators and assistants and which are also open to other interested parties. Museum visits have been planned as well, to see the works discussed in real life – and visit Brescia's most significant artistic and historical localities.

Again for the elderly, two parallel projects have been launched in collaboration with Brescia Council's Social Services and Family Policies Department, as well as a number of parishes and daycare centres in the city.

After the positive experience of the pilot project inaugurated in 2018, an agreement has been made between Brescia Museums Foundation, the Children's Hospital and the schools operating within it (Benedetto Castelli Institute of Higher Education and Istituto Comprensivo Centro 3 of Brescia). The project includes a series of interactive educational activities (especially workshops) aimed at introducing and developing knowledge of the artistic heritage contained in Brescia's museums and on the temporary exhibitions organized in the museums.

In recent years, the educational services have collaborated with therapeutic communities and day centres for psychiatric rehabilitation on specific projects intended to familiarize patients with the museums' historical and artistic heritage, with the aim of involving participants in stimulating visits and activities that increase their knowledge of Brescia's history and encourage them to feel part of it

During the health emergency period, the focal points of emergency activities were chosen in order to communicate serenity, trust and hope by means of heritage values, through two projects in particular.

The photography exhibition *Mirabili radici* - Il sito UNESCO di Brescia nelle fotografie di Alessandra Chemollo (Brescia, Fondazione Poliambulanza, 8 May – 26 September 2021) gave Brescia Museums Foundation the opportunity – thanks to a fruitful collaboration with the Poliambulanza – to enliven the hospital's central wing with texts and images made available those who were there for treatment, to assist relatives or in order to exercise their profession. The photographs, of Brescia's UNESCO heritage and accompanied by short texts, were intended to solicit reflections on the meaning of time in its various manifestations, in search of marks it has left on the monuments – but also, in a different sense, on mankind.

The Azienda Speciale Pro Brixia, with Brescia's Chamber of Commerce, the ASST degli Spedali Civili and Brescia Museums Foundation, in collaboration with Brescia Council, inaugurated a new project to enhance Brescian culture at one of the largest vaccination centres in Europe, located in the Fiera di Brescia. The project involves the decoration of some public areas in the vaccination centre and the creation of a narrative that can be accessed by users through their mobile communication devices (smartphones or tablets), with the aim of accompanying and entertaining those undergoing the vaccination experience with the positive values of culture.

Brescia's Winged Victory became a protagonist, a symbolic link between the concepts of "curing" and "culture". In addition to the large graphic applications designed by Paolo Tassinari, special QR codes on the floor connected those awaiting vaccination to the Winged Victory's website, featuring moving videos and accounts of the statue's artistic qualities and its new setting.

In the post-vaccine period it became possible to schedule a visit to Brixia. Roman Brescia's Archaeological Area and obtain a cut-price ticket by registering for the Brescia Museums Foundation newsletter.

Lastly, safe guided tours of *Brixia. Roman Brescia's Archaeological Area* are being tried out in which visitors include patients with stable cardiological and neurological conditions, cancers and long COVID. These were designed by museum curators and educational services staff together with medical specialists and guarantee both physical and psychological safety.

3. Conclusions

The current working method used in Brescia Museums Foundation's planning and operational processes has led over time to the development a number of different standards, which allow us to measure the achievement of several diverse objectives. Numerous interdisciplinary collaborations have increased our ability to work in large, heterogeneous groups, with the consequent growth of specific skills and the staff's general professional abilities at various levels.

Over the years there has been a progressive increase in the number of visitors, which is certainly due to a combination of factors. Firstly, the activities described above have also contributed to expanding the services provided for everyone, intercepting a greater range of interests and interested parties. The museum areas have also acquired a stable reputation for hospitality and familiarity, which has encouraged members of the public to make return visits. Lastly, highly inclusive proposals have satisfied the needs of those

who do not find hospitality and provisions for their requirements – including those concerning disability – in all museums.

Figure 5. Young visitors enjoying AR with the Vittoria Alata

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How Can We Ensure Accessibility of Cultural Heritage? Toward Better Utilization of Existing Assets in Japanese Context

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Abstract. How can we ensure accessibility of historical buildings that were built before the idea was ever dreamt of? Important historic monuments such as World Heritage have come to be made to some extent accessible with due consideration of their historical value (in extreme case, no accessibility is available, and replicated models or virtual reality is alternatively in place). Many buildings that are currently in use pose problems because they have to be usable by everyone. To what extent the historical values can be sacrificed for accessibility and usability? This paper tries to propose some ideas to meet both needs of historical significance and accessibility/usability through examination of several Japanese examples.

Keywords. Cultural heritage; buildings; usability; conversion of use; refurbishment; built environment; accessibility; priority

1. Introduction

Discussion on the importance of cultural heritage preservation started focusing on especially important ones, (such as National Treasure or Important Cultural Property in the case of Japan) whose historical and cultural values are utmost as discussed in The Athens Charter for the Restoration of Historic Monuments, 1931 [1] and International Charter for the Conservation and Restoration of Monuments and Sites - The Venice Charter 1964 [2]. In this context, it was quite often that the original purpose of buildings is that of the past, disregarding the accessibility and usability of diverse users/occupants. Even during the days when the two Charters were established, the existence of people with disabilities was mostly invisible and rarely noticed.

However, regarding the buildings, the discussion on accessibility along with historical preservation gradually shifted toward ones that are currently in use. Accessibility is more on functionality and usability rather than aesthetics, and when the buildings are still in use, they must be usable by everyone in the first place, not just by visitors but also by persons who work there as staff. Denying people with disabilities from being employed is a grave violation of human rights as stipulated in documents such as the UN-CRPD (and quite likely with legal requirements in respective countries arising from its ratification). Therefore, cultural values should not be given the priority.

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How can the potential conflicts be solved? In this paper, the author compares historical context, and will argue the directions to follow.

2. Historical buildings

2.1. Conservation movement

The modern conservation movement that started with Athens Charter gave higher priority on cultural authenticity, and usability for all is put aside in most cases.

Historical monuments that people visit and see as the record of the past might be left as they are, without extensive intervention for accessibility. A typical example is the Japanese castle, which has ceased its function as a fortress during feudal years. Access to its top floor is only possible with steep stairs difficult to climb even by a robust armored warrior, but introduction of an elevator is beyond question.

In 2010, Gomez Robles [3] referred to eight values for assessing the importance of a building to be preserved as a cultural heritage: Typological value; structural value; constructional value; functional value; aesthetic value; formal value; historical value; and symbolic value. If the building is to be seen with the surrounding environment, two more values need to be considered: Landscape value and overall value. Unfortunately, even the paper does not refer to the core value of accessibility and usability. In a sense, the idea of historical preservation can be adverse against access and use, the crucial value of UN CRPD and Disability Discrimination Acts and ISO Standard on accessible built environment [4, 5]. There must be a shift of emphasis in this regard.

2.2. Masonry or timber

In countries where the masonry structures are the standard, their life quite often extends beyond several hundred years. Many walled cities in the European continent have such a long history, and their buildings can be also very old. If they survived the passing of the time, their change of use is not rare. For example, many museums in Western cities are converted buildings from their original purpose: Musee du Louvre in Paris originally started as a fortress and then a palace, before it was designated to be a museum.

In Japan where timber was the only structural component, in contrast, only a small number of buildings survived more than hundred years with careful maintenance, and most of them are shrines and temples that have had religious importance as place of worship. In that sense, the idea of universal design for tourism will generally apply, i.e., to introduce accessibility to the extent practicable with due consideration of the cultural value – destroying it would damage everything. For timber structures, even access ramps made of any material might look awkward/strange.

Masonry and reinforced structures in Japan are just around 150 years old since their introduction, and most of them are already destroyed, partly due to their structural fragility against earthquakes despite of their significance. Only recent years, such non-timber structures have come to be recognized as historically important, worth preserving. However, such buildings generally lack accessibility - smaller ones did not have an elevator (it was a luxury until recently for two storied buildings), and even larger ones were often designed with grand staircases at the main entrance, denying access for people with reduced mobility. They also lacked accessible toilets for convenient use.

2.3. Ensuring access

How can we ensure access and use along with historical values? We can assume that detailed examination of both the heritage values and the needs for accessibility and usability will be conducted. Critical argument will be held between these two viewpoints, and final agreement will be reached in real settings. The deciding factors will be practicality with due consideration of economics, i.e., how much funds can be used in the current context including maintenance cost – degree of affection/attachment of people involved might affect the argument. When buildings are still used, with or without change of use, to fully utilize them is most important from sustainability viewpoint as well. DOCOMOMO is active in trying to document and conserve modern buildings. However, such buildings are often demolished against people's wishes.

3. Examination of Japanese preservation efforts

To find out the shift of emphasis from preservation to accessibility, some examples in Japan (mostly in Tokyo area) are examined and compared. These buildings, all built after the Meiji Restoration, i.e., after 1868, are listed in Table 1 with chronological order. Some are timber structures, but most are masonry or RC.

The first example, the Concert Hall of the Tokyo Music School (Fig. 1) was used for its original purpose until around 1980. Handed over to the Taito City in 1983, it was moved to its present position nearby. Major restoration was again done in 2018, but no means of access to the upper floor was provided where the audience seats are situated. There is one place for a person with a wheelchair, but no elevator is available. Since its significance is its pipe organ, whose performance is integral with the hall itself, and primary purpose of a concert hall is to have audience there, the lack of easily usable access features would be a serious flaw. The author asked how one can reach there – the answer from the manager was that a special stair climbing facility will be arranged by a designated company upon request, who will operate the machine. The cost must be borne by the person with a wheelchair (or by the concert organizer).

Figure 1a&b. Concert Hall, Tokyo Music School, and the wheelchair space in the hall

Three examples in the list were originally built as residences, and all are now open to public along with the garden. Both the former Iwasaki Residence and former Furukawa Residence are designed by a British architect Josiah Conder, who was one of the invited foreign employees in Meiji era Japan, to teach at the University of Tokyo.

Table 1. Buildings discussed in detail. Building name; purpose of use, structural system, year of construction and year designated as the Important Cultural property (if applicable).

Building Name	Original use	Structural system	Year of Construction /Designation as a National Heritage	Wheelchair Accessibility
Concert Hall, Old Tokyo Music School	School	Timber	1890/1988	No
Office of the Ministry of Justice	Office	Masonry*1	1895/1984	Yes
Former Iwasaki Residence	Residence	Timber	1896/1961	Partly Yes*2
Bank of Japan	Office	Stone & Masonry	1896/1974	Yes
Hyokeikan, Tokyo National Museum	Museum	Stone & Masonry	1908/1978	Yes
Akasaka Detached Palace	Residence/ Palace	Stone/Masonry	1909/2009	Yes
Former Imperial Guards Building	Office	Masonry	1910/1972	Partly Yes*3
Tokyo Station	Railway station	Steel Masonry	1914/ 2003	Yes
Former Furukawa Residence	Residence	Masonry	1917/ -	Partly Yes*2
Mitsukoshi Department Store	Retail	SRC	1927/ 2016	Yes
Mitsui Bank	Office	RC/SRC	1929/1998	Yes
National Science Museum	Museum	RC/SRC	1931/2008	Yes
Former Prince Asaka Residence	Residence	RC	1933/2015	Yes
Takashimaya Department Store	Retail	SRC	1933/2009	Yes
Meiji Insurance	Office	SRC	1934/1997	Yes
Tsukiji Honganji Temple	Religious	RC/SRC	1934/2014	Yes
Former Kenban, assignation office for geisha	Office	Timber	1936/ -	Yes
National Diet Building	Parliament	SRC	1936/ -	Yes
Tokyo National Museum Main Building	Museum	RC	1937/2001	Yes
Former Institute of Public Health	Laboratory, Education	RC	1938/ -	Yes
Former Museum of Modern Art Kanagawa	Museum	Steel	1951/2020	Yes
Museum of Western Art*4	Museum	RC	1959/2007	Yes
Asian Gallery, Tokyo National Museum*5	Museum	RC	1968/ -	Yes
Museum of Modern Art, Tokyo*5	Museum	RC	1969/ -	Yes
National Crafts Museum, Kanazawa*6	Offices	Timber	1898 & 1909/ -	Yes

*1 Base isolation is introduced to withstand earthquakes.
*2 No access to upper floors.
*3 Stair climber was installed at the main entrance when gallery was housed.
*4 Designed by Le Corbusier, with ramp inside.
*5 Both designed by Yoshiro Taniguchi.
*6 Two former Japanese Army buildings were moved and connected for the new purpose.

Although the former Furukawa Residence is not designated as an Important Cultural Property, the difficulty of arrangements seems to prevent it from installing an elevator.

The former Prince Asaka Residence had been occupied by many through the years after the war, being finally handed over to the Tokyo Metropolitan Government, which decided to use it as a museum, and when a new wing was constructed as a major extension, a half-independent elevator was added, making the most part of the building accessible although a minor step difference on the second floor could not be eliminated.

Three museum buildings at the Tokyo National Museum give good examples of ensuring accessibility in Museums. The first one, Hyokeikan (Fig. 2) was designed with a grand staircase at the front, and it is not easy to make it accessible. It was decided to add a glazed elevator at the back with an access ramp, demonstrating that the building façade is intact but ensured a compromising full access. The Main Building (Fig. 3) is designed with a grand carriage porch, where one can drive a car through. There are additional steps to enter afterwards, and ramps were added on the left side, which everyone can choose to walk in lieu of steps. The Asian Gallery (Fig. 4) was designed to be stepless entry with elevator access to upper floors. With an atrium in the center, the exhibit spaces were made as skip floors, which unfortunately made the original elevators without full access to every floor – left side gave access only to odd number floors and the right side only to even number floors. Renovation in 2012 added a glazed elevator within the atrium – with access to all floors. It has doors on two sides, enabling access depending on the floor layout. By the way, elevators with two-side doors were not allowed until 2000 according to the regulation of the Building Standard Law.

Former Imperial Guards Building had been used as the Crafts Gallery of the Museum of Modern Art Tokyo between 1977 and 2020, and it had a stairlift at the entrance (Fig. 5a). The Gallery moved to Kanazawa and changed its name as the National Crafts Museum. Utilizing two old timber buildings of former Japanese Army, it is now fully accessible with long ramps (Fig. 5b).


Figure 2a&b. Grand staircase at the front of Hyokeikan and glazed elevator at the back.


Figure 3a&b. Tokyo National Museum Main Building carriage porch and long ramp to the entrance.


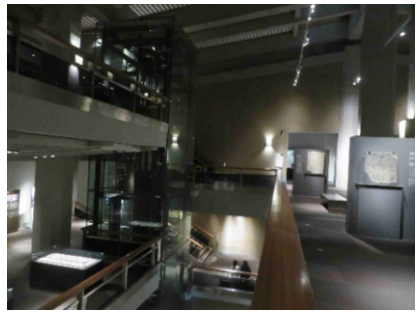

Figure 4a&b. Asian Gallery and the glazed elevator added in the atrium.


Figure 5a&b. Crafts Gallery, Museum of Modern Art Tokyo and the new National Crafts Museum.

Two buildings owned by the Minato City, Tokyo, seem worth mentioning regarding accessibility provision. The Kenban (Fig. 6), originally built as the assignation office for geisha had been used as accommodation for port workers after the war. Valuing its historical significance as a surviving timber structure, the city obtained the building and renovated it to become a new Center for Traditional Culture. Using the adjoining land lot, a small building was built to house an elevator to be connected to the old timber structure. Designed to be a timber house next door, the annex just looks as if it has been in existence long since.


Figure 6a&b. Kenban with elevator annex on the left. Stair guard was added inside.

Another example, the former Institute of Public Health building became vacant after the Institute moved out of Tokyo. Since the building was in fairly good condition (built after the Great Kanto Earthquake with the donated funds from the Rockefeller Foundation), the Minato City decided to convert it for several functions including the Local History Museum. Structural reinforcement and accessibility provisions were extensively introduced (Figs. 7 and 8).

These buildings are not designated as the Important Cultural Property, and it was much easier to arrange these changes. They are the Registered Tangible Cultural Property, but the restriction is less complicated compared to Important Cultural Property.


Figure 7a&b. Former Institute of Public Health. Long ramp on the right side, and structural reinforcement.


Figure 8a&b. Vertical lift at several places, and guardrail to prevent stair falls.

4. Discussion

Demolition is quite often the case in Japan for economic convenience of the owner/developer, but buildings cited in the list seem to have been in use for years, surviving the risk of redevelopment. These buildings of historical significance were saved through continued efforts of people involved.

It seems that the timing of the designation as an Important Cultural Property affected the decision whether an elevator can be added or not for smaller scale structures. Once it has become the Important Cultural Property, to change the status quo is rather difficult – the negotiation with the Cultural Agency becomes more complicated – emphasis on conservation is given priority. The Concert Hall of old Tokyo Music School was trapped with this problem. Although the primary purpose of the building is to be open to public of music performance, keeping the cultural values (original appearance) along with potential cost of installation of elevators may be preventing the move toward accessibility. In comparison, the former Kenban building, also a timber structure, had annex built next to it, enabling accessibility without destroying the appearance. Not yet designated as a National Heritage helped to introduce more positive choice. Still, different route needs be taken for wheelchairs to enter, which arises from the existence of two steps and another one at the original entrance.

The former Museum of Modern Art Kanagawa seem to have taken a clever approach – people tried to restore the building to the original design, but to ensure structural safety as well as accessibility, they not only reinforced the structure with new knowledge but

also arranged an elevator and a more accessible toilet. The former required some modification in the plan layout (a deviation from the original, but hardly noticeable in reality), while the latter did not cause any significant changes. The designation as the Important Cultural Property was done after the restoration/modification was done. If the timing was the other way round, it could have been more difficult.

It is interesting to note the different approaches taken by the museum organizers regarding the renovation of Taniguchi designed buildings (neither is designated as an important cultural property). The Asian Gallery (Fig. 4) of the Tokyo National Museum basically kept the original floor plan layout, but the Museum of Modern Art Tokyo employed a more drastic approach. Originally, the building was designed with skip floors, but void inside was completely eliminated for structural integrity against earthquakes. It is now impossible to try to imagine the original arrangement. Only a tiny photograph showing the previous arrangement is displayed.

The experiences of the National Diet Building could provide useful information [6]. Built in 1936 after 17 years of construction, it faced an urgent need to make it wheelchair accessible to accommodate new members of the House of Councilors elected through proportional representation in 2019. Only a few weeks were left to do a quick fix, then plan and implement a longer strategy was conducted. Ramps and elevators were needed, and space was squeezed out despite physical limitations. Argument against touching historic designs was raised, but equal rights as a member was utmost important, and accessibility was ensured as far as practicable, which was greatly appreciated from all sides. The reality that the problem was clearly visible helped to push through accessibility provision. The decision to avoid being designated as an important cultural property turned out to be a good choice.

5. Conclusion

Careful examination of examples of preservation of historical buildings in Japan through comparison gives valuable lessons for intervention toward accessibility, which is becoming urgent needs to be fulfilled. Presently, the Japanese access legislation gives exemption for existing buildings as long as the status quo is maintained. Without strong legislation on access rights in Japan, movement toward ensuring access is almost always struggling a difficult battle.

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The Accessibility of Cultural Heritage. A New Perspective Between Relational Gaze and the Philosophy of Gesture

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Abstract. The Italian museum system made significant progress in terms of accessibility. Despite the considerable increase in the number of people with functional limitations who visit museums, the percentage of those who do not visit museums is still very high, whatever the presence of limitations. Based on this empirical evidence, a new approach to the problem of accessibility becomes necessary. The paper argues in favor of a performative conception of accessibility. More specifically, it will be shown how the approach of relational sociology and the philosophy of gesture allow for elaborating a broader notion of accessibility than the prescriptive one that currently inspires most interventions. By redefining accessibility in terms of a social relationship that combines the adaptive dimension with the transmission of meanings, new possibilities emerge to make a museum visit an attractive and engaging experience. This guiding idea started to be implemented through the experimental project Smart Cultural Heritage 4 All realized at the Museo Sannitico of Campobasso (Italy).

Keywords. cultural heritage, accessibility, social relations, philosophy of gesture, Smart Cultural Heritage 4All

1. Introduction

In this paper we will analyze the data currently available on the diffusion of services aimed at facilitating the fruition of museums by people with disabilities and the frequency with which they have visited them in recent years. This overview shows that the Italian museum system has made significant progress in implementing measures to increase accessibility through lower fees, a range of services aimed at people with functional limitations, and technological innovations. However, at the present moment, there is not sufficient evidence to assume the considerable increase in the number of people with functional limitations who have visited museums in recent years as an outcome of accessibility policies. The pool of people who do not visit museums is still vast, regardless of the presence or absence of limitations. This empirical evidence suggests the need to reformulate the problem of accessibility differently than in the past.

After having redefined the issue of accessibility by resorting to sociological categories, we will try to show how the approach of relational sociology and the philosophy of gesture make it possible to elaborate a broader conception of accessibility than that which currently inspires most interventions. Our opinion is that redefining accessibility as a social relationship that combines the adaptive dimension with the transmission of meanings opens up new possibilities to make the museum visit an

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attractive and engaging experience. This guiding idea started to be implemented through the experimental project Smart Cultural Heritage 4 All realized at the Museo Sannitico of Campobasso, which we will illustrate in its essential elements.

2. The state of the art of museum accessibility in Italy

In Italy, an intense debate has arisen on the social function of museums, the enlargement of the audience of visitors, and the ways to make cultural heritage accessible [1] [2]. Within ICOM Italy, a special thematic commission on museum accessibility has been created to provide knowledge and useful operational tools to draw the attention of professionals to this issue. At the same time, the Ministry for Cultural Heritage, Activities and Tourism (MiBACT) has adopted several measures concerning the management, protection, conservation, and valorization of heritage and the improvement of services for visitors that, in a more or less explicit way, refer to the issue of accessibility.

The National Institute of Statistics (ISTAT) recently returned to conducting census surveys on museums and similar institutions [3]. However, it is worth noticing that the diversity of the items focused on in the surveys and their irregular periodicity allow only to provide a partial and unsystematic overview for the time being.

In 2019, Italy had 4,880 cultural institutions open (or partially open) to the public, including 3,928 museums, galleries, or collections (80.5%), 327 archaeological areas and parks (6.7%), and 625 monuments and monumental complexes (12.8%). Approximately two-thirds of all cultural institutions are public, while about one-third are private.

According to the 2019 data, 53% of Italian museums or similar institutions declared possessing equipment to ensure spaces accessibility and collection enjoyment by visitors with disabilities [Figure 1]. But in the same year, only 12.6% of surveyed museums were equipped with specific devices and solutions for people with sensory disabilities (visually impaired and blind).

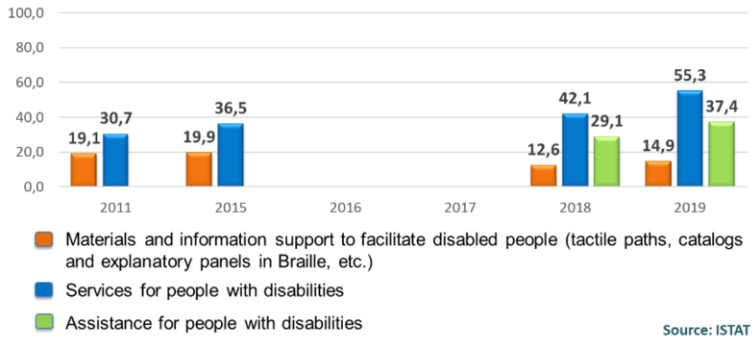

Figure 1. Supports and services for the accessibility of cultural institutions (Percentage of total institutions)

Nevertheless, between 2011 and 2019, services aimed at visitors with disabilities significantly grew: while in 2011, 30.7% of museums offered these services, in 2019, the percentage jumped to 55.3%. The most recent surveys verified the presence of assistance services for people with disabilities. The percentage of museums that offer them has also

increased from 29.1% in 2018 to 37.4% in 2019. At the same time, the share of museums equipped with materials and information supports that could facilitate their enjoyment by people with disabilities after reaching 19.9% in recent years drops to about 15%. This decrease could result from the ever more frequent use of new technologies in museums which, in the case of sensory limitations, offer alternative solutions to traditional information materials.

Not only has accessibility entered the agenda of cultural institutions, but "accessibility is one of the primary conditions that a museum must strive to ensure, as an organism destined to contribute to the growth of the (entire) community" [4]. The presence of devices and services that should promote accessibility does not allow us to conclude about their effectiveness in promoting the enjoyment of museums by people with disabilities.

Let us now consider the demand side. As mentioned above, at least in Italy, museum visitors and, more generally, their audiences are still poorly analyzed. The museums and similar facilities survey only considers the number of visitors, without further distinctions. A valuable information source to learn about how many people with disabilities visit museums, archaeological sites or monuments is the Multiscope survey on families devoted to everyday life aspects. Using this survey, we can notice how the percentage of people aged 14 and older without limitations, with mild or severe limitations, who visited museums and exhibitions at least once in the last 12 months varies between 2013 and 2020 [Figure 2].

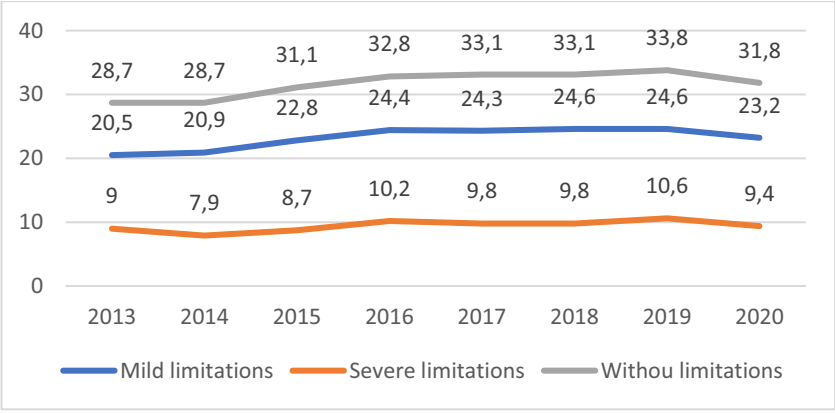

Figure 2. Percentage of people aged 14 and over with mild, severe, and without limitations who visited museums and exhibitions in the past 12 months
(Percentage out of 100 people aged 14 and over in the same condition)

The substantial decline in visitor rates in 2020 is the effect of the closures and restrictions imposed on museums because of the Covid-19 pandemic. Until then, visitor rates gradually increased for all three categories. Between 2013 and 2019, the increase was most pronounced for people without limitations (+5.1 percentage points) and people with mild limitations (+4.3 percentage points), while almost negligible for people with severe limitations (+0.1 percentage points). The share of visitors with mild limitations increased but did not bridge the gap between them and visitors without limitations. This divide has widened, especially for people with severe limitations, from 19.7 percentage points in 2013 to 23.2 in 2019.

In brief, museums have recently shown increased attractiveness, gaining new visitors from the vast pool of non-audience and potential audience, and only to a limited extent from the occasional or regular audience. This attractiveness has also proven effective among people with mild functional limitations. However, we do not have studies documenting whether and in what proportion this attractiveness is attributable to accessibility policies. It is a fact that, over the last few years, more and more Italians have chosen to visit museums and exhibitions, among the various options for spending their free time (a similar trend applies to archaeological sites and monuments). Nonetheless, the percentage of people who never visited a museum remains high, both among people without limitations (about 2 Italians out of 3) and among people with mild limitations (about 75%) and severe limitations (90%).

A 2011 ISTAT survey on social inclusion of people with functional limitations showed that a large portion of this population was not interested in visiting museums (76.6%). Most of them were aged people (85.2% aged 65 and over). Instead, 5.3% of respondents said they visited museums, exhibitions, and archaeological sites less often than they wished. An additional 10.3%, although not attending museums, would have liked to do it. These data prove the existence of a demand for the enjoyment of cultural heritage that was left unmet.

Given such a widespread lack of interest, even if museums and related facilities were made logistically accessible, the enjoyment of cultural heritage would not make significant progress. Legislative measures and their implementation would only create "potential accessibility" conditions. But to make them effective, we believe it is necessary to rethink the problem of accessibility from a different perspective.

3. Accessibility as an entry point to experience

Accessibility legislation initiated a change in the relationship between museums and their visitors, including those with functional limitations. Even though we agree with those who consider it necessary to shift the focus from the objects exhibited in a museum to the relationship that visitors establish with them, we believe that it could prove inadequate if we still understand accessibility in purely prescriptive terms. It is not possible to separate how cultural heritage is made accessible from the purpose for which it is made accessible. Considering the ultimate goal is to guarantee the right to participate in cultural life, the relationship established with a museum's exhibition itineraries has a specific situated purpose: the transmission of meanings. The principle of accessibility should ensure compliance with standards that create the conditions for people with disabilities to establish a relationship with the exhibited items in a museum and ensure that this relationship is meaningful for them, in other words, that it intentionally carries meanings.

As part of the experimental project Smart Cultural Heritage 4All, realized at the Museo Sannitico in Campobasso, we tried to develop a performative conception of accessibility to "give sense to culture." The word "sense" means both the enhancement of all perceptual channels through which the person enters into a relationship with reality (sight, hearing, touch, etc.) and the meanings associated with tangible and intangible evidence of human creativity exposed in a museum. In other words, the accessibility of a work of art, or an item exhibited in a museum, will remain an incomplete gesture if, in addition to the sensitive enjoyment of the artifact, it does not convey meanings to the

recipient. Likewise, any accessible communication of meanings is an incomplete gesture if it disregards the sensitive experience of the artifact that "carries" those meanings.

For some time now, visitor studies have abandoned the idea of the museum as a mere exhibition space to consider it an experiential context. Experience stems "from the dialogical relationship between the thinking and feeling of the visitor and the knowledge orchestrated by the museum." [6]

To illustrate how the Smart Cultural Heritage 4 All project reshaped the problem of accessibility in terms of a meaningful experience, we will draw on the "cultural diamond," a conceptual tool developed by American sociologist Wendy Griswold to analyze cultural phenomena from a sociological perspective [7]. The cultural diamond consists of four elements (the cultural object, the creators, the receivers, and the social world) and six relationships that connect these elements [Figures 3]. By cultural object, Griswold means "a shared meaning embedded in a form." [7]. Griswold further specifies the concept, stating that a cultural object:

- it is a meaningful expression that is audible, or visible, or tangible, or that can be articulated;
- it tells a story, which can be sung, recited, sculpted, published, or painted on the body.

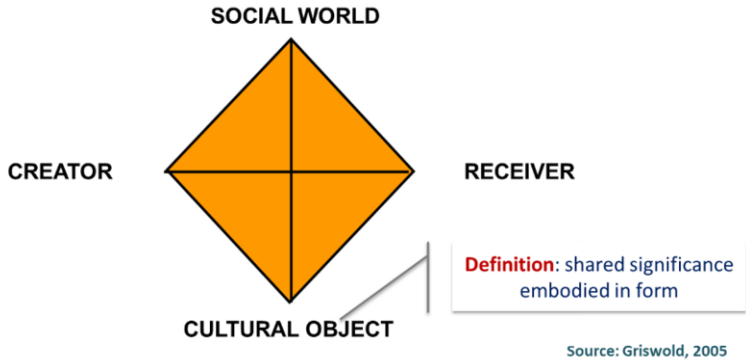

Figure 3. The cultural diamond

Museums house cultural objects, i.e., visible human expressions (e.g., an art gallery or an archaeological site). Although they are tangible, visitors cannot perceive them by touch for reasons of preservation and conservation, except under certain conditions. Creators (individuals or groups of people) are those who make cultural objects. To become cultural objects, they must have receivers: "people who receive them, hear them, read them, understand them, think about them, publish them, participate in them, remember them." [7] Both creators and receivers anchor to a particular context, a social world characterized by economic, political, social, and cultural needs that change over time. The social world of those who create the cultural object is not necessarily the same as the receivers. The social world that hosts the cultural objects them is no longer the same as when they were created. Therefore, the same cultural object can take on different meanings — be it a work of art or an artifact. The original meaning attributed by its creator adds to those attributed by museum operators and visitors. Exhibitions themselves are "cultural objects" in that they are forms that incorporate meanings.

The accessibility of cultural heritage implies other dimensions besides the logistic one, including the cognitive dimension. Without effectively sharing the meanings embedded in the objects exposed, museum fruition loses its appeal. [4] [5]. Accessibility is not limited to the single component that we have defined as "adaptive," which can take different forms depending on the type of functional limitation.

The guiding idea of the Smart Cultural Heritage 4All project is that considering accessibility as a social relationship is a more appropriate approach to it, one that preserves its multidimensional character. More specifically, it is a relation situated at the level of the practical order of reality, the one in which we relate to objects or situations. The referents of these relations are objects that encompass the "representation of actions previously performed by human beings, and thus incorporate a relational message." [8]. To observe object relations, we need "a kind of relational 'dialogue' with the objects and not just a physical relationship." [8]. The non-accessibility of cultural goods depends on the absence of this "dialogue."

The sharing of meanings often fails because the exhibition itineraries incorporate self-referential meanings, understandable only to experts. Only the restricted social world of museum operators and curators of exhibitions share these meanings without stimulating visitors' interest because they represent the actions of "experts." The sense of "cultural inadequacy" is one of the reasons that large groups of individuals who make up the so-called "non-public" often use to explain why they do not visit the museum." [4]

We can more accurately reformulate the problem of museum accessibility as a problem of receiving meanings inherent to the relationship between cultural objects and their receivers. We cannot adequately understand this relationship from the point of view of the museum operators who work to make the exhibition spaces accessible or from the visitors' point of view. We need a "third" perspective that can also observe the relation of reception as such. Museum operators need to be capable of relational reflexivity: "the reflexivity that an agent exercises not on herself about the context, or on what the Other thinks or does, but on the relationship with the Other." [8].

Cultural object accessibility thus implies a problem of communication of meanings. The traditional paradigm is that the communication of a cultural object is designed for the normally able people and then extended, through functional systems, to people with disabilities or other visitors with special needs. However, the situation is slightly different. Concerning cultural heritage, most people are, in many cases, "disabled," left to their own devices along exhibition paths that they cannot decipher or interpret. This lack of accessibility largely explains the lack of interest in museums widespread among people with disabilities and people with normal abilities. The stories told by the objects that visitors come across along the exhibition are hardly accessible to a broader public.

The reason is that museums are the result of an analytical conception of knowledge. An expert (archaeologist, historian, geographer, musicologist, anthropologist, etc.) finds the cultural good; another expert takes care of its preservation; a third arranges its exhibition; and finally, we have communication, which often amounts to mere marketing for the public.

The development of museum culture and new technologies entails a different conception of epistemology before communication. There is a profound continuity between objects, retrievals, conservation, curatorship, exhibition, and communication. No part of this process is analytically separate from the others. Therefore, all of these dimensions must be thought of together in a synthetic way.

From the Latin verb “gero” (to bear, to carry on) comes the term “gesture,” by which the philosophy of gesture defines this kind of communication [9]. The philosophy of gesture fits in here, claiming that for communication to be synthetic, it needs to be a relationship with a beginning and an end and carry meaning. What are the main characteristics of a gesture? First, from a phenomenological point of view, it must have an emotional and ideal dimension concerning meaning. Secondly, it must involve a physical experience. Finally, it must be replicable, to be a habit of action.

From the semiotic point of view, it must have iconic elements, i.e., elements related to the evocative resemblance of the signs with the object to be communicated; indicative elements, which fix references; symbolic elements, which involve an interpretation of meanings.

The accessibility of cultural heritage is fully realized when the visitor establishes a "physical" relationship with it that removes the obstacles that prevent the perception of the form and, at the same time, allows a "dialogue": that is, the sharing of meanings through forms of communication that have the characteristics of a gesture. Communication is not intended as a mere transmission of information but as a "ritual that brings people together in friendship and commonality." [10], even when meanings are divergent.

The prototype of the Blind Experience application created for the Museo Sannitico in Campobasso is a concrete realization of communication as a gesture. Safeguarding the phenomenological aspects means allowing the visit for blind people --and therefore also for non-disabled people who often see the museum without really seeing it-- to be an experience that involves physical elements: downloading the App, starting it up, walking while the earphones broadcast the story, following a path that progressively activated through beacons, touching an object reproduced three-dimensionally through 3D scanning and printing.

These are repeatable sensations, physical experiences, and habits of action. From the point of view of meaning, the story carries out meaning while blind people listen and walk. We have a dimension of narrative storytelling (symbolic) that engages the visitor in the story of a protagonist (indical element), making him/her feel his emotions through actor performance of the story and music (iconic elements). It is essential to underline that the symbolic aspect of storytelling must have a clear teleology: the story should illustrate a meaning (in this case, the meaning is that the Samnites were the historical-cultural alternative, and loser, to Rome). The story must have aesthetic features that make it plausible and, therefore, verified by consulting experts.

The communicative tool synthesizes the object and the knowledge into a gesture. And the visitor is asked to consent to it. In other words, by entering into a relationship with the objects exhibited, the visitor also participates in the meanings the experts know and want to communicate. Synthetic communication is meanings communication through a gesture, namely the sharing of the experience of the meaning that the museum expects to communicate and in which the visitor participates and cooperates by visiting. The more appropriate the gesture, the more the synthetic understanding is facilitated, and the museum enjoyment becomes a meaningful experience. Indeed, the Blind Experience application allows the visitors not only to expand their knowledge through the acquisition of new information – an effect for which an audio guide would have been sufficient. Most importantly, the visitors deepen their understanding because they can access one of the possible meanings the museum wishes to communicate. Most striking is that after experiencing the blind path, non-disabled visitors claim to have "seen the museum as they had never seen it" or "understood the museum."

5. Conclusions

According to the results we obtained so far, we believe that combining the philosophy of gesture and relational sociology opens a new perspective on cultural heritage accessibility. Digital technology, as such, does not make cultural heritage more accessible by mediating the relationship of visitors —whether they have functional limitations or not. Cultural heritage becomes accessible only if the technology is conceived and developed as a "complete gesture," i.e., one capable of transmitting possible meanings. In terms of relational sociology, this implies activating a different strategy to increase cultural institutions' accessibility. From the beginning, resorting to digital technologies should be made on new assumptions concerning the communication of meanings as the purpose of the cultural object's relationship with visitors. This goal is pursued by means chosen to meet performative and not merely prescriptive norms: namely, norms designed to increase both extensional and intensional dimensions of knowledge. In a nutshell, the guiding idea of the project we have outlined conceives accessibility as a social relationship: a social relationship that, by combining the adaptive dimension and that of reference to meanings, can make museum enjoyment a meaningful experience, that is to say – to use the words of the philosophy of gesture – a "complete gesture."

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Outside, Around, Inside. New Paths to Discover San Michele Castle (Cagliari, Sardinia)

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Abstract. In the framework of conservation and enhancement of cultural heritage, accessibility plays a crucial role. Architectural heritage peculiarities call for specific approaches: the same care must be adopted to improve accessibility to historic architecture, designing actions case by case. Starting from these considerations, the contribution is aimed to discuss the accessibility of fortified architecture, a not easily accessible heritage, to make it accessible both in a physical meaning as well as in cognitive, cultural and social. Particularly, the authors propose some reflections about alternative ways of usability for inaccessible architectures due to their typological configuration and as a consequence of previous conservation design. The case study is the medieval castle of San Michele in Cagliari (Sardinia), which was transformed several times during its life and restored at the end of the 20th century. The contribution analyses how a multidisciplinary approach is necessary for the formulation of effective accessibility solutions, especially in complex cases such as fortified architecture. This multidisciplinary approach must be accompanied by the widest possible consideration of the causes limiting accessibility, whether they are physical or related to motor, perceptive or cognitive disabilities.

Keywords. *fortified architecture, cultural heritage, accessibility, ICT, design*

1. Un-cover (VP)

In the framework of conservation and enhancement of cultural heritage, accessibility plays a crucial role. It is well known that peculiar weaknesses of architectural heritage require specific approaches: the same care must be adopted to improve accessibility to historical architectures, designing actions case by case.
Starting from these considerations, the contribution is aimed to discuss the accessibility of fortified architecture, a not easily accessible heritage, to make it accessible both in a physical meaning as well as in cognitive, cultural and social [1].

Accessibility's degree of a place depends on relations between places and the people enjoying them: in fortified architecture, these relations can be seriously compromised since inaccessibility itself is an essential characteristic, fundamental to its inherent defensive potential. Fortified architectures express military strategies that inspired them through the close link between function and shape: shape follows function requirements; function is exalted in every architectural detail and becomes a recurring reference. This issue makes the study of accessibility in fortified architecture an interesting challenge since the designers have to deal with a variety of accessibility/inaccessibility degrees, to seek the most appropriate solutions for adequate usability while preserving places values.

The castle represents a quintessentially inaccessible place and the purpose to make it "accessible" through shapes, elements and spaces transformations could disrupt that

close link between function and shape [2]. That is to say, authenticity and typological identity, historical-cultural and architectural recognisability may be compromised by the ambition to meet the requirements of new functions while altering the inaccessible nature of castles. It is not intended to argue that it is impossible to act on a fortified architecture as if it is an immutable object out of time, but rather to highlight the greater difficulty to find deeply conscious solutions that take into account accessibility necessities and preservation needs of intrinsic values and meanings.

In this sense, a multidisciplinary approach is required to define successful accessibility solutions, which should be capable of encompassing the widest possible causes that are limiting accessibility. As the presented work demonstrates, a synergic collaboration between Restoration and Drawing disciplines played a crucial role in the definition of widespread knowledge.

The case study is the medieval castle of San Michele in Cagliari (Sardinia, Italy), located on top of the namesake hill, inside an urban park (fig. 1). It has been transformed several times during its life and deeply restored at the end of the 20th century. The castle is visible from all the surroundings, but it is not easy to reach the park due to a lack of road signs nor to arrive at the castle itself once entered the park. Moreover, concerning cultural and cognitive points of view, the architecture is difficult to understand because of the recent reuse design which deletes historical stratifications and adds an invasive modern structure to adapt the ruins of the ancient castle into a contemporary museum, and so on.

Figure 1. San Michele Castle, aerial view (E. Mannai 2021).

The methodology follows a traditional approach also developed with the support of new technologies [3]. Analyses aimed to define conservation design while focusing attention on inaccessibility issues, considering different scales, and physical, cognitive and cultural points of view. The first step was to collect data from indirect exploration, through archive, bibliographic, iconographic and cartographic recognition. In the second step, a direct survey was carried on through UAS technologies for external areas, and LIDAR and Panoramic Photos, for interiors (fig. 2). Analyses results highlighted several serious problems at different scales that couldn't be solved by single “unrelated devices” but need a deep redesign of the whole urban complex, starting from accesses and paths.

Figure 2. Architectural survey.
Flight plans for UAS (on the left) and laser scanning stations (on the right).

In particular, the analyses highlighted an extensive variety of problems of accessibility and usability, related to mobility, perception and cognitive strictly, up to those arising from the lack of advice concerning the site and the ineffective communication tools [4] [5]. Therefore, the authors have proposed several solutions aimed to guide the user during the whole experience in the Castle of San Michele: starting from a new information system to reach the park and the top of the hill where it is located, up to the physical access into the castle with paths designed according to different users' needs. In addition, around the castle, tools such as information boards and AR apps are available to tell users about the castle's building transformation and the history of its owners and inhabitants (fig. 3).

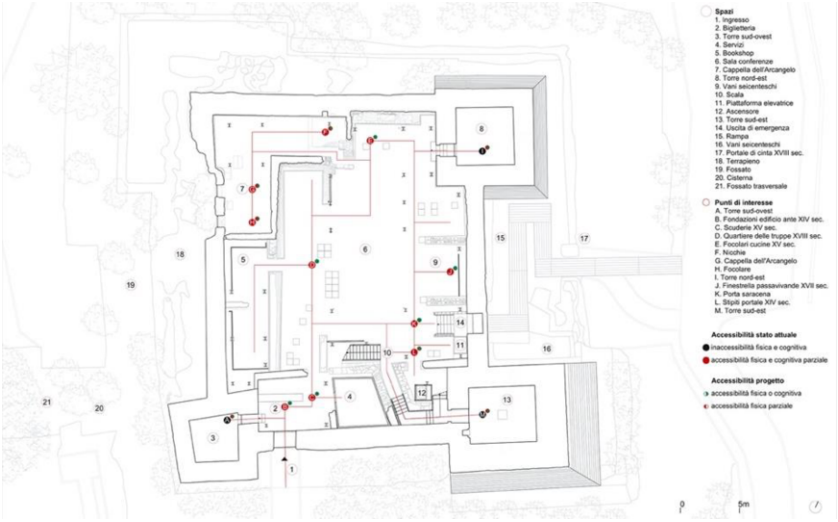

Figure 3. Architectural spaces, points of interest, the current condition of accessibility and new design.

2. Re-cover (EM)

The San Michele castle has been transformed over time by the functions performed: it was built as a fortified residence of the Carroz of Quirra family (14th cent.); then, it became an urban leprosarium (17th cent.) and later, back to a defensive use, it is renovated as a modern fort (18th cent.). Abandoned in the 19th century, at the beginning of the 20th century the whole hill is occupied by Military Navy and the ruins of the building are adapted to accommodate a radio station [6].

Several conservations work occurred: the purpose of the last one (1988-99) was twofold to arrest the serious state of decay of the castle and to transform it into a museum and the surrounding in an urban park. Specifically, the architectural project consisted of: archaeological excavations, consolidation and conservation works focused on the walls and the addition of a steel and glass structure inside the ancient perimeter to create a modern building (fig. 4).

Figure 4. The castle before the restoration works (1896).

Currently, the castle has a quadrangular architectural layout, with three corner towers and a surrounding dry moat. It is built using mainly limestone, which comes from the quarry of the hill, and lime plaster. Other materials were used in transformation and conservation works. The documentation analysis and the survey of the castle's current state allow for to identification of critical issues and specific needs regarding accessibility on different levels of intervention. On the urban scale, the mobility networks between the castle and the urban centre are disadvantageous, both in terms of public and private transport. Considering the castle inside the park, several critical issues are found due to the hill morphology: the entrances are not identified and marked; there is a lack of communication languages, particularly of multisensory devices, fundamental to support the accessibility of people with sensory disabilities. The paths show a dangerous current state: degraded pavements and several physical obstacles are present along with them. Several areas of the park are completely inaccessible due to the risk of landslides and rockfalls; basic services, adequate lighting and a security system are absent;

monumental components are unexploited. The elevators, located inside the park to ensure a direct connection with the castle, are out of use.

At the architectural level, the inside museum experience presents various problems, both physical and cognitive. The space of architecture is piecemeal due to its ruined state and height differences between the ancient courtyard, towers levels and the new upper floor, connected with stairs and an elevator. The contemporary structure interrupts vertically the space and makes a dimly lit environment that does not welcome visitors.

On the south front, access takes place along a short concrete walkway, which allows people to enter the castle by crossing the surrounding moat. On the east front, to reach the lower level of the gate, it is necessary to overcome a brief staircase, or to use an elevator platform; once out of the door, a tortuous ramp allows people to overcome the moat. It represents a temporary ineffective solution, made of wooden board and metallic tubes, built at the end of the 20th century.

Inside the castle, the reception and ticketing services are located on the ground floor, where people can find also the bookshop. Traces of the 18th-century walls are evident, although they are not valued nor adequately marked. The area of the courtyard is used as a conference room: when it is necessary, it can be closed off with movable panels. Along the inside path, there are panels with information about the history of the castle, written just in the Italian language. The second floor is an open space characterised by the presence of panels for exhibitions, an area dedicated to educational workshops for children and two looks towards the Archangel Chapel and the closing system of the eastern gate. The shape of the castle makes it difficult to create inclusive paths which allow all people to appreciate the site: for example, to visit the area of "Archangel Chapel" it would be useful to demolish historical walls; instead, access to the towers it is possible just passing along stairs, designed uncomfortably. At present the towers are inaccessible: the rooms are limited in access due to the lack of structural support so two of them are used as private spaces by the museum management.

Solutions proposed may provide alternative ways to link the castle spaces, aimed at better use of the architectural asset in relation to the size of the park and the castle itself. These solutions enjoy the use of augmented reality, digital technologies and multisensory tools, for greater physical, cultural and cognitive accessibility.

3. Dis-cover (RA)

As seen previously, accessibility issues range from physical to sensory and cognitive accessibility. Equally wide is the range of solutions that can be adopted to eliminate, or at least mitigate, these issues. Modern digital tools such as augmented reality or the use of virtual environments for the creation of tours are proving to be essential to ensure accessibility to historical architecture to an increasing number of users. Often these tools, however, do not provide a fully comprehensive and inclusive solution: on the one hand, the use of a virtual tour allows visiting a place physically inaccessible, but in some cases, sensory difficulties can limit or frustrate the benefits of this technology. Similarly, in the presence of particular cognitive conditions, the use of technologies that provide a high level of involvement can create confusion or discomfort in users. For this reason, solutions are proposed to combine digital technologies with physical tools, with the aim that one type can compensate for the shortcomings of the other [7].

A first example can be seen in the approach to the castle through the pedestrian paths; along these, the installation of information totems has been hypothesized (fig. 5).

The totems, while walking along the path, offer a story of the castle and its context; they have three components: a transparent panel on which various information is impressed, a tactile map with the same information and a QR code which makes it accessible additional information [8]. The transparent panel is designed to offer a sort of augmented reality simulation; by standing in front of the panel, the user sees the castle through the panel, and the information it contains overlaps with the vision of the castle, "augmenting" it. Using the QR code, it will be possible to offer further experiences such as the vision of the 3D model of the Castle, thus offering new points of view for most users, or the listening of audio information to support users with visual impairments (fig. 6).

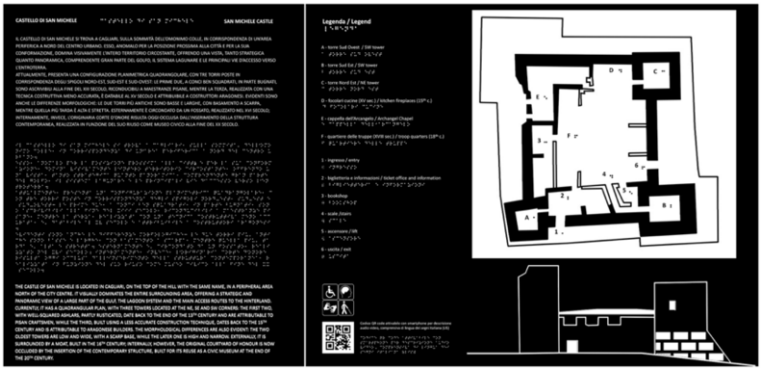

Figure 5. Illustration of the "welcome" totem: it is designed to be located near the entry of the castle.

Since the survey phases of the castle have included the use of laser scanning, the point clouds generated by the latter can be used to create 360° panoramic images with which to develop a virtual tour of the castle and the surrounding area [9]. Through the use of dedicated tools, such as game engines [10], it is possible to import the spherical photos and connect them through interactions to create simple tours inside and outside the Castle; this type of application allows the visit of the monument even when, due to physical limitations, it is not accessible. Moreover, the creation of a visitable virtual environment allows the user to access additional notions and information, enriching the experience; in fact, it is possible to implement further interactions that allow the reproduction of narrative media, the opening of information panels or the overlay of graphics with additional content on the screen. Similar experiences can be offered through the use of augmented reality. An example is the already mentioned system of QR codes impressed on the external totems, from which it is possible, through a special app, to visualize multimedia content. Through a careful arrangement of markers inside the Castle, it is possible to enrich the physical reality with new information directly superimposed on the real object to which they refer; in this way it is possible, for example, to show the history of an artefact or a part of the monument, to offer simulations of how the space could be before the restoration works or how it could become after new works. In addition, all this information can be filtered or calibrated by taking into account the users, in particular their age, their level of education, any sensory or cognitive problems etc.

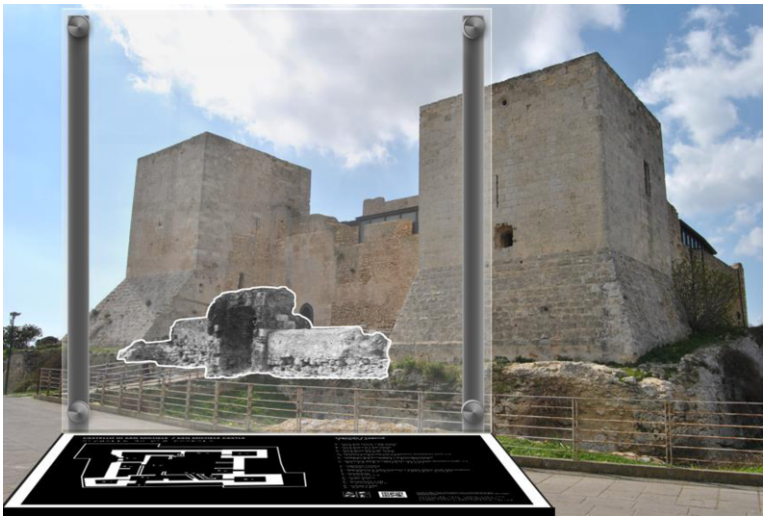

Figure 6. Transparent panel for augmented reality simulation.

Another interesting possibility is that of visiting, through augmented reality, nearby but inaccessible spaces; in fact, it should be considered that virtual access to the Castle is not necessarily an alternative to the physical visit, but it can complement it to offer a better experience to users and consequently enhance the monument itself. Some parts of the Castle require access through passages that make it difficult or impossible for certain categories of users to pass through. They find themselves close to a space they want to visit, without actually being able to access it; through the use of augmented reality, it is possible to virtually remove obstacles, such as a wall, to show what is hidden behind it, simply by framing the obstacle with a portable device (fig. 7). The proposed solutions are just a few examples of how the monument could be made more accessible to all users, to remove any limitations.

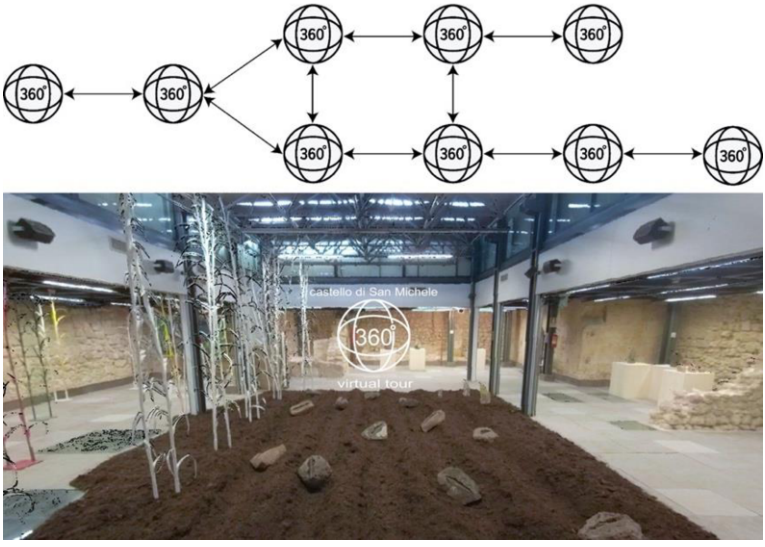

Figure 7. Screen captured from virtual tour application.

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Universal Design and Interoperable Digital Platforms Between Conservation and New Fruition Opportunities. The Case Study of Arianna's Domus in Pompeii

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Abstract. The paper aims to examine the last results of experimental and interdisciplinary research, started in the archaeological area in Pompeii by the "Federico II" University in 2010, on the enlarged fruition in Pompeii. After Covid-19 pandemic is necessary to rethink the use of the archaeological site considering the need put in place by the health emergency, combining instances of a perception of the archaeological heritage in safety with those of a direct and indirect experience, rationalized and increased thanks to the Universal Design and the use of new interoperable technologies. The increase of knowledge, the survey, and the digitalization of the acquisition processes, by developing optimized methodologies for integrated surveying and modeling for the Heritage Building Information Modeling (H-BIM) and for the archiving and management of data relating to the heritage, facilitate the sharing of cognitive elements starting from new methodologies and processes of knowledge. The searches, in line with the themes of the Universal Design and thanks to an interoperable web-based platform, experiment technological devices for the accessibility in relationship with the changed needs of cultural fruition due to the pandemic. A special focus analyse on how the conscious use of new technologies may be the key to understand the material and immaterial traces of the case study: Arianna's domus, in the Regio VII, Insula IV.

Keywords. cultural heritage, accessibility, Pompeii, digital, HBIM

1. Introduction

This paper presents the first results of the research "CHEAC. Cultural Heritage After Covid. Interoperable Pompeii", funded by the Italian Ministry of Universities and Research, based on the institutional collaboration between University of Naples Federico II, Polytechnic of Milan, and National Research Council (CNR). The research aimed to create a digital web-based platform for the monitoring and conservation of archaeological evidence and for the definition of new ways of use because of the possibilities and limits of cultural participation imposed by the pandemic. The use of digital technologies has a dual convenience. The platform, built according to the principles of H-BIM (Heritage Building Information Modeling), in fact, allows the "manager" the digitalization of the processes of control of flows and risks and it make more comprehensible and comprehensive educational content related to cultural heritage for the "user".

According to the principles of the Universal Design, in addition, the web-based platform allows quick access and easy interpretation of information, increasing the level

of fruition for the visitor in terms of flexibility, simplicity and perception (UD's 2nd, 3rd, 4th principles).

In this way, the platform promotes the monitoring of archaeological evidence, and his open spaces and feeds processes of Facility Management and new practices of active participation by any type of user (equity, UD's 1st principle). The web-based digital platform allows with absolute ease to share information, both managerial and informative, meeting the recent need to increase the standard of control and reception of archaeological parks. These entities represent the places of greatest interest as regards the topic of the decongestion of visitor flows in the most frequented areas, as well as the seasonal adjustment and diversification of the tour routes. It's useful also for a containment of physical effort (UD's 6th principle) and to make the spaces suitable for access and use (UD's 7th principle). Characterized by an "urban" dimension, in fact, the archaeological park requires innovative tools for new management strategies and an operational speed that can be supported only by the modern information technology.

For the first phase of experimentation of the web-based platform, we chose the case study of Arianna's Domus, whose critical issues were identified, both from the point of view of degradation and the use of the domus. The knowledge phase was based on the cross between the direct funds, archival documents also unpublished and bibliography available, with the relief using drones and 3D laser scanners. This comparative reading made it possible to reconstruct the domus's phases and the excavations and restorations that involved it over time, graphicized by photogrammetry and restitution software.

The next phase, combining all the data and information outcome of the cognitive phase, saw the realization by the company Acca Software, an H-BIM model that reports elements categorized according to their function. Each element can be inspected and refers to dimensional data, material and status of storage appropriately classified by technical data sheets readily available on the platform. The last phase of the research involved the drafting of a prototype maintenance sheet to indicate the interventions to be carried out *in situ* and the chrono-program of the maintenance activities. Moreover, from the point of view of accessibility, the analysis of internal flows for operators and the immediate availability of information for visitors, improves the fruition of the domus, increasing its cultural interest and ensuring its transmission to the future.

Figure 1. Location of the Arianna's domus in the Archaeological Park of Pompeii

2. Typological analysis. Excavation and restoration: historical values for an inclusive fruition

The Arianna's domus is one of the largest houses within the Archaeological Park of Pompeii, located in the Regio VII, Insula IV, with its 1700 m^2 of surface. This domus has two accesses, one on "Via della Fortuna" and another on "Via degli Augustali", occupying the North-South side of the Insula. The Regio VII, which includes the Arianna's domus, includes the area between the Civil Forum and most of the residential blocks located near the roads of "Vicolo dei Soprastanti", "Via Augustali" and "Vico Lupanare".

These residential blocks make it necessary, because of their position and spatial complexity, new systems of orientation and visit. It is, in fact, an area developed independently from the rest of the city for the orography, complicated by the inclusion in the urban complex of two religious and public areas: the Tèmenos of Apollo and the Forum Square. In the imperial age the area was equipped with shops, refreshment point and thermal baths, such as the Stabiane Baths and the Forum Baths.

Probably, in 79 AD, at the time of the eruption of Vesuvius, the Arianna's domus, also known as the House of Colourful Capitals, included about seventy rooms on the ground floor, organized around three areas of distribution: the atrium, the central peristyle and the northern peristyle. This typological and morphological complexity, enriched by the presence of sculptural apparatuses and precious frescoed surfaces, has made the Arianna's domus the ideal case study for digital systemization through an interoperable web-based platform.

Arianna's domus is also located along the path "Pompeii for all", inaugurated by the Archaeological Park of Pompeii in December 2017. This project has already eliminated the physical architectural barriers and solved the differences in levels inside the domus by stabilizing the beaten and vegetable paths (armed lawn).

Figure 2-3. On the left: Painting of the Casa dei Capitelli colorati (VII 4, 31), Fausto and Felice Niccolini, published in "Le case e i monumenti di Pompei", 4 vols., 1854-1896. On the right: Marco De Gregorio (1829-1876), La casa dei capitelli colorati, oil on canvas, cm. 47,6 x 38

From recent excavations (2004) the Arianna's domus is built in its entirety around 150-130 BC, occupying pre-existing structures dating back to the second century AC. Further changes to the domus date back to the Imperial era, as evidenced by the archaeological traces that emerged from the excavation.

Around the first century AC. the Arianna's domus underwent important planimetric and functional transformations. In addition, the state of "construction site" of the domus

at the time of the eruption of 79 AD, suggests significant changes in terms of entrances and the main directions of fruition and use of the villa. The hierarchies of the atria were probably overthrown and the rooms in front of the central peristyle were enlarged and redecorated. Despite the architectural changes carried out in the recent phase, the Arianna's domus is tripartite and with each of the parts developed around a void: corinthian atrium, central peristyle, tuscanic atrium. Each of these follows, in the arrangement of the environments, specific rules that make them formally autonomous but, at the same time, the three parts are put in relation to each other according to clear geometric/perspective rules. The formal order of Arianna's domus develops in a centripetal manner: the two atria are arranged on a street opposite the block and orient the respective rooms towards the central peristyle, making this place the fulcrum of the entire composition.

A single longitudinal perspective axis allows you to view the domus in all its extension from the *fauces* of "Via della Fortuna" to those of "Via degli Augustali", passing through the geometric centers of the *tablini*. This axis, from the centre of the peristyle, undergoes a perspective correction of some degree, to align with the sequence of the colonnades.

The excavations, which covered the entire area of the Regio VII, were started around 1827. In 1833, after six years of activity, the Arianna's domus was dug up, so called at the time for a painting that was found in one of the rooms, namely the *Oecus*. The domus, as can be deduced from the excavation papers, presented only small remnants of what it really had to contain, but was considered from the beginning to be among the most important of Pompeii. It was the expeditious and careless method of excavation that caused the loss of much of the surviving material.

The first restorations, carried out after these excavations, date back to the second half of the nineteenth century and provided for the construction of wooden roofs and brick tiles and the replacement of the existing lintels, now dilapidated.

In the twentieth century further restoration work was carried out: in 1950, under the direction of Amedeo Maiuri, support props were inserted in some points of the roof; In 1970, with Alfonso De Franciscis, the nineteenth-century roofs were further modernized with iron structural inserts and polycarbonate elements.

The most recent restoration works date back to 2014 and have further updated the previous restorations, replacing the polycarbonate cover with a false roof plate.

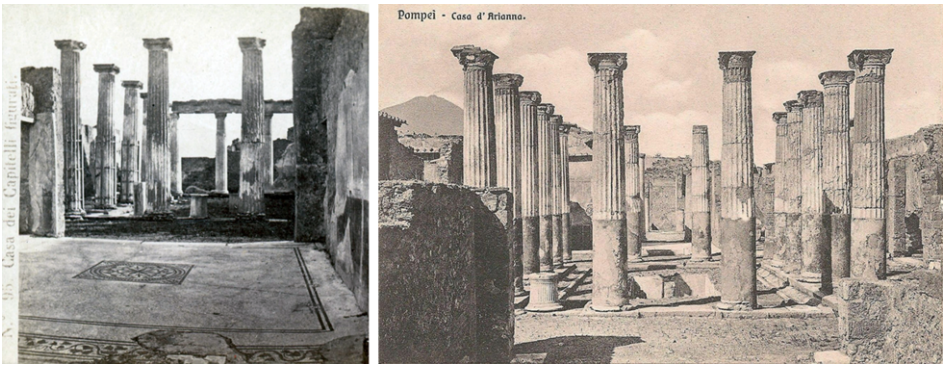

Figure 4-5. On the left: Pompeii. Stereoview by R. Rive, c.1860-1870s. Looking south across tablinum towards peristyle, showing original mosaic floor and decorated west wall. On the right: Pompeii, Naples. Arianna's domus, original photo with albumin, Brogi, c. 1880.

The degradation of a building is related to the aspects of technological and material conservation, to the problems of structural instability and to the resilience of the building structure. Through the analysis of the fissured picture, an integral part of the knowledge phase, it has been possible to identify the main phenomena of instability in progress, to understand and schematize them.

There are phenomena of crushing of the masonry, disintegration of the wall ridges and overturning of the columns. The crushing phenomenon includes among its causes the weight of the roofs and the restoration lintels, the antiquity of the materials and the poor quality of the mortars, generating as an effect the disintegration of the mortars, the detachment of plaster and peak load injuries. The disintegration of the wall ridges is generated by the absence of protective cases, infiltrations of meteoric water and cycles of frost and thaw, causing cracking phenomena and attack of autotrophic organisms.

Regarding the column system, the absence of connecting elements, the antiquity of the materials and the alteration of the trilithic system have generated as an effect the overturning of the isolated elements and the detachment of material. The decorated wall and floor systems are in a very poor state of preservation, this is due, basically, to the absence of protective elements and the lack of cyclical maintenance interventions. Almost all the wall systems have discoloration, which makes it difficult to interpret the decorations, surface deposits and lesions that lead the frescoes to detach from the wall support. For the floors, phenomena of biological patina, detachment of mosaic tiles and surface deposit have been found. These critical issues have been duly recorded and included within the BIM model, to interpret over time, the evolution of degradation. In addition, to combat degradation and prevent the loss of material, maintenance sheets have been developed in which, after a diagnosis phase, possible ways of cleaning, consolidation, protection, and maintenance are identified.

3. Technological and physical tools for accessibility. The H-BIM model and the web-based platform for the Arianna's domus

The prototype of the "enabling digital platform", the object of the project, is characterized as a web-based software solution. It is aimed at knowledge, restoration, Universal Design, new opportunities for use, management, and security of the archaeological site. The aim is to define a digital ecosystem of cultural heritage that can reconnect all the actors involved in the expected processes, enabling the exchange of information, including the public, through digital information modeling technologies.

Figure 6. The result model of processing the dense cloud, after the Domus relief with 3d laser scanner.

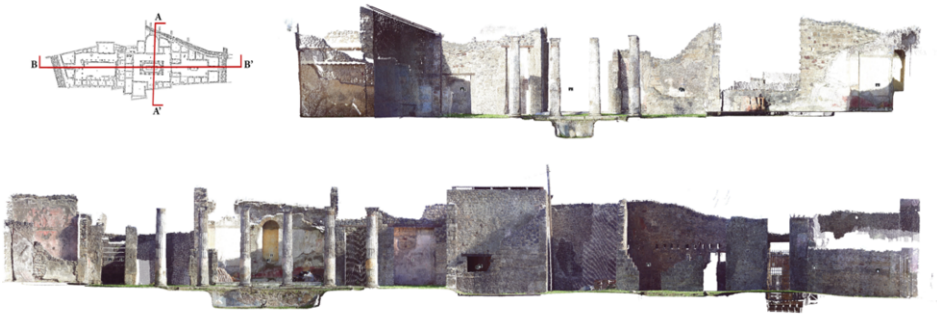

Figure 7. Two sections of the Domus, one longitudinal and one transverse, obtained from dense cloud with coordinated software.

The design idea proposes the use of the BIM management platform usBIM.platform, developed and marketed by ACCA Software S.p.A., IFC certified by building smart international.

The CHEAC project, as mentioned, focused on the Archaeological Park of Pompeii and specifically on the case study of the Pompeian Domus of Arianna. It is used to test the digitalization of the processes of reading, acquisition, storage, and management of data relating to the archaeological heritage, adopting optimized methodologies of integrated survey and modeling for the Heritage Building Information Modelling (H-BIM).

The project activities began with several inspections at the Arianna's Domus, of which an architectural survey was carried out using drones and 3D laser scanners. Obtained about thirty dense cloud - defined as a set of points referenced in space, containing information of both geometric and colorimetric character - the BIM model of an example part of the case study was generated, useful to the goal of the project, thanks to scan-to-BIM processes using BIM Authoring software from ACCA software "Edificius".

This operation has cross-checked the data of the material analysis and the critical conservative relative to the degradation of the archaeological evidence, with the help of the application of orthophotos on the digital model BIM. This way of creating the model has made it possible to digitize and share all the data collected during the field survey operations, easily accessible from the BIM model from anywhere and through any device, operating only via web-based browser. The model, equipped with textured 3D meshes, 360º panoramic photos, graphic tables, and text documents, thus optimizes the processes of acquisition, storage and management of data relating to the archaeological heritage. The platform also allows you to create tags, links and geo-references of information, documents and/or images, and it can be quickly consulted both by Pompeii technicians for monitoring and maintenance, and by visitors to guide the visit and storytelling.

In addition to the presence of valuable structural, architectural, and decorative elements, the platform can also signal to the visitor stepless entrances, non-slip surfaces, manoeuvring spaces, points of greater visibility, presence of audio-visual tools, Braille maps, qr-codes to web pages that provide alternative text to describe the images, etc.

Figure 8. usBIM.platform: definition of web user interface, potential actors/users involved

The platform, through a customized interface to the user who operationally intervenes in the real on the archaeological good, can certainly act as a support to the digitization of the operational processes of the Archaeological Park of Pompeii. It can provide a set of innovative digital services. These potentials guarantee data security and reliability, interoperability of functions and accessibility of services by all the different actors/users involved.

4. Conclusions

The project "CHEAC. Cultural Heritage After Covid. Interoperable Pompeii" has created a first version of "digital platform enabling" web-based knowledge, restoration, environmental redevelopment, use, management, and security of the Arianna's domus, adaptable to the entire site of Pompeii and exportable in other archaeological complexes. A digital ecosystem has been created that connects all the actors involved in the preventive and conservative process (architects, engineers, archaeologists, restorers, etc.), enabling the exchange of management information, and the public, through digital technologies of informative modelling for the communication of updated contents.

The potential offered using HBIM for the entire management of conservative interventions to be performed (prevention, maintenance, restoration) allow to operate in a three-dimensional system also useful for the management and simulation of internal flows, today only two-dimensional (SmartPompei platform). From an operational point of view, in fact, the platform promotes and facilitates the knowledge, restoration, environmental redevelopment and safety of the archaeological site, ensuring above all the use in complete safety. It represents a real collaborative network, hosting a large amount of information, data, and statistics that, outcome of the work of professionals and technicians of different fields and disciplines, allow a critical interpretation of all the factors involved in the processes of monitoring and maintenance of archaeological artifacts, based on a complete historical-morphological knowledge. This synergy, facilitated by interoperability and rapid consultation, reduces the probability of failure or

malfunction, monitors the status of archaeological artifacts, and allows the programming of maintenance works, to be performed at predetermined intervals. Similarly, the large amount of information, always updated and related to the morphological and historical dimension of the site, promotes the understanding of the artifacts, and increases the awareness of users. They, according to their interests or inclinations, can select the contents, choosing various and different modes of storytelling and oriented fruition.

Moreover, the searches experiment, according to the themes of the Universal Design and thanks to the interoperable digital platform, technological and "physical" devices for the accessibility in relationship with the changed needs of cultural fruition due to the pandemic.

In Italian post-Covid scenarios a first focus seems to relate the territory on which it is expected to implement a set of programmatic lines no longer deferrable (de-congesting, de-localizing, de-centering, de-seasonalizing, diversifying). Assuming a rich domus as case study, a possible strategy is proposed to applicate the "five-d" in Pompeii for the conservation of archaeological rests and a new fruition of tourist flows.

In this vision, innovative technologies allow:

1) new practices of active participation, with equity, flexibility, and perceptibility.
2) a broader understanding of the educational contents associated to the cultural heritage.
3) the digitalization of flow control processes can minimize risks or unwanted actions.
4) the equipment of the open spaces can make the space suitable for access and use.
5) the implementation of Facility Management processes.

The combined application of the principles of Universal Design and the use of an interoperable digital platform leads to the improvement of accessibility by all in compliance with the safety standards required in the post-Covid period for users (social distancing, remote use for some contents, provision of alternative visit scenarios, immersive reconstructions) and for the archaeological heritage (control, monitoring and prevention; real-time diagnostics, forecasting of future conservation scenarios).

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NEAR PROJECT – Accessibility Plan for the Monumental Complex of the Opera di S. Maria del Fiore in Florence. Accessibility as an Element of Social Cohesion

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Abstract. Italy is the country with the highest number of sites recognised as World Heritage by UNESCO and one of the nations with the highest density of sites of cultural interest both in Europe and in the world. Unfortunately, only a small part of these are completely and easily accessible, and certain of the most fragile sections of society, for example disabled persons, are in fact excluded from the possibility of visiting and discovering the said places. The research presented here represents an "experiment" in the application of the methodology of the Accessibility Plan to the monumental complex of the Opera di Santa Maria del Fiore in Florence, in other words the attempt to increase the degree of accessibility of the complex through a medium and long-term innovative strategic planning tool that takes into consideration not only material aspects (physical and sensory accessibility) but also aspects of an intangible nature, thus making it possible for people to fully understand the cultural meanings of the places, and focusing on the "experiential dimension of the visit" [1].

Keywords. Accessibility, Architectural Barriers, Human Development, Accessible Tourism, Inclusive cities

1. Introduction

The wish to increase the level of accessibility of places of cultural interest (often inherently inaccessible due to their ancient layout), through more or less complex actions or design interventions, is undoubtedly a worthy operation, useful for enhancing the places where we live. The worthiness of this ambition consists in ensuring access to certain specific places, which the community considers important in terms of its culture and identity, to an increasing number of people. Very often, however, intervention programmes aimed at improving the useability of places of cultural interest tend to consider them as elements that are isolated from the urban structure in which they are located, and this, to some extent, undermines the efforts to increase their level of accessibility. The use of a multi-scalar approach [1] that interprets the accessibility of a

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building not only in terms of its planimetric and spatial features, but also in relation to the urban structure on which it stands, to the paths that connect it to its surroundings and to the public services that complement it, represents the most appropriate solution for trying to modify the built environment so as to make it more inclusive, comfortable and welcoming. The expectation, in the view of a considerable scientific production on the subject, both theoretical and methodological, as well as operational, is that the research and projects aimed at increasing the environmental accessibility of places respect the multi-scalar nature of this issue, in other words that the need to address the improvement of the accessibility of places should take into account the entire urban structure and the dense relationships that exist between its various parts, both in relation to the activities and to the uses and behaviours of the people who live in them. As long as municipal administrations do not address the issue of urban accessibility seriously, considering it as a crucial element in their strategic planning, projects and researches, although necessary for enhancing the condition of places and increasing the degree of accessibility, will regrettably remain partial and produce a limited impact.

Since the topic of accessibility to cultural heritage represents a very vast and articulated field of investigation, with numerous parallel lines of study, in developing the NEAR project we attempted to focus not so much on possible solutions to the accessibility issues involving the monumental complex, but rather on the collective character of the theme of accessibility, understood as a resource that involves cultural, ethical and economic aspects. For this reason, since the early phases of the research we referred to goal number 11 of the United Nations 2030 agenda, that is to "*Make cities and human settlements inclusive, safe, resilient and sustainable*". In this framework, accessibility is considered in terms of inclusiveness, emphasising the need to modify the built environment in which we live so that it can allow all people to benefit from the available resources, both tangible and intangible, to express and fulfill their aspirations, and to use the services and functions that characterise contemporary life. This goal, applied to historical contexts of considerable historic-artistic value, can be achieved by activating a complex process based, on the one hand, on the needs of people, and on the other on the safeguarding and preservation of the built heritage [2]. This takes on a distinct character in places of cultural interest, and necessarily requires the establishment of a synergy between different competences and the use, increasingly essential, of technologies, and in particular of *Information and Communication Technologies* (ICTs).

2. The NEAR Project

The project entitled "NEAR – Inclusione all'*Opera*" contemplates the drafting and development of the Accessibility Plan (A.P.) for the monumental complex of the Opera di Santa Maria del Fiore (O.S.M.d.F.), in other words the determination of an operative tool aimed at identifying and classifying access issues (architectural barriers and lacking services) that limit and hinder the usage of the spaces open to visits and worship, and to either solve them or mitigate them through a coordinated set of interventions organised in accordance to a precise order of priority. The general goal of the *Accessibility Plan* does not regard exclusively the overcoming of existing architectural barriers and the adaptation of spaces to current regulatory requirements, but also aims to attune accessibility-related needs (to spaces and cultural content) to those concerning the safeguarding of the cultural heritage, so as to promote a culture of heritage protection and social inclusion. The ultimate goal of the drafting of the A.P. is to improve the

experience of the visit for all categories of users through interventions that promote access to culture while also preserving the historical and cultural value of the spaces and artifacts on which it intervenes.

The development of the A.P. is not, therefore, the definitive solution to all the problems concerning accessibility, yet it does represent a *plausible alternative* for allowing the inestimable heritage safeguarded by the Opera di Santa Maria del Fiore to become accessible to the widest possible public. Although it is inevitable that some accessibility issues will remain, both of a subjective and an objective nature, the reliance on the *architectural project* and the support from the most sophisticated immersive and virtual simulation technologies will ensure a greater degree of accessibility also to those places that are currently completely inaccessible to disabled and more fragile users. It is from these considerations that the procedural nature of the A.P. derives, which means that it is not constituted as a definite and finished product, but rather configured as a *tension* towards a goal to be achieved in time, aimed at ensuring, through adequate managerial and/or architectural solutions, better conditions concerning:

- The recognisability, reachability and accessibility of places;
- The enjoyment and understanding of cultural contents (the symbolic meaning and value of works of art and architecture) safeguarded at Santa Maria del Fiore.

Considering the monumental nature of the context of intervention, as well as the fact that the pressing preservation requirements impose strong restrictions to any possibility of modifying the existing state of places, the attempt by the A.P. of the Opera of S.M.d.F. consists precisely in determining those interventions which, while slightly modifying the appearance of the buildings and spaces, respect their worth and avoid any loss of value.

2.1. The main methodological aspects adopted

One of the challenges presented by the drafting of the A.P. of the monumental complex of Santa Maria del Fiore concerned the boundary delimitation of the context of intervention and the classification of the various spaces which compose the monumental complex. The field of application of the A.P. is in fact both articulated and complex since, being located at the heart of the historic city of Florence, it involves spaces and buildings which have been stratified in time, with functions, features, spaces and cultural values that are very different from each other. The first action undertaken thus concerned the determination of a *general unified map*, Figure 1, of the spaces and buildings involved in the A.P. The area under analysis is made up of a portion, albeit limited, of the historic city, namely the two squares, Piazza di San Giovanni and Piazza del Duomo (with their relative access routes); the three main elements of the monumental complex, in other words, the Cathedral of Santa Maria del Fiore, Giotto's Bell Tower and the Baptistery of San Giovanni; as well as the other spaces owned by the *Opera*, which overlook the squares or are in the immediate vicinity of them, and serve the operation of the entire monumental complex.

The complexity, articulation and diversity of the spaces involved in the A.P., have imposed the necessity to identify different strategies of intervention in accordance to their type and function. The choice of including public spaces in the Plan (squares and access paths) responds to the wish to satisfy, at least partially, the requirement of multi-scalarity, which the theme of accessibility to the architectural heritage demands [1]. By including public spaces and their access routes in the analysis, an attempt was made to reduce the degree of incompleteness resulting from the limited context of intervention

and the impossibility (in terms of resources and time) of considering a larger section of the city, such as the entire UNESCO centre. The survey phase highlighted the numerous access issues involving the buildings of the monumental complex, as well as the public space that surrounds them, and therefore also the need to identify a tool for organising and planning the necessary adaptation interventions within such a valuable context. It was therefore decided to ascribe a higher priority to organisational/managerial interventions (that do not intervene on the material structures of the buildings) and, only in the case in which these types of interventions are not sufficient or feasible, to devise adequate architectural solutions which, although modifying the context, do so in full respect of both its value and quality.

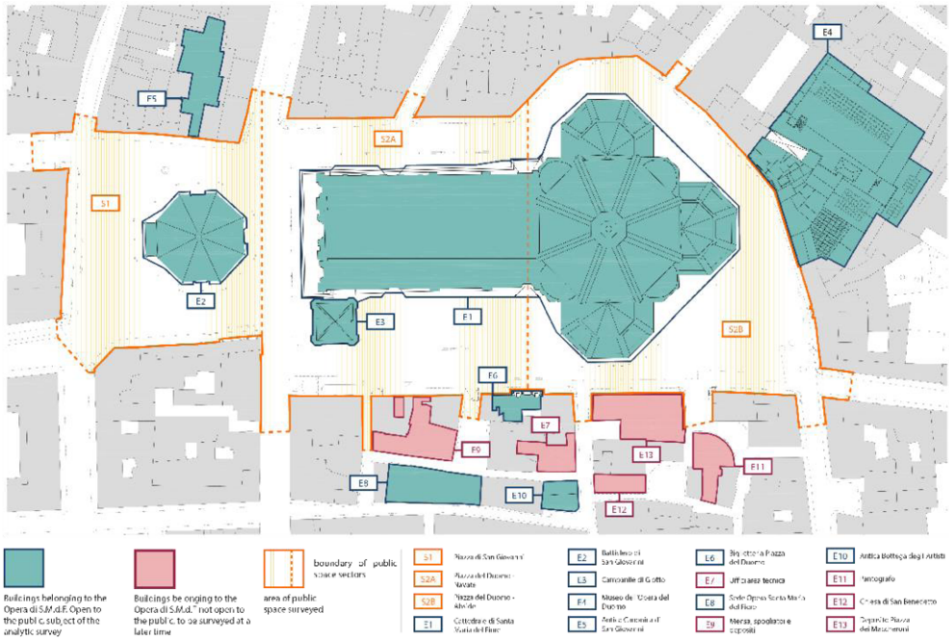

Figure 1. *General unified map* of the open-air spaces and of the buildings analysed.

Since the monumental complex of Santa Maria del Fiore presents elements with inherent inaccessibility issues, such as the Brunelleschi Dome or Giotto's Bell Tower, for example, and the use of mechanical solutions to ensure physical accessibility to these places is difficult and in many cases impossible, there are numerous solutions contemplated by the Action Plan that make use of *Information and Communication Technologies* (ICTs) in order to offer an alternative experience and the possibility, for everyone, to access content, information and data that are currently inaccessible [3]. Finally, since the possibility of enhancing the accessibility of a place is connected to its inherent features and its architectural essence, it was considered useful to assess, for every building and space analysed, the *carrying capacity*, in other words the threshold beyond which the intervention contemplated irretrievably alters the structure's essential features, as well as the *points of minor resistance*, that is the parts or areas of the asset that are better suited for accommodating the devices aimed at increasing the general degree of accessibility. The process of collecting this information is intended to promote the development of sensitive projects that are able to harmonise, from a functional, aesthetic and symbolic point of view, the needs of accessibility with the countless

objectives that the architectural project must achieve [4]. The acquisition of this information, as well as of the accessibility issues detected, will allow architects and designers to devise sensitive projects which are appropriate to the context of intervention, while avoiding the use of pre-packaged and standardised solutions, which usually tend to convey an idea of neglect and of lack of interest in the accessibility of places.

2.2. The main methodological aspects adopted

The NEAR project is divided into three subsequent phases:

- *Knowledge Phase* – construction of an exhaustive cognitive framework regarding the context of the intervention (analysis of the places, services and stakeholders' needs, and of the issues concerning access to the monumental complex through the application of dialogue tools and on field analysis;
- *Planning Phase* – determining a schedule for the adaptation interventions and their sequence, in accordance with clearly defined priority criteria;
- *Design Phase* – definition of a set of suggestions useful for determining suitable solutions to the accessibility-related issues detected, with the purpose of developing a guidance tool for the gradual increase of the degree of accessibility.

The core of the first phase, in addition to the application of the dialogue tools, consisted in the analytic survey of access issues, such as the identification and classification of both the existing architectural barriers and the missing quality indicators. The twofold interpretative key with which the places under scrutiny were analysed derives from the nature of the A.P. itself, in other words from the consideration that the improvement of the degree of accessibility of a place is not to be achieved only through the removal or elimination of what are commonly known as architectural barriers, but also through the installation of those services and equipment that are lacking and which contribute to making the said places welcoming and safe for differently abled people [4]. It is worth underlining how the survey of access issues represents a very delicate phase of the Plan, since it has a direct influence on the subsequent phases. In fact, both the determination of the *List of adaptation interventions* and the chronological order in which it is proposed to carry out the said interventions, are based on the information gathered during the survey, whose accuracy and precision are therefore crucial for the Plan to meet its objectives.

The accuracy of the survey is closely related to the quality of the available maps. For this reason, we proceeded to construct an updated cartography including all those elements necessary to determine the level of accessibility[2] and only then did we begin the phase involving the identification of architectural barriers and of quality indicators, based on specific functional categories [4]. In order to facilitate the visualisation of the architectural barriers and quality indicators, labels with an alphanumeric code were placed on the various plans of the surveyed spaces, Figure 2. Each label unambiguously identifies a barrier or a quality indicator and refers both to the *descriptive card* and to the corresponding *adaptation intervention* contemplated for the overcoming of the issue identified by the label. The system of alphanumeric codes and colours, facilitates the

2 Available maps often do not include the necessary information for assessing the various degrees of accessibility, such as, for example: the indication of the connections between streets and footpaths, the location and size of rubbish bins, storm drains, manholes, poles, and bollards, etc.

management, control and updating of the state of accessibility of the places covered by the Accessibility Plan, thus allowing an easy reading of the current condition.

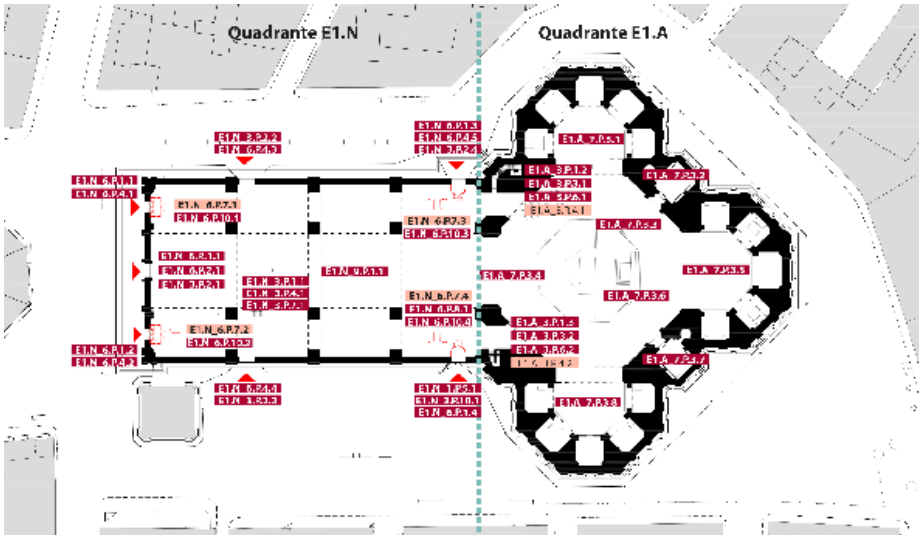

Figure 2. Identification of the existing architectural barriers in the Cathedral of S. Maria del Fiore.

Only after the survey was completed and the general cognitive framework was established did the Planning Phase, which is the fulcrum of the entire A.P., begin. During this phase all the *Complete lists of adaptation interventions* were established for every building and space included in the A.P., further divided into managerial and architectural interventions. All the interventions were described in their most essential and significant features, so as to better address the subsequent Design Phase. It is evident that the adequacy and feasibility of the interventions described directly determines the quality of the A.P., as well as its effectiveness. Given that the design of the adaptation interventions will take place after the planning phase, the most complex aspect in the programming of the NEAR project concerned the determination of the *Priority lists for the interventions*, in other words, the organisation of the interventions according to a priority scale based on a multi-criteria assessment established in agreement with the entity that manages the monumental complex. This assessment was based on an estimate regarding the *urgency* of every intervention to be implemented (solving safety issues, for example) and the *impact* that the implementation of every intervention could have on the community. Thanks to this scale of values and to the use of an *impact/urgency matrix*, it was possible to determine a precise order of implementation of the interventions that is consistent with the context and the available resources. The use of the matrix makes it possible to rapidly order the various interventions and to graphically display the order using a concise and compact form.

Finally, once the planning and scheduling of the interventions had been established, the first step in the Design Phase was to collect in a brief document the design suggestions proposed, in order to help identify the most appropriate solutions to the various existing issues. These suggestions are collected in a *guidance tool* and organised on the basis of 8 *problem areas*, in other words of 8 themes which have highly marked typical characteristics and can therefore be outlined through elements of a general nature. The purpose of the design suggestions is to provide support to the work of the architect

or designer in the search for solutions that are coherent with the context and with its aesthetic and architectural features, as well as in adopting the design approach (mimetic approach, prosthetic approach, etc.) that is more appropriate for every specific case.

2.3. Results

The results of the research are collected in 11 correlated documents, which together constitute the *Accessibility Plan for the Monumental Complex of the Opera di Santa Maria del Fiore*. The documents can be divided into two categories: *methodological documents*, which contain the data collected during the Knowledge Phase, including the description of the activities carried out, as well as of the methods and tools used to complete them; and *operative documents,* produced during the Planning and Design Phase, which contain the results of the various activities, including a detailed analysis of the current conditions, the framework of needs, maps of critical environmental issues, and a schedule and order of the interventions and design suggestions. In brief, the results of the NEAR project can be summarised as follows:

- identification, classification and description of approximately 400 access issues;
- construction of a website that can be consulted and updated which contains all the *descriptive cards* regarding the access issues detected;
- identification of 5 strategic interventions aimed at improving the management of visitor flows and the general experience of the visit, and description of more than 100 interventions to be implemented in the buildings belonging to the *Opera* and in public spaces of the Municipality of Florence;
- drafting of 16 intervention Priority Lists, organised in accordance with a multi-criteria assessment;
- development of a *guidance tool* which contains the suggestions for a thorough planning of the adaptation interventions identified;
- identification of *concurrent alternatives*, in other words of different design solutions aimed at achieving the same objectives in alternative ways.

Independently of the results listed above, a broader assessment of the results achieved by the NEAR project is necessary in order to highlight the more general, and therefore replicable, aspects of the A.P. for the Opera di S.M.d.F. Although the A.P. is in fact configured as a tool for implementing a strategy to gradually improve the degree of accessibility of the places on which it intervenes, it also constitutes an important resource for harmonising, within a single operational tool, the entire process of management and preservation of the architectural heritage. In this sense, the A.P. must be understood as an element in a wider Management Plan for the monumental complex, in which all the activities necessary to keep it functioning (be it restoration interventions, extraordinary and ordinary maintenance; activities linked to safety, improvement of accessibility, etc.) are coordinated and included in an overall design. Since the management of an architectural heritage such as the one belonging to the Opera of S.M.d.F. necessarily involves the planning of numerous interventions aimed at the restoration and preservation of monuments, the existence a tool for planning interventions for improving accessibility would allow to coordinate the various different activities necessary for the overall management, and therefore produce positive effects in terms of the following: optimisation of available resources, reduction of the negative

impact of the works necessary for carrying out interventions on monuments, and reduction of the time necessary to achieve adequate levels of improvement.

3. Conclusions

The research work carried out represents a useful assessment of the methodological and conceptual elaborations of the A.P. The application of the principles that inspired the A.P. for the monumental context of the Opera di SMdF, in addition to initiating the implementation of interventions aimed at increasing the accessibility to the complex's spaces and cultural contents, represents one of the first, if not the first, instance of effective "testing" of the methodology of the A.P. as applied to a specific cultural heritage site. The inherent differences that exist between a municipal territory (object of the application of the original A.P.) and a site of cultural interest such as the Opera di S.M.d.F., which has numerous protection restrictions (landscape, monumental, archaeological, etc.), determines the need to adapt the original methodologies and tools to the characteristics of the context of reference. If, for example, we consider that the A.P. of a municipality can contemplate the relocation of a regional office (such as a registry office, for example) from a place that is difficult to access to one that is more easily accessible, simply by identifying a suitable space for that purpose, it is easy to understand how this method cannot be applied to a monumental complex, which is such because it is located in that very place with those specific characteristics. In the same way, if we consider the general *carrying capacity* of the system, in other words its ability to bear interventions without suffering a loss of value, it is easy to understand as well how the carrying capacity available to a municipal A.P. is much greater than that which is available in a context such as that of Santa Maria del Fiore. These and other elements could lead to unexpected results, and although there is still much research and investigation work to be done in order to develop a tool that is up to the standards of the heritage of which we are the custodians, the good results achieved and the experience acquired, in terms both of the obstacles to overcome and of the strategies to be applied regarding the context under analysis, make it possible to envisage the replicability of the experience undertaken at the Opera di Santa Maria del Fiore in many other contexts of cultural interest, increasing the research, studies and projects aimed at preserving the heritage from the past and encouraging its use and enjoyment, remembering that, in the words of Georg Gadamer, "Culture is the only asset of humanity that, when divided between us all, becomes greater rather than smaller".

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Values-Based Conservation in Practice Accessibility at Akershus Castle

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Abstract. Akershus Castle is one of Norway's most important historical monuments and is listed with the highest grade of protection. The earlier medieval castle from around the year 1300 is an arena for the Norwegian state and in use for such as government dinners and receptions. The castle is also an important tourist destination and is used for public events like concerts, etc. Until today, people in wheelchair have had to be carried into the buildings due to stairs and differences in levels inside. In the autumn of 2021 five measures that make large parts of the castle accessible, were completed. Making public buildings accessible has high priority in Norway. Having achieved this at Akershus Castle is of great symbolic value. During the process of defining the projects extent and measures the method *values-based conservation* was applied. This was done through involving several stakeholders in assessing and quantifying an array of values and criteria. On this basis it was possible to define the project, achieve the permits from the heritage authorities and get acceptance from the organisations representing people with disabilities. The result has been very well received by the public, stakeholders and by the cultural heritage authorities.

Keywords. Accessibility, Cultural Heritage, Equality

Introduction

Akershus Castle and Fortress is located at the seaward approach to Norway's capital, Oslo (Figure 1), and is one of the country's most important historical monuments. The fortress has been in continuous use for more than 700 years and is defined as a national monument. Today, the Norwegian government uses Akershus Castle for, among other things, government dinners and state visits. It is also a tourist destination receiving about 55,000 visitors a year. The castle also houses the Norwegian royal family's burial chamber. In the castle church, which is the Norwegian Armed Forces main church, services, baptisms, weddings, and concerts are held on a regular basis.

Until now, people in wheelchair have had to be carried, due to stairs and differences in level. It has not been a worthy solution. Ever since the turn of the millennium, various solutions have been studied to improve the situation. In the autumn of 2021 building works with five improvements were completed, giving improved accessibility to the most important parts of the castle (Figure 2).

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Figure 1. Akershus Castle and Fortress. (Photo: Erik Selmer/The Norwegian Defense Estates Agency)

1. Akershus Castle and Fortress

Akershus Castle and Fortress was erected as a medieval royal castle around the year 1300. In the 17th century, the castle was rebuilt into a Renaissance castle surrounded by bastions. After only a few decades, the castle began to decay, and was later used as military storage and archives. When Norway became an independent kingdom in 1905, the idea arose that Akershus Castle could become a symbol for the nation, and an extensive restoration was initiated to make the castle a place of representation for the Government. One of the most famous Norwegian restoration architects of the time, Arnstein Arneberg, was assigned to lead the work in the 1930s. Arneberg left his clear architectural signature on both the restored parts, and in his own interpretations when rebuilding parts that had been demolished throughout history.

2. Accessibility to a castle listed with the highest grade of protection

Akershus Castle is listed with the highest grade of protection. In Norway, all permanent cultural monuments dated before the Reformation in 1537, such as buildings, are automatically listed due to age value. It is not permitted to alter, move, excavate, cover, or conceal an automatically listed cultural monument without permission by The Directorate for Cultural Heritage. At Akershus Castle, the protection applies to the castle's exterior, interior, and courtyard as well as a protection zone around the castle. The extensive restoration of the 20th century is also defined as cultural heritage in the listing. All interventions required a dispensation by The Directorate for Cultural Heritage, and groundwork had to be supervised by an archaeologist.

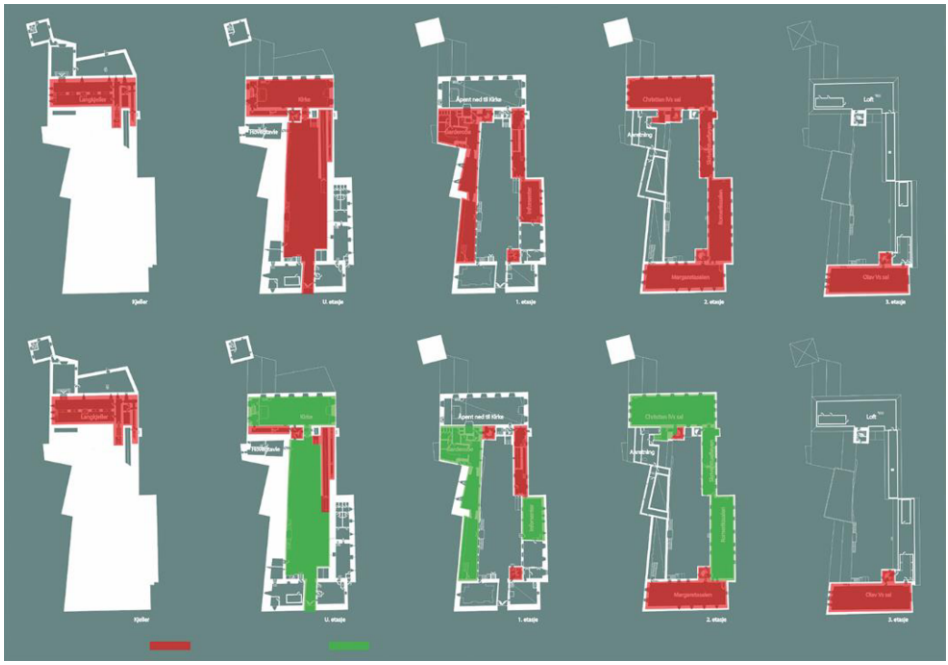

Figure 2. Areas that were inaccessible before measures shown with red hatches. Areas that became accessible after measures shown with green hatches. (Illustration: Arkitektskap AS)

3. Universal design (UD) vs. accessibility

In universal design (UD) the aim is that a main entrance and main functions should be accessible by everyone in an equal manner, and that no alternative entrance or special solutions should be necessary, such as wheelchair ramps and stair lifts. The project at Akershus Castle chose the working title "Improved Accessibility" because it was considered impossible to achieve a complete universal design in an historical environment as this, with the limitations the building and the Act concerning the cultural heritage presented. The distinction between the concepts of accessibility and universal design was an important clarification of expectations at the beginning of the project. Nevertheless, it was throughout the process an ambition that the measures chosen should be as close to universal design as possible. It was also emphasised that visitors should be able to move about without the need of assistance. Equality and dignity were therefore two of several value criteria that were listed at the beginning of the project and were given major importance.

At Akershus Castle the symbolic value in that all guests can use the same entrance and pass through the same doors is very strong, because the governmental ceremonies are linked directly to the core values of democracy. The Directorate for Cultural Heritage therefore allowed major alterations, to enable the main entrances and official rituals to be accessible to all guests attending official dinners and receptions.

4. User participation

Pursuing UD in listed buildings and cultural environments lies in an intersection between the consideration that everyone should be able to participate in society in an equal manner and the protection of cultural environmental values. When a cultural monument such as Akershus Castle is to be made accessible, there are two different special acts that are important: Equality and Anti-Discrimination Act and Act concerning the cultural heritage. The Equality and Anti-Discrimination Act allows exemptions if the consequences of measures may entail a disproportionate burden, which includes protection of cultural heritage values. The cultural heritage authorities have an ambition to make cultural monuments and sites as accessible as possible, but without significant architectural or cultural-historical values being lost. Good measures that enable cultural monuments and environments to be experienced by more people, also add extra value to the cultural monuments.

In the project at Akershus Castle, it was important to involve a wide range of stakeholders to achieve the best possible solutions, that all parties could accept. This included among others disability organizations, organizations within the cultural heritage field with a commitment to the castle, authorities etc. The involvement of the disability organizations was particularly important to safeguard the quality of the measures where requirements or guidelines in the legislation could not be achieved.

Figure 3. L.h.s: One of the halls before intervention. R.h.s.: A lifting platform is integrated in the floor. (Photo 1: Oslo Byggentreprenør AS; 2: A.M. Malkenes Mathiesen/The Norwegian Defense Estates Agency)

5. Method

In the process, principles from the value-based conservation method were used [1]. The purpose of the method is to be able to compile and weight different criteria through a participation process, in order to make objective choices to the highest possible extent. The process started with identifying all stakeholders who were affected, and then mapping what was important for each stakeholder. A feasibility study was then conducted, in which owners, staff and user of the castle, as well as the organizations mentioned above, were invited to participate. The study ended up with a total of 28 different measures for solving stepless access to different areas of the castle, as well as

improvements for people with visual impairments. The next step was to make the values measurable. The list of values and criteria, which included both concrete values, some of which are easily measurable, and intangible values, which are more subjective, were: functionality; ease of use and capacity; dignity; equality; extent of visual changes; extent of irreversible measures; impact on fire safety and evacuation; durability, operation, and maintenance; cost and risk.

5.1. Functionality

It was a goal that all solutions should be intuitive in use, and that they should facilitate orientation, so that visitors should feel safe. Few of the guests invited to the formal events know the castle well, and many will be a little nervous and excited when they arrive at a government dinner. In such a situation, it becomes especially important to avoid situations that can feel unpleasant or stigmatizing, and thus impair the experience of the visit.

It was also important that all guests, regardless of functional level, should follow the same route and be able to participate on equal terms during formal events, such as dinners and receptions as well as ceremonies in the church. It was a goal that there would be no need for special assistance to be able to use the installations. Another important aspect was that the technical installations or interventions chosen should not appear unappealing or have a negative impact on the castle's architectural qualities and interiors, nor be perceived as stigmatizing for those who must use the specific installations. It was therefore crucial that all interventions were to be executed with the highest quality in design, materials, and craftsmanship (Figure 3 and 4).

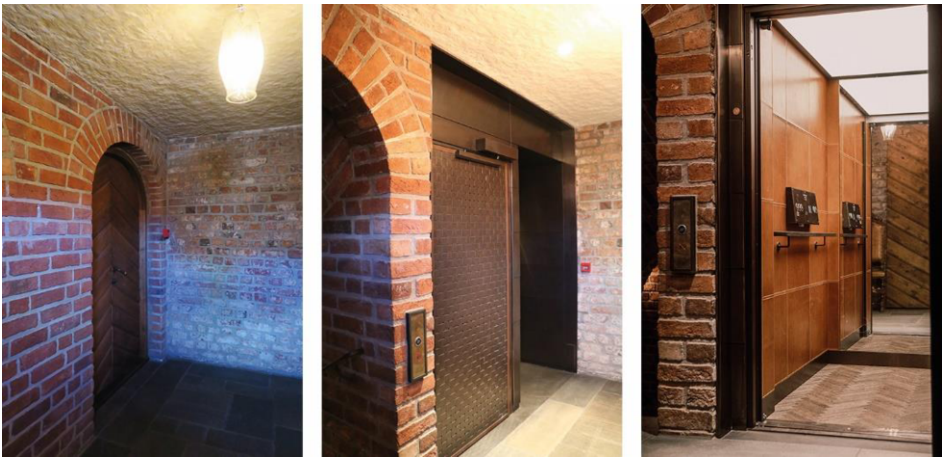

Figure 4. L.h.s.: The hall in the second floor before intervention. In the middle: An elevator has been fitted inside. R.h.s: Elevator interior. (Photo 1 and 2: Marianne Brenna; 3: Anne-Margrethe Malkenes Mathiesen/The Norwegian Defense Estates Agency)

5.2. Heritage values

Values associated with cultural monuments are not static but will always be influenced by contemporary views and by context. Taking on a project of this complexity today, the approach and theory applied differ from those that were the dominant ones in the 1930s, when the last major change at Akershus Castle took place. In the feasibility study, therefore, the castle's cultural-historical values were analysed and assessed again, in the light of today's understanding of the castle, its history, symbolic values and cultural heritage values in general.

In the feasibility study, two specific criteria were applied to assess the impact on the castle's cultural-historical values: the extent of irreversible interventions and the extent of visual changes. Irreversible interventions, look at the consequences of having to demolish and make interventions in existing structures – emphasizing the importance of avoiding interventions in masonry and structures from the Middle Ages, as far as possible. Visual changes, look at how changes and additions would affect the castle's architectural and historical values and could potentially impair the overall appearance, as well as aesthetic qualities, documentation value, historical timelines, experience value etc. Today's need for new functions should not be hidden, but instead carried out with such high quality that they add new values to the castle.

5.3. Technical conditions

When choosing technical solutions and materials, special emphasis was placed on durability and the possibility of being able to easily carry out maintenance and obtain new parts for replacements. This applied both during implementation and after completion. It was also important that future repairs can be carried out without the needing structural interventions. It was essential that the solutions chosen would not require much supervision to be operational. It was also an absolute requirement that the interventions should not imply restrictions on escape capacity and thus affect fire safety.

Figure 5. L.h.s.: The courtyard before intervention. R.h.s.: An elevator tower has been established in connection with the new stair. (Photo 1: Arkitektskap AS; 2: M. Brenna)

6. Accessibility vs. cultural heritage

The five main measures which have been completed are two elevators, two lifting platforms and one ramp. In addition, modification of several doors and various improvements for people with visual impairments have been carried out. Throughout the project, assessments have been made to balance the consideration between the UD and the cultural heritage protection.

Making then main entrance accessible is an example. The monumental and symmetrical limestone stair in the courtyard had to be dismantled entirely (Figure 5). The new stair was erected in an asymmetrical shape with a horizontal part connecting the elevator. The new stair had to be wider, and the landing higher than the original. All the old limestones in the front and railing where reused and adapted to fit the new shape. Due to the new hight an additional iron railing had to be mounted.

One of the most important alterations, however, was erecting the new tower, containing the elevator, in the courtyard. This represents a major change from a heritage perspective and the courtyard´s appearance (Figure 5). Thus, it was imperative to find the right balance making the elevator functional, easily visible, and as prominent as the main entrance – and making the addition blend into the historical environment. The result combines use of traditional materials such as limestone, bricks, and iron, but with a contemporary interpretation. The new tower is placed on the footprint of the first medieval tower at Akershus, but it has a clear contemporary character, and represents an addition to the castles long history of alterations.

The church entrance is an example where the limitations in the existing castle and heritage values limited the possibility for accessibility interventions. In spite of expanding the entrance hall, there was not enough room for an elevator and a stair (Figure 6). The result was fitting a lifting platform integrated in the stair (Figure 7). To obtain the overall architectural quality, the platform is covered in the same marble as the stair, making it almost invisible, when not in use. When it is in use the stair is not blocked for others, so the entrance complies fully with the aim to accomplish equality and dignity

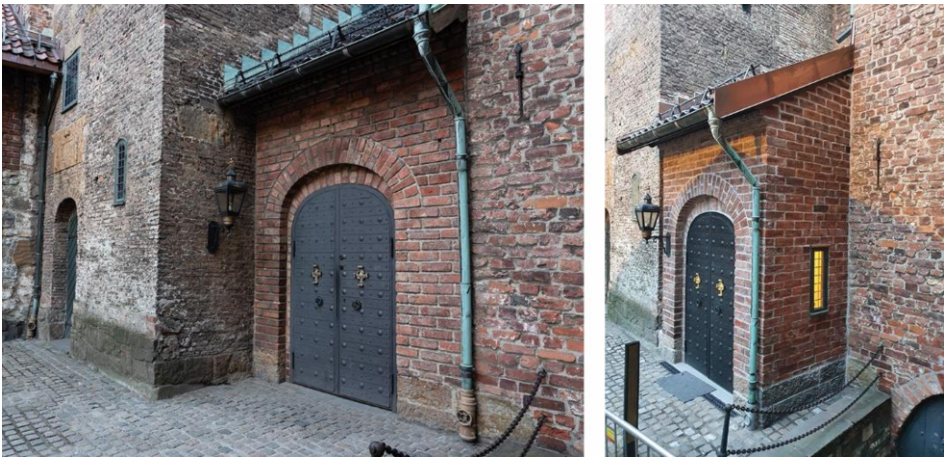

Figure 6. L.h.s.: The church's entrance hall before intervention. R.h.s.: The church's entrance hall after intervention. (Photo: Oslo Byggentreprenør AS)

Figure 7. A lifting platform is integrated in the stair in the church's entrance hall. (Photo: Anne-Margrethe Malkenes Mathiesen/The Norwegian Defense Estates Agency)

7. Summary

Based on the overall assessment, five interventions were selected for execution. Furthermore, the process also defined the premises for how the new elements were to be integrated and appear in the listed castle.

The results of the feasibility study and the documentation from the participation process, were used to a full extent in the application process towards the different authorities involved.

The process clarified the complexity of improving accessibility in such a special cultural monument as Akershus Castle, and at the same time, giving everyone involved an insight and a greater understanding of the needs and special interests of other stakeholders. For everyone involved, there was a significant learning factor in participating in the process. There was also an acknowledgment that all interests cannot be fulfilled in a monument as important and complex as Akershus Castle.

The result has received very positive response from stakeholders and the public, and the accessibility measures at the castle have been included in the Directorate's collection of examples of successful improvements in listed buildings [2].

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Usability of Visiting Routes in Heritage: The Case Study of Mercati di Traiano

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Abstract. Large museums as services to the community, can be considered strategic facilities needing exploitation after the health emergency. Through optimising usability, some methodologies and tools taken from other building uses (hospitals, airports) for analysing users and flows seem effective in testing new spaces' uses. The case study of Mercati Traianei–Museo dei Fori Imperiali was investigated in two different periods and methods for comparing the impacting factors on usability and orientation of visiting routes. A direct analysis in 2015 detected crucial issues for walking through museum routes and connections, while a more recent indirect analysis went deeper through configurational methodologies included in the Spatial Decision Support System (SDSS). This methodology empowers analysis of the space syntax, and the factors affecting the visitors' satisfaction. The two methods were found to be effective for a deeper knowledge of the museum and its priorities. Tools of direct on-site observation are essential to promptly identify obstacles for upgrading usability. Instead, the configurational analysis allows a much faster application and supports a more global and dynamic vision of more inclusive visiting routes, avoiding visitors' stigmatisation.

Keywords. Large museum, Wayfinding, Spatial Decision Support System (SDSS), Configurational Analysis

1. The relaunch of heritage and the tools to support the revitalization project

Culture and tourism were among the sectors severely hit during the pandemic restrictions. In Italy, as well as in the rest of the world, over 90% of museum complexes and heritage sites faced a lockdown, that stopped the growing trend of visitors recorded in the pre-pandemic [1]. This figure, compared to 2019, dropped down to 72%, with a dramatic impact on the cultural sector, which rates over 5% of European GDP and it is a key of national identity and a business driver. Acknowledging heritage as a key strategy value for providing services to the community [2], the relaunch challenge of NGEU (PNRR Mission 1-Culture and Tourism) pis a recovery driver, also by highlighting innovative use methods as already tested to face the crisis (virtual access and interaction with culture in a digital environment, etc.). Along with strengthening 'intangible' formats of enjoyability to increase the audience engagement, the cultural institutions' strategy is also striving for an inclusion policy implementing physical access to heritage by removing architectural, physical, cognitive and sensorial obstacles to cultural experiences. This includes the largest extent of visitors, also by optimising routes and increasing the overall quality of the visiting experience, and it focuses on tools and

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methods for monitoring, analysing and evaluating design solutions as drivers to decision-making process.

According to the ICF model by WHO [3], physical space is a key factor for empowering, facilitating, or hindering the performances of human tasks and activities, which in this case also include the enjoyability of heritage. Thus, ICF must be adaptive to different functioning models that suit multi-faceted human needs.

Access to culture, also through the qualitative use of different heritage pieces, is then identified as an instrument for ensuring human rights and equal opportunities [4].

To focus on environmental communication as a driver for inclusion, the survey is carried on with other indirect analyses able to objectify characteristics of configuration and mutual visibility in different building spaces. This can produce project inputs of remodelling solutions for the optimization of usability, use methods and times of visitor's flows. These indirect surveys are defined as configurational analysis [5] and refer to Space Syntax-based methodologies [6]. They can empower, through specific SDSS, observation of factors impacting on spaces' usability and flows, which affect visitors' satisfaction [7].

This paper shows the potential of indirect detection tools such as the configurational analysis belonging to the SDSS, already tested in large museums such as the British Museum in London [8] and integrated to direct analysis in a previous study on the large archaeological museum of Mercati di Traiano-Museo dei Fori Imperiali in Rome [9]. This emphasised, together with the overall accessibility items directly observed, proximity spaces relations, circulation hierarchy, routes differentiation, legibility of accesses, ways of using spaces.

2. The case study of Mercati di Traiano-Museo dei Fori Imperiali

To check the integrability of direct type analysis with the study of Space Syntax, we selected the large archaeological museum of Mercati di Traiano-Museo dei Fori Imperiali as a case study. It is in a strategic core location of the Roman Forum, next to the Colosseum and the Capitoline Museums. It is a typical case of layout complexity, due to different altimetric features. This museum was relaunched in 2007 and belongs to the Civic Museums of Roma Capitale (Musei in Comune). It consists of three different levels for visiting the outdoor archaeological area of the Great Hemicycle (Figure 1, "levels 0, 1, 2") and the Great Hall with the main entrance accessible from Via IV Novembre (Figure 1, "level 3"). The upper level (Figure 1, "level 4") of the Great Hall houses permanent and temporary exhibitions. The last level (Figure 1, "level 5") houses administrative offices.

2.1. Direct analysis: detecting critical issues for accessibility

The direct analysis was carried out starting from a cooperation program on the evaluation of accessibility and usability in the built environment ("Avaliação de Acessibilidade e Usabilidade no Ambiente Construído") between the Federal University of Rio de Janeiro (UFRJ PROARQ / Núcleo Pró-acesso) and CNR (2013-2015). This project examined and compared the regulatory and application context of accessibility in Brazil and Italy for the development of an evaluation tool that could merge requirements, guidelines and recommendations of the two countries in order to obtain a homogeneous evaluation method for two different contexts.

Figure 1. Layout of functional areas and visiting routes of Mercati di Traiano-Museo dei Fori Imperiali

The evaluation format included 8 macro-areas of the built environment, applicable to most public buildings: **A**-Outdoor access area to the building; **B**-Entrance/Access; **C**-Reception (information desk, ticket office, cloakroom); **D**-Circulation (corridors, footbridges, walkways); **E**-Vertical circulation (ramps, staircases, elevators, lifting systems); **F**-Specific areas/rooms (depending on building type); **G**-Information, signage and orientation.

By merging requirements from the accessibility codes of the two countries (highlighting the most favourable or innovative measures in case of requirement conflict), a questionnaire of about 180 questions was developed for reporting the state of accessibility/usability of the items within groups A to G, according to a tree structure with "yes/no" questions going deeper to further questions.

This tool applied to two case studies of large museums: the Imperial Museum of Petropolis (Brazil) and the Mercati di Traiano-Museo dei Fori Imperiali in Rome.

For the Italian case study we mapped blue circles of crucial points and passages in the four floor plans (levels from 2 to 5), associated with photos and a commentary - classified from A to G according to the macro-area, also in reference to orientation and wayfinding [10]. We report question G.2 (section G *"Information, signage and orientation area"* of the questionnaire) on accessible maps and G.2.1 on proper use (Figure 2a). Two G.2.1 points are reported in a commentary with suggested solutions for signage and reference photos (Figures 2b and 2c). We finally illustrate (Figure 3) the inspection routes, the observation points, and the photos of the critical issues discussed in the following sections.

G.2 Is there an accessible map? **Brazilian reference: NBR 9050:15** 5.4.2 Accessible surfaces and maps. 5.4.2.1 Accessible surfaces and maps are visual, tactile and/or sound representations that serve to guide and identify spaces, routes, geographic, cartographic and spatial phenomena. 5.5 Emergency signage 5.5.1 General conditions 5.5.1.3 Staircases connecting different floors, including emergency areas, next to the fire doors, must have tactile, visual and/or audible signage, informing the floor number. The same information must be signaled on the handrails, as per 5.4.3. Indoor, separate rooms, such as in hotels, hospitals and public and private institutions for multiple or collective use, must contain an accessible map of the building's escape route, according to 5.4.2.	Yes	G.2.1 Does the accessible map have location, sizes and characteristics that allow approach and proper use? **Brazilian reference: NBR 9050:15** 5.4.2 Accessible surfaces and maps. 5.4.2.1 Accessible surfaces and maps are visual, tactile and/or sound representations that serve to guide and identify spaces, routes, geographic, cartographic and spatial phenomena. 5.4.2.2 The information applied must comply with the provisions of Table 1. 5.4.2.3 These surfaces and maps must be built so to allows access, visual and manual reach, in compliance with Section 4 (Anthropometric Parameters) and 5.4.1-a). 5.4 Essential applications 5.4.1 Signage of doors and passages Doors and passages must have visual information, associated with tactile or audible signalling, as shown in Table 1. They must be signaled with numbers and/or letters and/or pictograms and have signs with raised text, including Braille. This signalling must consider the following aspects: a) the signage must be in a vertical range between 1.20 m. and 1.60 m., as shown in Figure 59. When installed between 0.90 m and 1.20 m, it must be on the wall next to the handle with inclination between 15° and 30° from the horizontal line and comply with the description in 5.4.6.5, when exceeding 0.10 m.	Yes		No X (Skip to item G.3)
		G.2.2 Is there signage in relation to an accessible map?	Yes	Visual Audible Tactile: Braille / Alarm / Directional All	No	
G.3 Are there easily identifiable natural or artificial guides for people with visual impairments?	Yes √	G.3.1 Are the guides located in a logical sequence so to be easily identifiable by people with visual impairments?	Yes		No X	No (skip to item G.4)
G.4 Are there visual devices and aids for people with hearing difficulties?	Yes					No X

Figure 2. a) Question G.3 from the questionnaire in section G (Information, signage and orientation); b) Point PC120024: clearer horizontal sign with bigger legend needed ; c) Point PC090009: more legible text with bigger fonts and legend needed.

Figure 3. Graphic representation of the synthesis of the direct investigation

This survey highlights solutions to improve the accessibility situation as from 2015, after a previous remodelling with three accessible visiting routes. To better understand the effectiveness of solutions after the on-site survey and to identify further issues in the specific area of environmental communication, the application of configurational analysis was tested on the same spaces.

2.2. Indirect analysis: the survey on spatial configuration

Based on previous findings, we carried out a set of configurational analysis to objectify the relevant space syntactic properties for the purpose of usability and wayfinding (permeability, proximity, connections, visibility). In this phase, we adopted the open-source software called depthmap 0.8.0. This application helps perform two analyses: 1) physical accessibility, by measuring connectivity and integration among different spaces; 2) visual access to different spaces, which, as shown in several studies [11] [12], considerably affects visitors' navigation and thus their visiting experience.

To carry out the first session of analysis, the first step adopts an abstract spatial building model through a graph development of spaces as nodes and lines as connections, i.e. the points of physical access among spaces. Applying the specific case-study (sequential or not), environmental links emerged to bind visitors to a specific route. Further analysis was then conducted to measure the connectivity of each space (given a 'root' space linking to a maximum number of spaces). By replicating this calculation for each space, we measured the integration (HH) level of each space in relation to the all museum (Figures 4a and 4b).

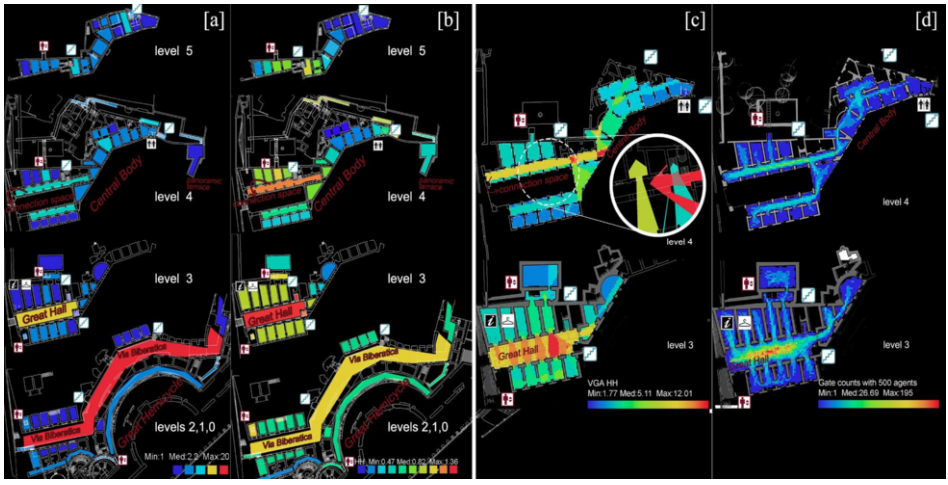

Figure 4. a) analysis of connectivity; b) analysis of the spatial integration (HH); c) analysis of visibility level; d) analysis of flows through agents.

The software rendered a qualitative visualisation of the results, marking the most connected spaces in red (and the best integrated ones by the same chromatic scale) and the most isolated spaces in blue. Based on connections number, as shown in Figure 4b, the outdoor of Via Biberatica appears the main access way to most rooms. However, it is not accessible to wheelchairs due to the irregular ancient basalt paving, as detected in the direct observation (Figure 3). Although hardly walkable with reduced mobility, Via Biberatica is still enjoyable from the upper view on level 4, thus giving an indirect visual access to the layout.

Observing Figure 4b, the best integrated space in relation to the all museum is the Great Hall, which is a key function as a reception hall, but also as "pivotal space" of access to different rooms through the least number of passages. The rooms of the Central Body at level 4 are not really connected and integrated. However, they help access the

outdoor of Giardino delle Milizie, the panoramic terrace and the outdoor route that connects to Great Hemicycle at level 1. This step is therefore essential for "closing" a loop route that would positively impact on all the visiting areas, without coming back to the start point.

For the second session of analysis on visual access, the space was discretized into a grid of points from which we calculated the visual integration, i.e. the largest number of mutually visible points (Figure 4c). Finally, a flow analysis was carried out based on 'agents' (entities that, basing on the visibility of the grid points, make decisions statistically like human behaviour) able to simulate flows inside spaces (Figure 4d).

In this case we noted that the environments with better visibility and more likely to be visited are once again the Great Hall and the connection space on the upper level. The linear sequence of some passages through the rooms of that level makes a number of visual "corridors", which suggest route guidance to visitors. These "intuitive" routes, as observed during direct survey, especially when next to the points of direction change, would need an implemented communication through a wayfinding system (signs, devices, environmental clues, etc.) able to disclose a coherent sequence of the exhibition rooms and a clear relationship between the different rooms. Moreover, this system should include an implemented reachability of the Central Body's rooms. These resulted less connected and less visible for the purpose of a circular visit route, which, while crossing the outdoors, would go back to the Great Hall entrance (Figure 4a).

3. Analysis results and routes suggestions

The two analyses were carried out in different periods and objectified some crucial issues for the full use of the museum, suggesting potential values to address solutions. To overcome the "criticality" of spatial configuration, which detected a poor connection and visibility of the rooms in the Central Body, we need to implement the overall information system through multisensory solutions and specific direction signage once you reach the second level of the Great Hall (which appears to be the second most integrated space). This is advisable due to high heritage constraints that do not allow design remodelling. Thus, to increase environmental communication, information totems should be used. Configurational analysis to identify highly visible points can facilitate strategic points for installations. To date, as observed in the direct analysis (Figure 4b), information are located in the staircase wall; however, as observed in the analysis of the "2D isovists" (i.e. the polygons formed by all the points visible from a given observation point), these would be more visible if located next to the parapet in front of the staircase, so to be visually accessible among all visitors going up/downstairs and using the lift. The final segment of the current visiting route ends with the last rooms of the Central Body, through which the visitor can walk downstairs back to the Great Hemicycle. This connection, however, could not be inclusive of visitors with reduced mobility. Therefore, installing a new lifting system in harmony with heritage constraints is advisable for inclusive use. This installation would also normalise a visit experience with no hassle for visitors with reduced mobility, who currently have to cover the route back to one of the two lifts. Generally, to implement an inclusive wayfinding system, we need to increase the environmental communication level. To allow all visitors a faster and intuitive understanding of personalised visiting routes, the strategy is information reverberation through a communicative approach able to convey information through multiple sensory channels, also through innovative sensory materials [13], reversible devices and

technical solutions with minimal impact on the museum. Based on three most common scenarios of heritage constraints for potential installations, we assume three strategies, sorted by increasing impact, as a reference for proper space transformability.

a) Spaces with valuable features.

Adopting minimal strategies, i.e. with a low-cost budget, by upgrading an existing wayfinding system or traditional signage with reversible solutions, or replacing old signage with "light" artefacts. These are cognitively more intuitive and can communicate information through multisensorial channels.

b) Spaces with more flexible options.

Strategies with no prejudice to pre-existence. This implies an overall reconfiguration of the wayfinding system by interactive devices and technologies, also including innovative materials (sensorial, nanotechnology materials, etc.).

c) Spaces with more options of design solutions.

Redesigning of the wayfinding system with a consistent layout remodelling. This comes along with the interior design, the environmental (lighting, ventilation, etc.) systems, the finishings and the multimedia (sound, optical effects, etc.).

4. Conclusions

The two applied analysis and evaluation methodologies of crucial issues for usability helped for a deeper knowledge of the museum in order to evaluate common impact factors and to identify better layout of flows and routes. This appears to be a positive approach for visitors and museum managers in implementing cultural content, reducing stress factors, promoting inclusion, hospitality and safety in the museum through an overall visitors satisfaction, as well as scheduling personalised visiting routes and optimising resources. Indirect analyses on spatial syntax study are complementary to common direct analysis tools of designers and evaluators of large museums (check-lists). To complete the evaluation of all relevant usability factors, the next development of this research would provide further effective information directly from end users through common methodologies (Post Occupancy Evaluation, user experience, etc.) that record how visitors perceive the space and its communicative features. The result of integrated observation/detection systems (direct-analog and indirect-digital) determines a valuable observational/scientific knowledge that stimulates collaborative work and dialogue among institutions, experts and stakeholders from the heritage management. This allows defining shared policies and action. The data obtained (interactive, updatable and proactive) should support decision-making and governance processes to identify alternative solutions, strategies, actions and planning of large museums.

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The Economic Impact of Universal Design on Cultural Heritage Contribution to SDGs: Evidence from Italian Museums

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Abstract. United Nations' Agenda 2030 highlights the need to "make cities and human settlements inclusive, safe, resilient and sustainable" (SDG 11) and reduce inequalities (SDG 10) for the good health and well-being (SDG 3) of the citizens. Although most Italian museums have been forced to comply with the rules for accessibility in public spaces since 1971 following Law 30/3/1971 n. 118 and, more recently, Legislative Decree 81/2008, in this context, Universal Design can contribute to the achievement of these goals by improving accessibility to spaces, services, and the community's well-being on the one hand, along with providing a deeper comprehension and awareness of the informational processes on the other hand. In this regard, museum organizations play a critical role in enhancing the quality of life and society's education by preserving and distributing cultural heritage over time. Despite the large number of studies focused on museum organizations, there is little research that takes into account Universal Design and its macro-and firm-level economic benefits on museum institutions (not-for-profit, public, and private). Considering this research gap, this study's aim is twofold: 1) to explore how some Italian museums have actually improved their facilities and services according to Universal Design principles and 2) to assess the economic museum accessibility. A qualitative methodology was applied using a questionnaire delivered to eight Italian museum, and collected data was compared. The findings underline how museums' investments in Universal Design may produce relevant economic benefits, both on the macroeconomic and firm levels, providing guidelines for public policies concerning welfare, transport, environment, education, and well-being. Universal Design principles can lead museums to an increasing convergence toward Sustainable Development Goals, improving their overall economic performance as well as strengthening their role in a more aware and participative society. This study has several relevant implications in terms of both policy and management. Policymakers should promote Universal Design investments in museums in order to ensure accessibility to a greater number of visitors, and cultural institutions should consider accessibility as a specific key management dimension to be monitored and improved.

Keywords. Cultural heritage, Universal Design, economic benefits, museum, Sustainable Development Goals.

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1. Introduction

The 2030 Agenda for Sustainable Development Goals underlines the need to "make cities and human settlements inclusive, safe, resilient and sustainable" (SDG 11) and reduce inequalities (SDG10) for the good health and well-being of the citizens (SDG 3).

In detail, by investing in accessibility, museums can enhance the community's well-being and the improvement of their quality of life, especially for all those segments of population that – for different reasons – have some difficulties in enjoying museum's services (i.e. elderly people, disabled, pregnant women, children).

In this regard, the Universal Design principles may orient museums' activity toward a wide range of potential visitors, according to inclusion, active participation, non-discrimination, and cultural sharing. This approach requires museums to spend money and effort to improve accessibility while expecting some economic return. The analysis of the relationship between museums' accessibility goals, short- and long-term investments, and economic implications has received limited attention by scholars. Thus, this paper's aim is twofold: 1) to explore how some Italian museums, that might be considered benchmarks, have actually improved their facilities and services according to Universal Design principles and 2) to assess the economic impact of broader museum accessibility.

2. Accessibility regulations in museums

In 2007 the Italian Ministry for Culture gave birth to a Commission on Accessibility[2] aiming at collecting and analyzing good practices worldwide to establish and foster policies on the increased usability of cultural sites by overcoming all kinds of accessibility barriers, including both physical and cognitive ones. It started out with specific requirements to include people with various types of disabilities and all those people who might be temporarily disempowered. The Commission produced the *Guideline for overcoming architectural barriers*[3], which made it clear that the removal of physical and cognitive barriers in secluded ambiences might play a major role in the design of audience development and engagement strategies and policies.

The broader approach of the Culture Accessible Commission of the MiC followed the 2006 *Convention on the Rights of Persons with Disabilities*[4] whose Art. 2 introduced the concept and principles of Universal Design. One of the first actions that the Commission subdued, however, was the reactivation of an Implementing Decree[5] of the articles 71-bis and 71-quinquies of Law no. 633-April 22, 1941, on the matter of granting copyright in favor of people with sensorial disabilities, followed by a series of training courses for superintendents and regional directors to sensitize them to the theme.[6] The

[2] Decreto dirigenziale 27 giugno 2017

[3] Decreto 28 marzo 2008 - GU n. 114 del 16.05.2008 Supplemento Ordinario n. 127

[4] The United Nations Convention on the Rights of Persons with Disabilities and its Optional Protocol (A/RES/61/106) was adopted on 13 December 2006 and was opened for signature on 30 March 2007.

[5] This action gave birth to the Decreto Ministero, Beni e attività culturali 14/11/2007 n° 239, G.U. 20/12/2007, which was circulated among managers and officials of the Ministry to sensitize in the work of the Commission.

[6] An initial class took place on 27 and 28 September 2007 under the direction of the late Prof. Arch. Fabrizio Vescovo of La Sapienza, Roma. The topics were particular concerned with the following: the design criteria for extended users, the legislation on architectural barriers, the compatibility between the protection of

Decree also promoted the *Service Quality Charter* within cultural institutions as a tool visitors could use to verify the compliance of the promised quality levels offered by services with what was actually provided: an embryonal CRM that was, for the first time supported, at the central level. Doing so, Italian legislation paid its undivided attention to inclusion in the cultural heritage field. In fact, some 15 years earlier, legislation on safety in the workplaces[7] had already partially taken into consideration some macro-aspects related to the removal of barriers connected to safety within working spaces. Cultural sector workspaces were included, albeit not in a specific and dedicated way. At the time, visitors could partake in the improvements after the workers first reap the benefits.

Another important antecedent for the Commission on Cultural Accessibility was the *Guidelines on technical-scientific criteria and on the operating and development standards of museums*.[8] In addition to the implementation of the museum's safety regulations (Area V), the concept of usability was introduced for the first time in a distinct and compulsory manner. Although the *Guidelines* were not converted into national law, their impact on regional and local levels is still important; hence, they served as the basis of the Sistema Museale Nazionale Decree,[9] which nurtures the centrality of inclusion, usability, and visitor engagement.

The Commission on Cultural Accessibility concluded its work in 2018 with the internal publication of the *Guidelines for the preparation of the Plan for the elimination of architectural barriers (P.E.B.A) in museums, museum complexes, archaeological areas and parks*. The application of national legislation or the implementation of ministerial decrees at the regional level[10] has not always been possible: following the results of an ISTAT survey in 2018, only 53% of museums, monuments, archaeological areas, and state and non-state parks improved their structures by removing physical barriers. Furthermore, only 12% addressed the issue of perceptual, cultural, and cognitive barriers.

Mission 1 of the *National Recovery and Resilience Plan* (*N.R.R.P.*) (*Digitization, innovation, competitiveness, culture, and tourism*) foresees the allocation of a conspicuous budget to overcome the residual barriers in cultural spaces and sites as indicated by the Minister of Infrastructure and Sustainable Mobility, the Minister for Disabilities, and the aims of the new Study Commission for resilience, social integration, and the rights of disabled people, in line with the goals of the UN 2030 Agenda.

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cultural heritage and interventions to overcome architectural barriers, and specific aspects relating to architectural barriers in protected buildings and places (i.e., examples of good practice). A second class took place from 8 to 10 October 2007 under the direction of Dr. Antonella Fusco, then-Director of the Center for Educational Services of the MiBAC, and was attended by 300 MiBAC officials.

[7] Legislative Decree 19 September 1994, 626: Implementation of the EEC directives concerning the improvement of the safety and health of workers in the workplace

[8] *Atto di indirizzo sui criteri tecnico-scientifici e sugli standard di funzionamento e sviluppo dei musei* (D. Lgs. n.112/98 art. 150 comma 6) - GU Serie Generale n.244 del 19-10-2001 - Suppl. Ordinario n. 238

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[10] The 2001 *Guidelines on the standards of museums*, for instance, was not converted to law, as mentioned, but has been implemented in several regional legislation on cultural heritage with light modifications and not always consistently. The regions that have adopted the *Guidelines* were entitled to choose the standards that best fit their museum's situation.

3. Universal Design and 2030 Agenda for Sustainable Development Goals in museums

The 2030 Agenda for Sustainable Development Goals is mainly linked to the enhancement of social and environmental dimensions. In this regard, attention has been progressively paid to non-economic driven organizations, which include museums that traditionally play a relevant role within non-profit organizations in terms of promoting cultural diffusion. Indeed, they contribute to the improvements of the well-being and quality of life of communities through the enhancement and sharing of cultural heritage and facilitating the achievement of sustainability [2, 7, 8].

The museums' activities can contribute—directly or indirectly—to the achievement of specific United Nations sustainable development goals, such as SDG 3 (good health and well-being), SDG 10 (reduced inequalities), and SDG 11 (sustainable cities and communities). In this regard, Target 11.4 recommends making cities and human settlements inclusive, safe, resilient, and sustainable by "strengthening efforts to protect and safeguard the world's cultural and natural heritage." Similarly, the New Urban Agenda identifies cultural heritage as a fundamental component for achieving sustainable development conditions through the enhancement and sharing of all cultural resources with the community [12].

In this context, museums' contribution to the achievement of Sustainable Development Goals finds in Universal Design's approach a potential supporting condition in terms of higher accessibility of spaces, delivered services, and information. Indeed, museums' choice to make their strategic, managerial, and operational decisions compliant to Universal Design principles confers museums inclusivity, ensuring the equality of rights and culture accessibility for each individual. In this regard, Universal Design enables the orientation toward both 2030 Agenda SDGs and the improvement of the community's well-being.

However, scholars have paid little attention to the analysis of the role played by museums in achieving 2030 Agenda's goals, and there are almost no studies about the Universal Design implementation in museums. On the one hand, the majority of studies refer to cultural heritage and sustainability issues without analyzing this topic according to the Universal Design economic implications [8, 10]. On the other hand, the literature about Universal Design in museums is focused mainly on building structural aspects or on the opportunity to ensure greater accessibility for disabled people, focusing mainly on digitization [3, 6, 11].

4. The economic benefits of Universal Design in museums

The implementation of Universal Design principles enables museums to make available to visitors certain services, products, messages and spaces, according to specific conditions such as accessibility, active participation, equal opportunities, inclusion, and removal of any barriers that could impede access to the museum experience.

However, Universal Design not only has social and cultural implications, but also economic ones. The extant literature has not addressed the analysis of the economic benefits of Universal Design investments with specific reference to museums; rather, it has employed a mostly general approach. Scholars have mainly focused on the assessment process of Universal Design economic implications [1, 4, 5, 9] and on the key actors involved, specifically, firms and public administration [1].

In particular, the main economic benefits implied by Universal Design can be explored according to two main perspectives: the intra-organizational one and the one related to products and services delivered, as well as to available spaces. With reference to the former perspective, Universal Design principles facilitate the inclusion in the workplace of all individuals by enabling the improvement of innovation capabilities, the increase of productivity rate, and the reduction of obsolescence of firms' assets [1].

At the same time, the offer of highly accessible products and services enables firms to gain technological, competitive, and reputational advantages [1]. In general, the economic benefits include the reduction of additional costs, which are required to accommodate products in order to make them more accessible, as well as the so-called social costs that burden the community (i.e. reduction of consumption, increase of legal and insurance costs for injuries due to low accessible spaces).

With reference to museums, the economic benefits of Universal Design cannot be easily identified and appraised; they are mainly indirect advantages that require, first of all, investments in order to make spaces and services more accessible. These benefits may occur in terms of direct potential advantages (higher revenues due to a larger number of disempowered visitors and accompanying people, sale of services and goods within and between museums, such books, food, training courses, Edu labs etc.; the possibility to access public and private funds) and indirect advantages (reputation and brand improvement).

Universal Design principles can lead to the creation of positive externalities by generating benefits for the museum's communities and for the public administration in terms of services delivered to public (i.e. public transport, social care and assistance and the participation to a more widely shared culture) and to other institutions and organizations (i.e. Centers for Care Innovation and start-ups hubs).

As to museums, to our knowledge there are no studies about the analysis of the potential economic benefits implied by investments in higher spaces and services' accessibility and inclusion.

5. Methodology and data

This research has been carried out according to the qualitative case-study approach, which is recommended when the research's aim is to answer "why" and "how" questions [13]. To do so, a questionnaire was formulated and delivered to selected museums. The paper is based on the replies to a questionnaire distributed to four institutions: one State Museum representing the benchmark for accessibility at the national level, one autonomous participatory foundation of a national museum, one municipal participatory foundation managing a system of complex assets including museums, and a system of eight municipal museums. In total, the research sample includes 10 museums.

Three out of four of the chosen institutions are based in Northern Italy, two are in Lombardy, one in Piedmont, and the final one is in Le Marche. Additionally, the geographical locations of the respondents may represent a sort of benchmark since the regions in which they are situated have been pioneers in adopting quality museum standards. All but one of the respondents were located in historic buildings. This may represent a limitation or weakness in the conformation to the requirements not only for physical accessibility. To some extent, ancient building structures might also limit the infrastructural adaptation needed to develop technologies in support of cognitive and perceptual accessibility.

The questionnaire was structured to investigate, through time: awareness of the topic, interest in the application of the principle of Universal Design, willingness to comply with the requirements, actual conformation to the requirements, and the economic weight of complying with the undertaken actions. Fallouts on staff training and development of sustainable economics for the institutions and potential impact on audience development and on policy-making drive have also been explored.

6. Results and discussion

The analysis of the questionnaires delivered to the selected museums enables the underlying of some preliminary conclusions with reference to the level of implementation of Universal Design principles.

In this regard, the answers point out that more than half of the selected museums have declared a good knowledge of Universal Design principles, while the remaining museums are characterized by a low level of knowledge. Thus, there is a need to promote a greater understanding of the Universal Design approach in order to facilitate its implementation.

With reference to the level of implementation of Universal Design principles, there is only one museum that attained the maximum score, while the other two museums had average scores over 4. Three museums are characterized by values that range between 3 and 4, while the remaining four museums underline a low level of implementation (average values under 2 and 3) (Table 1). In general, the level of implementation of Universal Design is moderate and should be improved. The main weaknesses refer to the "flexibility in use" principle; this might depend on the little structural and infrastructural flexibility of historical buildings where museums are located.

Table 1. The extent of Universal Design principles' implementation.

Museum	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Equitable use	5	2	5	4	3	nd*	4	4	1	1
Flexibility in use	5	2	4	4	2	2	3	4	1	1
Simple and intuitive use	5	2	5	3	nd*	5	2	4	1	1
Perceptible information	5	1	5	3	nd*	4	2	3	1	1
Tolerance for error	5	2	4	3	nd*	5	4	3	1	1
Low physical effort	5	2	4	4	nd*	5	4	4	1	1
Appropriate size and space for approach and use	5	1	4	4	3	5	4	4	1	1
Mean	5	1.71	4.43	3.57	2.67	4.33	3.29	3.71	1	1

*nd: not disclosed

With reference to the potential Universal Design's benefits, nine museums out of ten believe that higher accessibility may create advantages for the museum, its community, and the public administration. In detail, the main positive effects (both

economic and non-economic) for the museums involve the improvement of their reputation and an increase of the number of general public, since it is not possible, with the present methodology of ticketing, to have a clear repartition of the kind of reductions or free entrances granted to disabled visitors. On the other hand, the museum's community and public administration may benefit in terms of higher awareness about the issue of inclusion and in terms of greater closeness to the citizens.

In general, the collected information about the museums' awareness of potential returns on accessibility investments is unclear and sometimes inconsistent, especially with reference to the economic implications. In this regard, only seven museums out of 10 show awareness of this relationship, while three museums believe that there are no relationships at all between investments in accessibility (i.e. building adjustments, new infrastructures, establishment of sensory itineraries, purchase of special lifts for people with disabilities) and economic advantages. Besides, those museums that believe in a direct relationship between accessibility and economic advantage do not provide details in terms of identification of benefits. This evidence underlines a wide lack of accessibility culture, meaning that generally, museums invest in accessibility only to comply with mandatory regulation; there is no real awareness of the correspondence between accessibility and increased appreciation by visitors; and there is a lack in understanding of the relationships between investment and returns. Findings underline that there is a lack of an effective managerial approach in addressing the accessibility issue. Despite the medium level of implementation of Universal Design principles, selected museums show clear weaknesses in terms of management, organization, and reporting of their activities, hampering their ability to translate potential investments in accessibility into better performance. In particular, with reference to the organizational dimension, only two museums have declared their willingness to bear the training costs associated with improved accessibility, while only one museum has established an organizational structure including people specifically dedicated to accessibility issues (i.e. an the accessibility manager). As to reporting and assessing performance processes, only one museum out of 10, draws up an integrated report; thus, in general, they have neglected the opportunity to report potential activities aimed at improving accessibility and assessing related economic benefits.

The above-underlined weaknesses—referring to the three main corporate dimensions (management, organization, and reporting)—lead to a low-developed managerial approach that is not suitable for the clear identification and effective assessment of the economic effects of investments on accessibility.

Regarding the costs and investments required for ensuring higher accessibility according to Universal Design principles, only a few of the selected museums identify specific areas to focus on. They are as follows: the establishment of special visiting itineraries according to cognitive, sensory, and physical accessibility; special training courses for personnel; and adjustment of the buildings.

7. Concluding remarks, limitations, and research implications

This research's aim is twofold: 1) to explore how some Italian museums have actually improved their facilities and services according to Universal Design principles and 2) to assess the economic impact of broader museum accessibility.

In order to achieve the above stated goals, a questionnaire has been delivered to 10 Italian museums, of which nine are located in Northern Italy and one in Central Italy.

The analysis of the answers has underlined a medium level of implementation of Universal Design principles, even if the same can be improved. The findings also highlight a low awareness of economic implications, implying the risk of jeopardizing value creation over the long run. In general, this research underlines a strong and consistent missing link between the willingness to invest in accessibility and the development of a managerial approach aimed at ensuring satisfying economic returns on these investments. The above-stated evidence has several relevant implications; first, research findings underline the opportunity to develop public policies to support the implementation of Universal Design principles in museums and, additionally, through specific contributions aimed at covering, for example, the lack of income from the free tickets for people with disabilities. Second, museums should develop specific managerial capabilities based on the understanding that investments should generate profitable returns. This second implication requires museums to establish effective reporting and management control systems to appraise the museum's economic and non-economic performance. This study can contribute by enhancing the literature about sustainability, Universal Design's economic benefits, and cultural heritage; however, there are some limitations that mainly refer to the selected sample. Thus, further research should study a higher number of museums.

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Urban Accessibility in World Heritage Cities. Accessibility Considerations in Pedestrian Routes in Historic City Centres

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Abstract. In Spain, fifteen cities have been declared World Heritage Cities by UNESCO. This implies a responsibility to conserve all the heritage wealth of these places. However, what is the point of heritage if it cannot be known and visited? In order to be able to do this for all people, in equal and inclusive conditions, it is essential to consider Accessibility and Universal Design principles. This is a challenge that requires a personalised study in places that were precisely built with the idea of being inaccessible. In particular, the study of the urban fabric and pedestrian itineraries are the determining spaces that this article develops.
The aim of this study is to determine the keys and possible guidelines for the definition of urban accessibility indicators in the routes of historic city centres. For this purpose, significant routes have been sought in historic centres from the accessibility point of view: areas of high pedestrian traffic (in many cases for tourist reasons). Thus, six of the fifteen historic quarters of the World Heritage Cities in Spain have been selected for the study, with examples of good accessibility practices and difficulties that can be identified in their itineraries. For this analysis, an initial study of the existing documentation on the subject (secondary information sources) is carried out, in addition to a direct analysis (primary information source) of the graphic documentation compiled in each of these places. Subsequently, a complementary analysis will be made of some examples of good practice in pedestrian routes in historic city centres in cities in other countries.
On the basis of this preliminary analysis, a comparison will be made to establish common points and singularities among the different case studies first, and then with other cities. This diagnosis provides results that are identified as "keys to consider in the intervention on pedestrian routes in historic centres". These keys not only address issues of mobility, but also location, orientation, understanding, etc., thus addressing a holistic consideration of accessibility as a fundamental principle for all people, and in particular for the elderly sector, which is one of the groups that is clearly growing and which, without necessarily having to have a severe or recognised disability, needs an accessible environment that is easy to use.
As a main conclusion, it can be said that the results of this study do not only have an internal application for these cities but can be perfectly extrapolated as a basis for the elaboration of specific indicators for any historic city centre in any city in the world, considering the necessary adaptation to the specific characteristics of each city.

Keywords. Urban Accessibility; Accessible Heritage.

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1. Heritage and Urban Accessibility; Introduction

Heritage is our legacy from the past, what we live with today, and what we pass on to future generations. Our cultural and natural heritage are both irreplaceable sources of life and inspiration [1]. But in order to experience this heritage it is essential to be able to access, understand and enjoy it independently. And for this, Accessibility plays a decisive role.

Among the different heritage elements, Historic City Centres (HCC) are a specific typology to be considered. In addition to the difficulty of coexisting with this historical legacy, "among the complex problems of the roads in historic centres, we can highlight the difficulty of coexistence between vehicles and pedestrians" [2]. And another relevant factor is the tourist character associated with the condition of Heritage, which entails the visit of this space by a large number of people, who are also unfamiliar with it: how it is understood, how it is used. So, HCC have specific accessibility characteristics that differentiate them from other urban spaces. The historical heritage with which they coexist, as well as tourist activity, plus the urban activity itself (cars, commercial areas, administrative facilities...) are determining elements in their study.

In Spain there are 15 cities declared World Heritage Cities[3], and in all of them these characteristics are evident. An in-depth study of the accessibility of these spaces must therefore take these singularities into account. The definition of these singularities is the objective of this study.

2. Singularities in historic city centres; Goals and Methodology

For the analysis, the tourist has been considered as a study user, as this is a real scenario for all HCCs and, unlike residents, tourists do not know the place and are more sensitive and vulnerable to accessibility conditions (a resident already knows the existing difficulties and can avoid complicated situations and anticipate alternatives).

Among the existing Heritage Cities in Spain, the following have been selected for this study as being the most significant in terms of the results: Avila, Cáceres, Córdoba, Salamanca, Santiago de Compostela and Toledo. Subsequently, a non-exhaustive, complementary comparison is made in order to highlight the relationship of similarity or differentiation with other cases (national or from other countries).

In the study of the accessibility of the urbanised public space, a multitude of elements are analysed [4][5], which are translated into a large number of indicators, corresponding to pedestrian routes (for walking, crossing, or staying) and urban elements (pavements, urban furniture, urban pedestrian signage...). From among all these urban accessibility indicators [6], we select in this article those in which historic centres coincide, and which in turn differentiate them from other urban spaces.

These urban accessibility indicators which characterise HCCs can be structured according to their scale of consideration. This classification highlights the need to consider urban accessibility from different perspectives:

1. *Approaching*: The first objective is the possibility of accessing to HCCs. To know its characteristics, including its location in relation to the rest of the city and the possibilities of choice if users have any specific difficulty.
2. *Touring*: Once inside, the next basic action is to walk through the HCC. The analysis of the different interior routes.

3. *Arriving*: The third basic action to be considered is the relationship with the short-distance environment and with the arrival at the destination.

2.1. Approaching

- **Possibilities of Access**: This first indicator assesses the possibility of access to the HCC. Whether it can be reached from a single location or from several options, and whether their characteristics allow it to be considered as accessible pedestrian routes within the urban fabric.
- **Connections**: This indicator refers to the difficulty or ease of connection (distance, location...) with relevant elements in the city for visitors: transport infrastructures (stations...) [7] hotel areas,...
- **Existence of alternatives**: This indicator considers whether there are alternatives for people with some difficulty to the main accesses considered, both in terms of public transport (bus, taxi) and alternative accessible routes (e.g., taking a detour, using an urban lift...).

2.2. Touring

- **Orientation:** Existence of landmarks in complex urban patterns (sometimes mazes) as well as directional signage designed for pedestrians (or wayfinding).
- **Distances and slopes:** These are the two most decisive characteristics of accessible pedestrian routes at an intermediate scale, and which can determine the choice of one route or another. [8]
- **Coexistence with vehicles:** [9] Some conflicts can be found in both crossing points, as particularly sensitive places (perpendicular traffic), and shared streets (parallel or interlaced traffic). Bicycles and personal mobility devices should also be considered here.

2.3. Arriving

- **Pavements**: Although they are generally very relevant in any urban space, the heritage character of HCCs often translates into historic or representative uneven pavements or excessive separation between pieces (e.g., cobblestones), along with difficulties of intervention (e.g. TWSI layout).
- **Resting points**: In areas of tourist interest where long distances are covered and where not everyone has the same stamina or capacity for effort, the existence of resting points is necessary, which must be different from restaurants terraces (private areas where it is necessary to consume in order to be able to rest). Their provision and characteristics need to be considered (bench height, backrest, armrests...).
- **Identification of resources**: Once we have arrived, we must be aware of our arrival and understand exactly where we are. Signposting together withclear and easily understandable information about the place are also determining factors in this study.

3. Urban Accessibility at different scales; results

At this point, the results lead us to identify these different basic actions of the indicators (Approaching, Touring and Arriving) with a triple analysis of the accessibility of HCCs from three different scales of study[10].

1. *Global scale:* where accessibility is considered at a city level. Relating to the Approaching indicators: Access possibilities, Connections and Existence of alternatives.
2. *Intermediate scale:* where the element of analysis is the street or square and its relationship with the rest of the urban whole. Corresponding to the Touring indicators: orientation, Distances and slopes and Coexistence with vehicles.
3. *Detail scale:* where the specific characteristics of the different urban elements are considered: pavements, street furniture, signposting, etc. As a result of the Arriving indicators: Pavements, Resting points and Identification of resources

3.1. Global scale

From the analysis of accessibility on a global scale, it is worth highlighting the great similarity of the situations in terms of the existence of structural problems, which cannot be solved, but where the solutions are aimed at reducing their incidence or improving the situation for better coexistence. Among the problems detected, the following stand out:

Regarding the possibilities of access, the case of Ávila is noteworthy, where the wall limits the points of entry to the HCC. It is important on an urban scale to locate these strategic access points. Generally speaking, in the six cases analysed, a river runs close to the HCC, creating a barrier with the new city where the points of passage are limited to bridges[11], and in many occasions making it necessary to make detours. The case of the river Guadalquivir as it passes through the city of Córdoba and the entrance via the Roman bridge (now only for pedestrians) is perhaps the most relevant case (Figure 1).

Figure 1: Access Barriers: the medieval wall of Avila and the Guadalquivir River in Cordoba [source: GoogleMaps]

With regard to connections with significant elements of the city, it should be noted that in most cases transport infrastructures (e.g., train station) are far away. From the

analysed cases, the most disadvantageous situation would be Segovia, with the station six kilometres from the HCC, and the most favourable in the case of Cordoba, with the station 1.5 km from the HCC. The hotel and commercial areas, however, tend to be close to or even overlap with the HCCs themselves.

Regarding the existence of access alternatives, it should be pointed out that in all cases there is the possibility of entering the HCC with an accessible taxi and in almost all cases there is a city bus service (with accessible buses) with stops inside the HCC. Topography is a handicap in several of the cases, which is especially relevant in the case of Toledo where the installation of escalators, although they are not elements that solve accessibility barriers, do represent an improvement for many tourists (e.g., elderly people who do not have to make a great effort to go up to the HCC) (Figure 2).

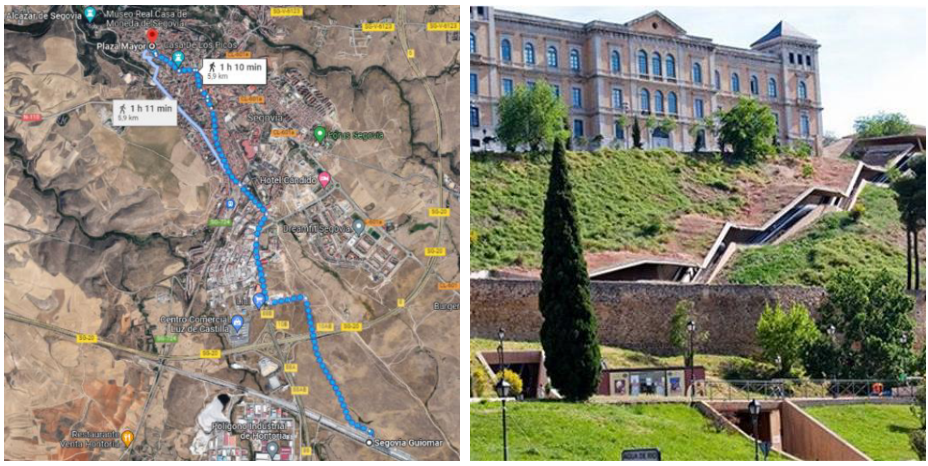

Figure 2: Barriers to connection: the problem of the distance to the train station in Segovia, and the help of escalators in the face of the topography of Toledo.

3.2. Intermediate scale

On an intermediate scale, the most determining factor in terms of accessibility is the possibility of being able to walk and find one's way around the streets of the HCC. In this case, the most significant findings have been:

The difficulties of orientation in these complex urban areas, especially those with an Arab layout (Cordoba and Toledo) where there are no clear urban references to facilitate orientation and there is a great dependence on signposting (in many cases insufficient or inadequate) or other aids (maps and orientation apps). Many tourists are forced to suffer situations of feeling lost in the middle of an urban maze.

With regard to the slopes of the streets and the detours to be made, the few difficulties in Salamanca (direct routes without steep slopes) should be highlighted, as opposed to the need to tackle steep slopes, negotiate steps or make long detours in the city of Toledo. The Cordoba initiative is very interesting, with the creation of an accessibility map of the HCC in Cordoba, with details of the slopes of the streets in order to be able to organise the interior routes according to the abilities of each person (Figure 3).

In terms of coexistence with vehicles, it is worth noting that in some cases the HCC is practically pedestrianised, as is the case in Santiago de Compostela, where vehicles remain on the perimeter and therefore do not generate major problems (Figure 4). In

contrast, the cases of Salamanca, Ávila and Toledo present difficulties in terms of coexistence with vehicles: narrow pavements, dangerous crossing points or poorly designed shared streets.

Figure 3: Labyrinthine crossroads in Cáceres. Steeply sloping street in Toledo.

Figure 4: Slope plan at the HCC in Cordoba. Pedestrian street at HCC Santiago Compostela.

3.3. Detail scale

The close relationship with the elements and materials that make up the urban space is evident at close range. In the cases studied, the most relevant results in these indicators are:

On the pavements, the existence of cobblestones or stone slabs with large joints between pieces that generate discontinuities and balance difficulties is widespread. This is also a problem for wheelchairs and pushchairs [12]. In view of this situation, it is worth highlighting the provision of strips with suitable smooth paving in Cáceres or Santiago de Compostela (Figure 5). Regarding the installation of TWSI strips, there are significant difficulties with the issue of colour contrast, which sometimes conflicts with the heritage

character of the space (in Avila, the use of red on HCC pavements was prohibited) and the lack of continuity in the tactile routing strips (something common not only in HCCs).

Figure 5: Accessible paving strips in areas of historic paving in Santiago de Compostela and Cáceres.

Regarding the resting points, their major weaknesses lay in the lack of provision of benches (or inadequate ones without a backrest or armrest) or the inexistence of accessible public toilet cabins. This situation often forces some users with less resistance capacity to use the facilities of private businesses (bars, restaurants), forcing them to pay to be able to rest (sit down or go to the toilet).

Concerning the identification of places, although in general it does not seem to be a relevant difficulty, there are many users who need better signage or additional information (pictograms, QR information, etc.) to better understand what they have in front of them. Most of the analysed cases have pedestrian signage, but it is insufficient.

In both indicators (rest points and identification of locations), all analysed HCCs are deficient, which is significant compared to other urban spaces in the city where there are not so many pedestrians and where pedestrian signage is complemented by signage for drivers.

4. Conclusions

All the urban accessibility indicators considered characterise HCCs. However, while in some of them several cities have already promoted solutions, even if only partial, in other cases the evidence of the problem reflected by the indicator is widespread. Making a final comparison after the study with other external cases, it is worth highlighting some examples of good practices in relation to the analysis that has been carried out:

Globally, urban accessibility in historic areas is a need that has been worked on for many decades. A good example is the Santa Justa lift in Lisbon, created to connect two consolidated neighbourhoods, and which has now become one of the city's tourist attractions. Another interesting example is the cable car in Dubrovnik (Croatia) to access the HCC.

On an intermediate scale, several cities have undertaken interesting initiatives on accessibility, as is the case of Venice (Italy) and accessibility through its bridges (with

their difficulties and facilities), or the urban support elements in Vitoria (Spain) that provided travelators and lifts to reduce the effort on certain HCC routes.

On a smaller scale, interesting intervention initiatives are the grouting of the access pavement in Versailles (France) or the accessible pavement strips in the streets of the HCC in Tallinn (Estonia).

This confirms the need for special consideration of HCCs in terms of accessibility, compared to urban accessibility in general in other places (e.g. new growth), and identifies some of the most relevant indicators to be considered in their study.

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Improving the Accessibility of Cultural Sites During Pandemic Through Microclimate Control. The Case of CapsulART Applied to the MANN Museum in Naples

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Abstract. The use of cultural sites has been profoundly altered by the recent pandemic events with relevant consequences on the cultural heritage industry. While before the CoVid-19 pandemic access to Cultural Sites used to involve a simplified form of control, in the transitional period between the pandemic and the post-pandemic, additional steps are required. The research aims to combine seemingly distant aspects: counteracting the spread of contagion and reorganising the admission processes to institutes of culture, such as museums. Based on the literature, it has been shown that the parameters determining air quality (temperature, relative humidity, concentration of pollutants, dust, CO2, etc.) influence the state of conservation of works of art, while their interaction with the spread of the epidemic has been slightly investigated. The research seeks to find innovative technological solutions to allow access and safe visits to the greatest possible number of users. A conscious design, therefore, must be put in place to allow everyone to enjoy works of art, exhibitions and shows. This is how the concept of universal design is declined here, introducing the concept of 'safe environment accessibility'.
The first results of a research carried out on the microclimate and the air quality inside Tyrannicides Hall at the National Archaeological Museum of Naples (MANN) will be presented. A device called 'CapsulART' is designed to be placed at the entrance of a specific room, which acts as a filter and as a decompression chamber to lower the level of pollutants present on people's clothes and shoe soles. Through a reduction in temperature, parameters that may increase the ease of contagion (e.g. sweating) should be decreased.

Keywords. Microclimate, Cultural Heritage, Abatement of Pollutant, Pandemic Events, Risk Reduction, Safe Environment Accessibility

1. Introduction (MP)

In the last two years, Italy has had to deal with a new, totally unforeseen situation. In spite of the fact that numerous alarms had been sounded by various parties, actually the Covid-19 pandemic changed the entire set of rules governing social life. All previous habits involving any form of encounter were disrupted.

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All of a sudden, encountering each other, whether in an organised or casual way, has become a risk factor, with consequences whose lines are being drawn. The health effects have now been identified; but uncertainties remain as to the long-term effects of the disease. All the remaining repercussions, in psychological, educational, cultural, sociological terms, remain to be explored. And some of these side effects will have to do with the topics discussed in these pages.

Pandemic has had serious consequences on all forms of associated life, from work to the modes of sociability: the moments of recreation (restaurants, tourism, etc.) and the ones of culture (cinemas, theatres, museums, cultural institutes, etc.). It is precisely the cultural venues, wrongly considered to be completely irrelevant to the general well-being of citizens and to income generation, that have been severely affected for much longer than the other sectors. As a result, there have been total closures, draconian restrictions on the admissible capacities in the places of reception, with substantial reductions in the number of visitors and, therefore, in the possibilities of enjoyment. Some studies have already been undertaken to investigate the impact of covid-19 on cultural heritage [1, 2, 3, 4].

This situation should have led to a wide-ranging rethinking of the ways in which these facilities could be used, which is not always the case. In this paper, we will focus above all on the criticalities encountered with regard to museums and places of culture; and how these difficulties have pushed the writers to try new ways of approaching the problems of which, in a perspective as holistic as possible, attempting to produce solutions that can be "used" in different ways, all related to the problems of protecting the historical-artistic heritage and its use.

All this through the implementation of technologies that, in a fundamental part, are based on the use contemporary technologies able to monitor the conditions of those who use the heritage and of the context in which both, heritage and visitors, are inserted; and how, through the use of tools that are now mature for the analysis and control of some of those parameters, an attempt has been made to combine the fight against pandemic risk and the preventive conservation of the heritage. In short, a strategy capable of bringing together the well-being and health of the visitor and the conservation of the work “enjoyed"[5]. Thus ensuring, and for a not secondary part, the implementation of art. 9 of the Italian Constitution.

The aim of the research here presented, which is currently in progress, is to take advantage of the pandemic emergency to introduce measures that can also improve the conditions of the context in which the works of art are conserved. The emergency and the resulting crisis have therefore become an opportunity, an occasion for a more general rethinking of the ways in which the goods were benefited. It has been useful for clarifying the question of the effects of the presence of dust in museum environments, a sure risk factor for the conservation of the heritage, and a probable increase in the risks of pandemic effects. The outcome of this process was a more general rethinking of the ways in which places of culture are used. Two points have been set, which have become milestones in the process: 1. the ways in which Heritage is benefited must in any case guarantee a higher level of safety for visitors than that which must be guaranteed outside museum spaces; 2. all the choices made to achieve this objective must at the same time guarantee a better level of protection of the historical and artistic heritage. These fixed points, as it is clear, are even more relevant if only one thinks of the close relationship that exists between the conservation of cultural heritage and the sustainability of tourist flows.

The project, funded within an FISR programme, was called 'Through the CapsulART: Enhancing Preservation and Health in Artistic and Cultural Sites during Pandemic Events'. It involved three universities (Unibo, UniCampania, Polimi) and was carried out in collaboration with the National Archaeological Museum of Naples (MANN). The project takes advantage, as will be made clear in the following pages, of the now extensive possibilities of studying the indoor microclimate of environments in real time, and those available through the use of software for digital microclimatic simulation, thanks to which the variations induced by the use of HVAC systems have been studied; but also by the adoption of 'basic' measures, such as opening of doors and windows. To this monitoring was added that of the presence of dust in the same environments, again subjected to modelling and simulation processes based on the use of digital technologies. The data collected were used to study the interaction between the presence of the public, changes in microclimatic parameters and trends in dust content; the dimensions and chemical composition of the dust were defined.

The ultimate aim of the project was to study technological solutions to control the phenomenon and reduce the risks for visitors and the works "enjoyed"; therefore, the design of a device, called "CapsulART", which will be placed at the entrance to the monitored premises, in which visitors will be studied (determination of the parameters useful for verifying their state of health) and at the same time "treated", through the use of appropriately directed air flows and filters capable of intercepting the dust, With the ultimate effect of reducing the presence of dust in the rooms thus 'defended', with the twofold result of improving the conditions of conservation of the heritage preserved in them and reducing pandemic risks, given the relationship between virus transmission and the presence of particulate matter.

2. A new relationship between Conservation, Health and Accessibility (LS)

The pandemic has introduced a change in our lives, especially in the way we move and use public spaces. While before the CoVid-19 pandemic access to cultural institutions involved a simplified form of control (at most, you were asked to show your ticket and, in case of special advantage, the identity card or other kind of document), in the transitional period between the pandemic and the post-pandemic, additional steps are currently required (at least a green pass check, body temperature verification, etc.), causing a lengthening of the time taken to access, as well as a significant reduction in the number of people allowed to stay in the same space at the same time. The decrees, guidelines and laws that have followed since the beginning of the pandemic (at the very beginning DPCM 8th March 2020 and DPCM 9th March 2020, D.L. 25ft March 2020 n. 19 converted into L. 35/2020, and the most recent one D.L. 24th March 2022 n.24 as a result of the end of the state of emergency) have called for a planning of operation that has required a considerable effort of adaptation over time, adding to the concerns for heritage conservation the economic one, tracing an "anatomy of uncertainty" [6]. These range from the planning of visitor access (opening days, opening hours, maximum number of visitors, reservation system, etc.), internal routes (favoring interpersonal distancing and providing for separation between entrance and exit) to a series of other obligations, including the presence of disinfectant gel dispensers as well as greater attention to daily cleaning.

As Pretelli already pointed out, the research aims to simplify the management of these new processes by exploiting the tools of conservation, in order to combine

seemingly distant aspects: counteracting the spread of contagion and reorganising the admission processes to the cultural sites, such as museums. Based on the literature, it has been shown that the parameters determining air quality (temperature, relative humidity, concentration of pollutants, dust, VOC, CO2, etc.) influence the state of conservation of works of art, while their interaction with the spread of the epidemic has been slightly investigated. Recent literature in the medical field stresses how particulate matter and pollutants are a vehicle for spreading bacterial load [7, 8, 9].

The entrance has become much more than an 'opening' or a 'threshold' to be crossed, but a moment of admission that needs to be recalibrated. It is therefore necessary to develop and to digitalize this process on the basis of more updated needs. By doing so, the cultural institution is supposed to take care since the entry of both conservation of Cultural Heritage and the health of people.

2.1. Accessibility as an evolving concept

The CapsulART project seeks to find innovative technological solutions to allow access and visit in safety to the greatest possible number of users. A conscious design, therefore, must be put in place to allow everyone to enjoy works of art, exhibitions and shows. This is how the concept of universal design is understood here, projecting an 'object' which can solve different issues (at least be useful under different aspects) improving safety and health.

The concept of accessibility – which is part of 'universal design' thinking – is thus broadened to include safer access for more vulnerable people (such as immunodepressed subjects), who will be able to visit these places at a lower risk of infection, both under ordinary and extraordinary conditions, such as pandemic ones. If accessibility in architecture was previously understood as something having to do more with the physical aspects, it's nowadays pretty clear that the meaning of this word is evolving and it's about enabling a wider audience to access also to 'intangible' issues, such as all the data which are helpful in improving the comprehension of an asset. In this view we think that accessibility is gaining step by step interesting values and beside other kind of already known declination (i.e. 'digital' accessibility) we introduce here the concept of 'safe environment accessibility'. Just as the concept of Heritage is gradually changing [10] (along with others related to it, such as Authenticity for example), the concept of accessibility is also undergoing a transformation, and it is curious that it is a common factor in these areas, which in the project find a link through an aspect that draws on the medical field, on 'prevention'. The new concept of 'safe environment accessibility' is related to the UNESCO Convention on the *Protection and Promotion of the Diversity of Cultural Expressions* (2005) which supports policies and measures to promote access with regard to diverse cultural goods and services. In our view, it means to ensure the right to access to culture to the widest audience having a safer experience, with special regards to fragile people, intertwining the objectives of the ERC project DANCING-*Protecting the Right to Culture of Persons with Disabilities and Enhancing Cultural Diversity through European Union Law: Exploring New Paths* [11]. Cultural Sites characterized by a 'safe environment' are places where people can feel safe and sound, even during pandemic events, thanks to specific prescriptions put in place to maintain the best indoor air quality.

An important connection between Health and Cultural Sites is already being developed [12, 13]. One of the most innovative aspects of this research encounters existing studies on the importance of Cultural Sites in alleviating certain diseases as

depressive disorders, extending the scope of action into a broader perspective of 'care and prevention' that intertwines human life and Cultural Heritage. In fact, Cultural Sites are already considered an alternative solution to psychological and psychiatric support by using culture and art as a remedy that has taken on the authority of a medical aid. People suffering could alleviate their troubles through the experience of art and this approach to mental disorders started to be considered actually a therapy, to the extent that in some pioneering countries doctors can prescribe it. What if the power of Cultural Sites as a therapy meets healthier indoor conditions of enjoyment, related to a better air quality, which is related also to a better conservation of artworks? In this frame 'safe environment accessibility' becomes a new fondant concept, improving the experience of medically fragile people by ensuring that the risk of infection is lowered among more susceptible subjects and at the same time granting a better conservation of the Cultural Heritage.

The pandemic – apart from the disastrous aspects already known, which are not the subject of this contribution, but which are clear to the writer – have had some positive effects, for instance it has been a driving force to speed up the digital transition. The point is that the research wants to go further and imagine how unfortunate circumstances such as the pandemic we have been through can instead turn into a revolution in the practice of prevention and planned preventive conservation.

3. A method to design CapsulART (MADV)

MANN Museum ties its history to the interweaving of the building's architectural evolutions, its uses and the collections that have been housed within it. The building was erected as a cavalry barracks (1585) and was completely modified by the work of architect Cesare Augusto Fontana, who designed an extension in 1615, with the aim of housing Palazzo degli Studi. Fontana's project, however, remained incomplete until 1742, when the eastern wing was built under the direction of architect Ferdinando Sanfelice. It was only in the early 19th century, after adaptation and elevation work, that archaeological, artistic and bibliographic collections were placed inside the building. In 1816 the palace was named the 'Real Museo Borbonico'. Later, with the end of the Bourbon kingdom, the Museum became the 'National Museum of Naples'.

The spaces subjected to microclimatic analysis and energetic simulation are those of Tyrannicides Hall and Farnese Corridor, located on the ground floor of the Museum's east wing. The first, which takes its name from the sculptural group of Tyrannicides that is exhibited there, has a complex history of transformation and has hosted various types of exhibitions (paintings, mosaics and statues) over the years. Tyrannicides Hall is characterised by a pattern of arches, cross vaults and barrel vaults that divide the room into five bays. The maximum height of the rooms is 11,7 m and the floor area is approximately 490 m^2. It has two openings: the first on the northern side of the hall and the second on the eastern side. Access to the room is only possible through the opening on the northern side, through Farnese corridor, as the door on the east side is not accessible because the adjacent space is used as a storage facility and is separated from the rest of the room by a plasterboard wall.

Farnese corridor, characterised by five large windows surmounted by five lunettes, originally looked like a portico of the east courtyard. It was later modified according to the design of architect Ferdinando Fuga in 1780 with the plugging of the arcades.

The project exploited the possibility of studying the indoor microclimate of the investigated environments in real time and the thermal/microclimatic analysis of the buildings. Since the first days of 2022, a microclimatic and air quality survey has been set up. Alongside the microclimatic monitoring, particulate matter (PM), CO2 and volatile organic compounds (VOC) were also monitored: these parameters were subjected to modelling and simulation processes, based on the use of digital technologies. The data collected was used to study the interaction between the presence of the public, the variation of microclimatic parameters and the variation of concentration of PM, the size and chemical composition of which were defined.

The aim of the project was also the study of technological solutions to control the indoor air quality and reduce the risks for the health of visitors and for the conservation of works of art. This led to the design of a device, called "CapsulART", which will be placed at the entrance to the monitored rooms (Figure 1), in which visitors will be studied (determining the parameters needed to check their state of health) and at the same time "treated", through the use of appropriately directed air flows and filters capable of intercepting dust, with the aim of reducing the presence of the latter in the rooms. The final outcomes of this process are the reduction of the pandemic risk and preventive conservation of the heritage works (given the relationship between virus transmission and the presence of high percentages of particulate matter) and an increase in the comfort conditions for visitors and staff.

All this is achieved through the use of technologies that, to a large extent, exploit the possibilities offered by the digitisation of data for the study of micro-environmental parameters and for the transmission and monitoring of such data in real time. Thus, digitisation is - also - a tool for the prevention and use of museum and tourism systems.

It is also interesting to note that the technology being pursued was initially developed for hospitals and in particular for operating theatres. These places, in fact, need tight control of microclimate and polluting sources, in order to prevent contagions and further complications for patients.

CapsulART is meant to be modular and replicable, and its design refined in such a way as to allow it to be adapted to different sites, while preserving the architectural qualities of the sites and improving the use of the space. The capsule acts as a filter to control the body temperature of visitors and as a decompression chamber to lower the level of pollutants present on people's clothes and shoe soles, reducing, through a decrease in temperature, parameters that may increase the ease of contagion (e.g. sweating). The capsule can also act as a filter to limit variations in temperature and relative humidity between the room itself and adjacent spaces.

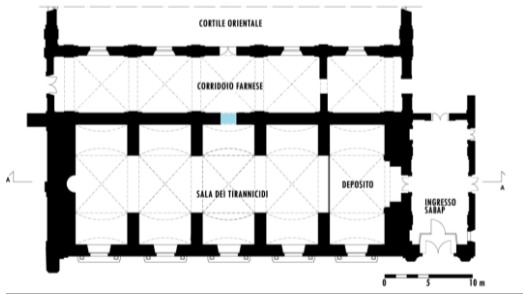

Figure 1. Planimetry and section of Tyrannicides Hall. The position of CapsulART is highlighted in blue, in the only access point to the room, which is therefore a confined environment whose ambient air is "filtered" by the presence of the new technological system.

A software simulation (IES.VE) of the application of the capsule at the entrance of Tyrannicides Hall demonstrate that a new way of controlled and technological access to the hall can improve the quality of the internal air.
Two hypotheses for the design of the capsule have been developed (Figure 2): the first as a technological passageway through which to pass, the second as a closed chamber in which to stay. In any case, the capsule is equipped with a ventilation system for dust extraction.

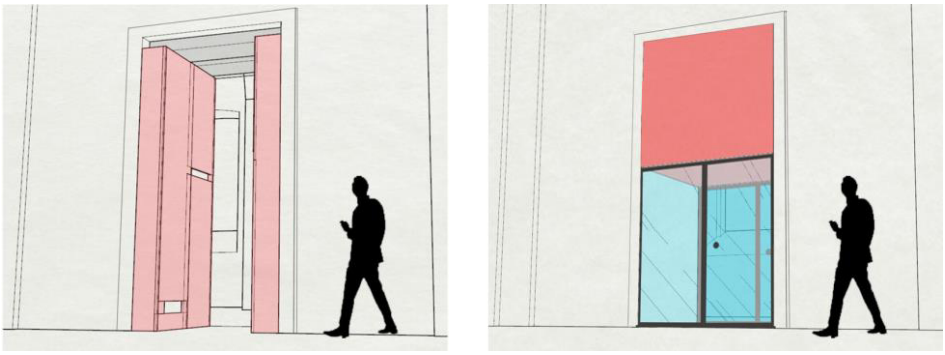

Figure 2. Two possible configurations of the CapsulART technological gate: an open portal through which visitors pass, stopping for a few seconds (left), a closed chamber with two automatic doors that open at the end of the person's "sanitation" (right).

In the first case the air treated is that of the entire environment, and while visitors pass through, the dust is sucked up and collected. A sensor at the entrance signals to the capsule that people are passing through and activates the machine, which sucks up the dust brought in by the visitors from below. From above, the purified air is fed back into the environment.

In the second case, the only effectively sanitised and controlled environment is that of the capsule (air volume of 6 m^3) as the system draws the air from the capsule and conveys it to the filters that capture the dust. It is equipped with two automatic doors: once the user has entered, the exit door has a red light that after ten seconds (once the disinfection and cleaning of the air from microparticles is complete) turns green and invites him to leave.

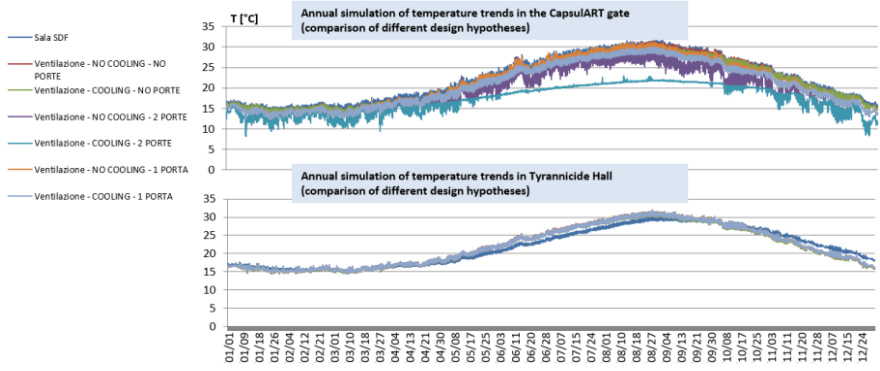

Figure 3. Graph of the temperature trend in an annual simulation of the actual state and the 6 design hypotheses in CapsulART (above) and in Tyrannicide Hall (below).

The objective of the simulation is to verify that the software recognises the effects of the capsule on the microclimate of the room. Since the variable used to characterise the microclimate in the simulation model is temperature, the simulated scenarios are evaluated according to their effect on the temperature inside Tyrannicides Hall and Farnese corridor (Figure 3). Based on the temperature difference it is possible to get an idea of the effect of the various design configurations on the internal microclimate of the rooms.

Another design variable is the presence or absence of a climate control system in the capsule. It is possible to include a cooling system to lower the temperature of the micro-environment so that the visitors might emit less water vapour (e.g. sweating).

4. Conclusions (MP, LS, MADV)

The design of CapsulART allowed us to confront the new challenges of accessibility in a complex museum context. If the concept of Universal Design itself is increasingly broadening, it is precisely in the new challenges of the post-pandemic scenario that we must find the engine of innovative growth, which seems more and more necessary every day.

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Transforming our World through Universal Design for Human Development
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Innovative Accesibility Data Inventory Tools for Urban Environments in Historic Sites

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Abstract. The development of the cognitive framework regarding the current performances of the historic built environment in physical accessibility plays a key role in the definition of inclusive design strategies. To this end, this paper presents the comparison between two survey methodologies: one based on an on-site investigation, and one based on a semi-automatic process, using artificial intelligence. The presentation of the two methods aims at describing the processes, underlining their potential outcomes, and the procedures for presenting and interpreting the data. The result is a set of observations to propose a strategy that integrates both the approaches, to exploit ICT in managing inclusive design processes.

Keywords. Physical accessibility, Survey, Laser scanning, Methodological approach, ICT

1. Introduction

Developing inclusive planning and design strategies requires to cope with the multiple needs of the city's users, regardless of one's physical, sensory, and cognitive capabilities. Actors involved in decision-making and design processes must provide a range of performances for the built environment, addressing the complex system of different design scales, the tangible and intangible components of the project and much more.

A discrepancy between legislative, cultural, and methodological advancements and the design practice has arisen from the difficulties in properly understanding the topic of inclusion and managing the variety of actions that could lead to this outcome [1, 2]. Stemming from this premise, an integration of current tools to support inclusive processes is deemed essential. Particularly, the early stages of survey and knowledge acquisition require an accurate reading of the environmental accessibility, as well as operational optimization that ensures the effectiveness of the following design phases.

In the field of architectural design and urban planning there is a general agreement that ICT may play an increasing role in the promotion of inclusion, both as an operational tool and as a system for information sharing [3]. The first application is the focus of this contribution, in continuity with previous works from the authors [4] and showing the

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progress of a research project whose purpose was the definition and assessment of urban features useful for the analysis of the built environment physical accessibility [5].

The initial parameters were previously selected through the systemization of legislative prescriptions, literature review, applied research analysis and the study of some experiences of design practice. This paper aims to show and compare two different accessibility data inventories: one based on Direct Experience (from now DE) and a second that applies Artificial Intelligence tools (from now AI). The work presented in [4], continued, and after the detection of sidewalk surfaces on the digital 3D survey, their geometric attributes were computed and a sidewalk network was generated and stored in a shapefile [6], in order to be easily visualized, implemented and exploited by the interested users, at all levels, from the public entities to the planners and the citizens.

The case study for the empirical investigation (conducted during 2021) has been the city of Sabbioneta (Mantua), an UNESCO World Heritage Site. The choice of working in an historic city allowed to address the complexity of the peculiarities that characterize cultural heritage, testing several performances of the two methods, e.g. reliability, accuracy, control capacity and data collection speed.

2. Empirical Investigation: comparing two methods

The two different surveys started from the definition of some methodological choices, based on two principal aims: (1) provide a reading of the level of inclusion within the urban environment and (2) evaluate how the historical features of a city impact on it.

The setting of the survey parameters (Figure 1) in the previous research phases focused on measurable data, also able to give a more complete perspective on inclusion by overcoming the limited concept of architectural barriers and considering absent qualities.

2.1. Direct experience: methodology and results illustration

The first performed analysis was of quality kind, based on the direct fruition and observation of the city streets.

The outcome of the survey was a set of photographs, video recordings and annotations of different nature, which required a visual representation to account for the various data. The arrangement of the graphic proposal for the report on the investigation took into consideration three main objectives: (1) to render the spatial extension of the conditions observed in the urban environment; (2) to convey the complexity of the components that contribute to the definition of inclusion and how exclusion features can arise from the interaction between the latter; (3) to understand whether certain situations of inaccessibility correspond to peculiar characters of the historical city.

Based on these premises, the graphic solution represents a linear abstraction of the same path and the public spaces it crosses. Subsequently, the assessment of public space was made with an illustration of each parameter through symbols (Figure 2), used singularly or reproduced in a line or surface. In addition to the use of a single colour, this choice was intended to give a direct depiction, through the amount of colour, of the consistency of the many constraints that are still present in a historic site as Sabbioneta.

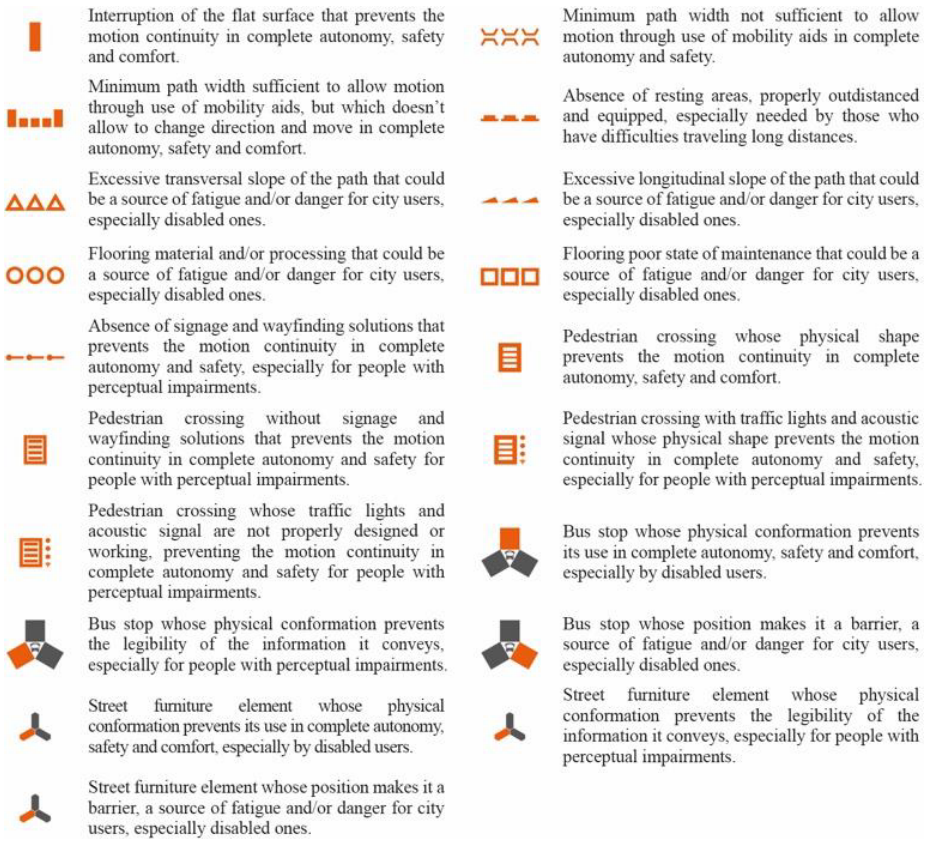

Figure 1. Graphic representation and description of the parameters used for the evaluation of the level of accessibility in the built environment © S. Marconcini

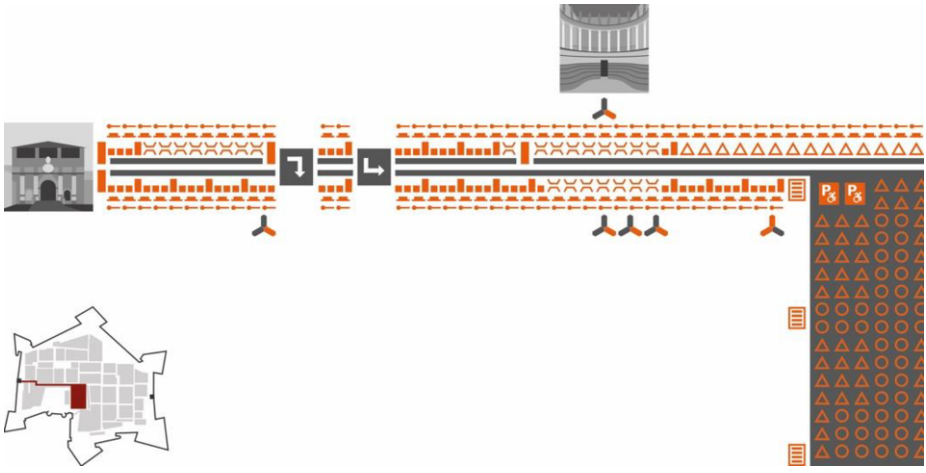

Figure 2. A section of the graphic outcome of the on-site survey in Via Vespasiano Gonzaga in Sabbioneta (in red in the general plan on the left) © S. Marconcini

2.2. Semi-automatic method: workflow and results

The aim of the AI method was the inventory of sidewalk attributes, through a semi-automatic method, implementing Artificial Intelligence. First of all, a 3D digital survey of Sabbioneta was conducted using a Mobile Mapping System: Leica Pegasus:Two. The resulting point cloud had a great density of points on ground surfaces (more than 1000 points per square meter) so that it was suitable for subsequent data processing techniques.

Then, through a knowledge-based and a Machine Learning approach, it was possible to semantically segment the point cloud and identify the points that pertain only on sidewalk surfaces [5]. Then the sidewalks areas were analysed, computing portions of sidewalks (of 2 meters wide along the road trajectory) one at a time. Basing on points attribute it was possible to compute several geometric attributes pertaining to the sidewalk portion analysed. The attributes included the width, the height respect the road, the transverse and longitudinal slopes, the material of the paved surface.

The computation was conducted for the whole dataset, and the results were stored in a vector layer (i.e. a shapefile) containing the sidewalk network of the city [4]. Each portion of sidewalk analysed was converted into a point in the vector file, then edges were generated to connect the nodes and to create a proper network. Together with the spatial position, also the attributes were linked to the corresponding edge in the network. From the vector network was then possible to generate thematic maps and to compute accessible routes within the city.

The semi-automatic approach was able to generate a shapefile with specific data automatically computed from a geometric survey of the city. The generated shapefile was then a proper basis for further analysis. An important step in this method was the definition of which attributes to compute and how to retrieve and convey those data to the final users.

2.3. Comparison of the two approaches

On the basis of the results obtained from the two methods (empirical evaluations and a set of measurements), it was possible to compare them in terms of the reliability of the measured data and the usefulness of its interpretation.

Referring to the first case, among the computed parameters, it was decided to focus on the sidewalk width. While for the direct experience, the width was measured by hand with a tape measure on specific zone of the city, for the semi-automatic method the analysis was carried out focusing on several portions of sidewalk and the width was retrieved as the difference between the farther away point and the closer one to the road centreline. To take care of possible errors, computed values were then rounded to the closer 0.05 m.

A simple analysis of the two methods was based on the comparison of the sidewalk width in several zones of Sabbioneta. Figure 3 shows the 10 points where the comparisons were done, while Table 1 provides the values of the measures and the differences.

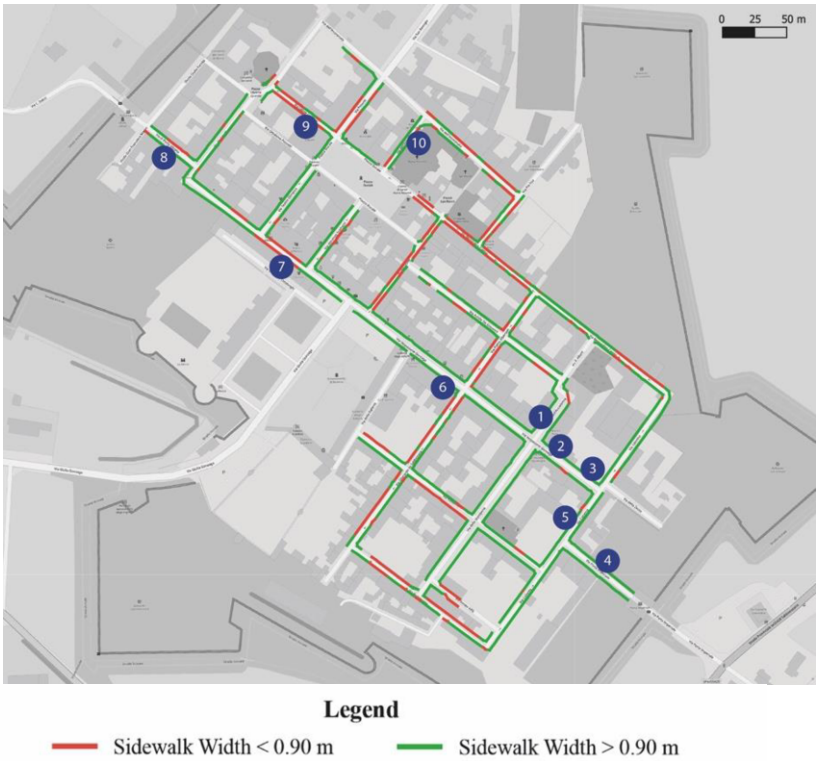

Figure 3. Spatial position of the 10 check points on the city, selected for the comparison between sidewalk widths, measured on-site (DE method) and resulting from the automatic computation (AI method). The background is the city map with the sidewalk network thematized according to widths @ D. Treccani

Table 1. Comparison of sidewalk widths, computed by the AI method and measured on-site within the DE method. The position of the check points on the city are reported in Figure 3 @ Daniele Treccani

Check Point	Computed width (m) AI method	Measured width (m) DE method	Difference (m)
1	1.55	1.53	+0.02
2	1.30	1.37	-0.07
3	1.20	1.16	+0.04
4	1.25	1.20	+0.05
5	1.00	0.99	+0.01
6	1.38	1.31	+0.07
7	0.85	0.83	+0.02
8	1.25	1.25	0.00
9	0.70	0.73	-0.03
10	0.75	0.68	+0.07

The average difference is 0.04 m, with a maximum peak of 0.07 m. basing on the width attribute it was interesting to note that both the semi-automatic and the direct experience method were capable of underlying several problematic areas of the city.

An example is provided by Figure 4, where a sudden reduction in sidewalk width was detected by the computations (the red and green lines were generated relying on the shapefile produced by the automatic method). The same sudden change in width was also observed by the on-site survey developed within the DE method.

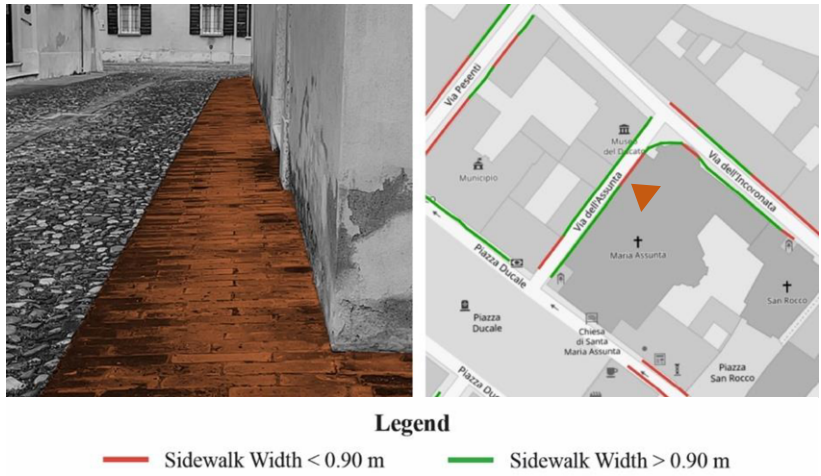

Figure 4. A photo (left) of a sidewalk of Sabbioneta with a sudden change in width. The change was also detected by the automatic method and graphically displayed by the map (right) with sidewalk network coloured according to sidewalk widths, defined accessible or not accessible according to Italian law. The orange arrow on the map marks the position where the situation occurs @ S. Marconcini, D. Treccani

A second interesting fact to observe was related to the attribute " transverse slope ". In this case, analysing the map, it was noted that in some specific positions there was a sudden change in the computed value of this parameter. To better understand these situations, comparing them with the data collected on-site, it was noted that in these positions there were entrances to public buildings and therefore the sidewalks have ramps that allow access from the street. An example is given in Figure 5, where the portion of the pavement with the ramp in front of a bank entrance was shown.

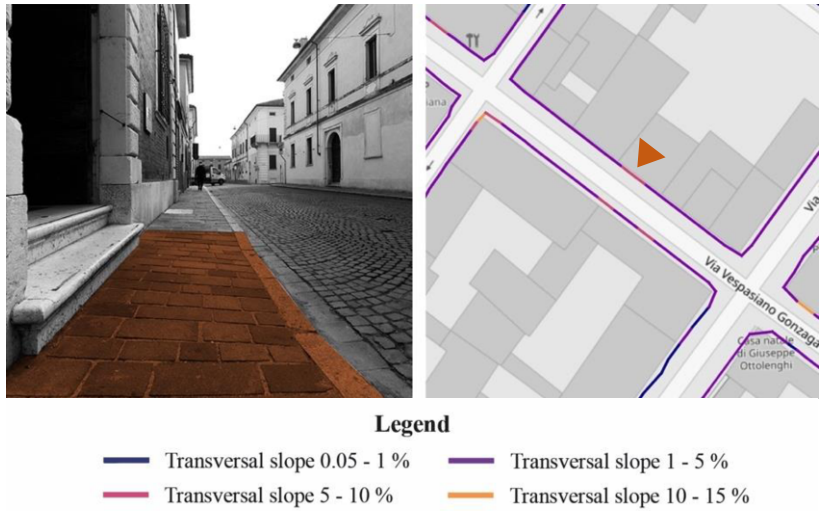

Figure 5. A photo (left) of a sidewalk of Sabbioneta with a change in transversal slope. The change was also detected by the automatic method and graphically displayed by the map (right) with sidewalk network coloured according to sidewalk transversal slope, defined in percentage (>1% is considered inaccessible by Italian law). The orange arrow on the map marks the position where the situation occurs @ S. Marconcini, D. Treccani

3. Discussion and conclusions

In this paper two approaches to study the physical accessibility of historic urban environments were presented and compared, the Direct Experience one, made on-site, and the Artificial Intelligence one. In both cases, the results of the measurements, the criticalities examined, and the analyses carried out were conveyed in different ways to represent the results obtained, one more graphic, using symbols and colour as interpretive tools, and one linked to a spatial representation of measurement data on the city map.

From the analysis and comparison of the two methods, it is easy to observe how both are reliable in collecting information, while presenting some peculiarities through which they can complement each other.

Stemming from the previous examples on the analysis of the paths width and their transversal slope, the AI method makes it possible to collect geometric data that are objective and reliable, with a high density of information (in this case, the data relate to sections of sidewalk every 2 meters). It is precisely the objectivity and rigorousness typical of a method that uses Artificial Intelligence that represent its positive aspect: the data collected are objective and all consistent with each other, since they are measured according to the same rule applied systematically to each section analysed.

It can be deduced, therefore, that if the AI method allows to obtain reliable data, for design purposes the measurements carried out need to be understood. This interpretation of the data collected, closely linked to what is occurring in situ, is a characteristic and fundamental facet of the presented DE method. Particularly, the latter makes possible to determine the reasons underlying the geometric variations in space that lead to a state of inaccessibility, in addition to the opportunity to display the absent qualities of the built environment. Finally, for the specific purpose of interpreting data, the graphic outcome provides already processed information which can be compared to further data, like cultural heritage features, and can be used quickly, without additional effort by decision makers, in planning inclusive design strategies.

From these results, the will for further developments is the elaboration of a methodology that integrates both the approaches, exploiting the fast data processing capability of ICT and the interpretive skills of experts in the field. As discussed at length, the two are deemed to be complementary and not successive stages in a process, as shown by the following first methodological proposal: 1) Development of a direct experience, on-site, to read the main features of the environment; 2) Interpretation of the data of the first investigation and definition of the parameters to be used by the AI for the survey; 3) Data gathering with the semi-automatic method and reports processing; 4) Final interpretation and systematisation of information for the implementation of inclusive design strategies. Finally, it is possible to conceive a subsequent use of ICT to track the constant changes, both positive and negative, in the built environment, amid this constant interaction between technology and expertise.

The experience gained in the work presented in this article has shown how interdisciplinary approaches, including the use of ICT, are fundamental for the achievement of quality results in the field of physical accessibility (in this case the historic urban context). This opens the way for future projects where teams of researchers and professionals with different experiences could work together to reach tangible and effective results.

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Section 8

Universal Design to Create Inclusive Educational Environments

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Transforming our World through Universal Design for Human Development
I. Garofolo et al. (Eds.)

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Universal Design in Primary Schools

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Abstract. The Norwegian building code give an apparently clear framework for the implementation of universal design (UD) in public buildings. However, it seems that neither increased awareness of UD, nor compliance with building regulations can so far guarantee equal use. Statistics and inspections reveal that there still are shortcomings as regards accessibility for many groups. Children with reduced mobility or impaired vision are better cared for than students whose needs are less documented. There is still a necessity for understanding the needs of other groups, such as children with hearing impairments, or other sensory challenges, children with social anxieties and those within the autism spectrum. A key part of achieving UD should be a design process where users' needs are in focus. Based on recent research carried out by SINTEF Building and Infrastructure and funded by the Directorate for Children, Youth and Families, this paper presents 1) Examples of practices where primary and lower secondary schools have been designed within a framework of UD, and 2) Important drivers for universal design during the design process. Recommendations will be proposed for further development of standardized tools. Findings indicate that opportunities to challenge the minimum requirements for UD within a conventional design process are few without having a supportive and competent client. The regulations and standards do not necessarily ensure inclusion and equal use. Low understanding about what UD entails in terms of user knowledge and involvement may be one reason. Norwegian standards for UD do not appear to be in significant use. Tools for UD often appear as checklists, based on the building regulations. The examples show that effective collaboration between the client and the architect plays a central role in the UD of schools. Architects not only need tools to think about usability at all design levels, but the ability to collaborate with the client and users in every phase.

Keywords. universal design, school environments, user involvement, user needs, regulations, standards.

1. Introduction

The Planning and Building Act with regulations seemingly provides a clear framework for universal design in public buildings. However, it does not appear that either increased awareness of universal design or dutiful compliance with the building regulations (TEK) guarantee equal participation for all in new school buildings and outdoor areas.

Statistics, several surveys [1] [2] as well as independent controls carried out by SINTEF show that there still are shortcomings regarding accessibility for many groups of users, even in new schools. Children with reduced mobility or visual impairment are better cared for than pupils whose needs are more easily documented, but where requirements are less explicit. The understanding of universal design is traditional, i.e., there is a strong focus on physical barriers for people with reduced mobility, vision, or hearing, while little consideration is given to invisible disabilities or diagnoses, because it can be more difficult to understand what solutions are needed [2].

SINTEF has been commissioned by Standard Norway to study schools' and municipalities' use of standards and other standardized documents for universal design. The Directorate for Children, Youth and Families (Bufdir) has funded the project.

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1.1. Regulatory Framework

Norway has a system of Building Code and regulations supplemented by recommendations and guidelines. These form the basic framework for accessibility and universal design, within which architects must design the built environment. Most requirements are function-based, few specifications are to be found in the regulations. Compliance with the regulations is a matter for the companies who apply for a building permit (mostly architects) and during the last 20 years, they have developed systematic routines for checking just that, including accessibility and universal design. However, accessibility checks have received less attention than fire safety or building construction and relates to the minimum requirements in the regulations.

The purpose of the regulations is "*to ensure that projects are planned, designed and executed on the basis of good visual aesthetics, universal design, and in a manner that ensures that the project complies with the technical standards for safety, the environment health and energy*." A central function-based requirement in the regulations points out that rooms in public buildings, which must comply with universal design requirements, must be designed, and dimensioned to enable *equal participation*.

The building regulations refer to guidelines, to Norwegian standards and to descriptive series published by the Norwegian Building Research Institute. These series or planning leaflets contain detailed specifications and advice, but none of them are to be understood as requirements, nor do they have legal powers. They show solutions which satisfy the functional requirements, and which in direct translation from Norwegian are called “pre-accepted solutions”.

1.2. Approach to universal design

Accessibility, quality of use and universal design are discussed by Iwarsson and Ståhl [3] as three central concepts in research and practice that deal with human-environment interaction. According to them, the difference between accessibility and universal design is mainly about social inclusion, democracy, and citizen equality. Universal design is therefore in clear contrast to accessibility requirements and is much about changing attitudes in society. Universal design represents an approach to design that is more about process than result. Traditional design can provide accessibility to otherwise inaccessible buildings and products. The underlying principle of accessibility is that there are two different populations - the normal population and the population that deviates from normality, i.e., people with disabilities. The result is segregation and stigmatization, as opposed to «universal design», which is based on the principle that there is only one population consisting of individuals with different characteristics and abilities [3].

Ryhl [4] notes that universal design still is defined in relation to disability and accessibility, and not as a part of the academic discussion about quality in architecture. In the Norwegian context, the understanding of universal design as a high level of accessibility has overshadowed the dimension of universal design as a principle and a design method for increased quality of use for everyone [5]. UD is largely associated with regulations and standards. This is partly due to the structure of Norwegian regulations, which require that public buildings such as schools shall be universally designed while housing must be accessible, and thus conform to a different level of performance requirements. However, the building code is clear about UD as an overall principle for all construction works.

Ryhl [6] sheds light on the importance of sensory experiences through architecture, and therefore she also includes visual, acoustic, and tactile quality as central qualities for everyone. This approach is particularly interesting in terms of primary schools.

According to Ryhl, the complexity of sensory impairments is so great that it would not be possible to set general requirements for solutions, partly because there would be contradictions between the needs of different groups. An example is how environments adapted to some visually impaired people can provide unpleasantly strong light for normally sighted people or other visually impaired people.

Universal design presupposes a user-centered process. This requires extensive knowledge of the needs and preferences of different user groups. The disabilities and user groups that are taken care of through universal design are constantly expanding. It has traditionally been focused on mobility impairments, and thus the needs of wheelchair users are well known and to a large extent taken care of in new buildings. Allergies and disabilities related to the senses, such as sight, hearing and orientation are taken care of to varying degrees. There is an increasing focus on other groups, such as children, elderly, people with cognitive impairment, dementia, and neurodevelopmental disorders.

2. Objective

Objectives for the project has been 1) to gain better knowledge about how standards for universal design and other normative documents are used in the design phase of new schools and to what extent they can contribute to inclusion, equal use, and a broader approach to diversity among pupils, teachers, and staff, and 2) to map drivers for a more ambitious approach to UD in the design phase

3. Methodological approach

This paper is based on qualitative case study methodology research. The method has been twofold: 1) Document review: Norwegian standards that apply to educational environments; guidelines with a focus on specific user needs; requirement specifications for schools in municipalities where such exist, and recent Norwegian research within universal design of primary schools; 2) Semi-structured interviews with key stakeholders in 5 municipalities. A total of 11 interviews have been conducted: four builders, three architects, two ICT managers and two consultants for universal design in the case municipalities. In addition, we have had a dialog with universal design advisors in two other municipalities. The informants were selected based on their knowledge of the early phase of the building process, either as clients in relation to the municipality (builders and UD advisers), as consultants (architects), or because they had experience with planning for a digital learning environment (Municipal ICT managers).

The framework for the study did not allow any post occupancy evaluations. The schools have therefore primarily been assessed on basis of the informants' insights, in addition to an examination of site and floor plans, as well as photos of the schools.

The municipalities were selected because of their recent experience in planning and building primary schools. The schools are built according to new legislation and can be said to represent «best practice» in terms of inclusion and universal design. The municipalities are of different sizes and located in different parts of the country, because we assume that small, medium-sized, and large municipalities face different challenges

regarding universal design. The schools have been in use for at least one year, and it has thus been possible to obtain considerations about trade-offs during the construction process and experiences with the solutions as well.

4. Examples

4.1. Example 1: A large school in a small municipality

The new school replaces two smaller schools and includes a primary and lower secondary school. The architect who designed the school had experience with many users' participation processes, but they were not specially related to UD. The former principal was responsible for user participation and according to the client, he was good at leading the process with the educational team, the municipal board, and the users. He knew the students and teachers personally, but only representatives of the employees, the students and the parents were involved.

The client trusted that the architect met the requirements for universal design in the regulations but had no higher ambitions. The architect, for her part, was primarily concerned with complying with the regulations. She suggested the need for a simpler document with an overview of all requirements, provided it is kept up to date. There were rewarding discussions along the way between architect, consultants, client, and users, and they had time to address various topics about use and users. The municipality had a meeting with all the parties where they discussed the process itself afterwards. Having competent consultants along the way was crucial.

4.2. Example 2: A primary school in a medium-sized municipality

The school is located on a challenging site as regards step-free access. The design team chose to address the height difference, so that the building has two separate entrances, one on ground floor and one on the second floor. The youngest children enter on the second floor and thus meet a low-rise building, which according to the client, provides a less overwhelming impression. The design team was aware that a centrally located lift is required but opted, after discussions, to place it out of sight. The lift has been subject to trade-offs for two reasons: 1) the children do not need to use the lift, as they all enter on the floor where they will be during the school day, and 2) the school is a BREEAM[2] project, where one of the prerequisites is that the stairs should be the main alternative, and the lift should not be used unless it is necessary.

Doors are a theme in three of the cases and are especially mentioned by the builders. In example 2, the municipality has decided not to deliver a completely threshold-free building but make use of threshold eliminators when needed. If they had decided to go for a threshold-free building, it would have been a large additional cost because of fire safety. The toilets are decentralized and located near the classrooms, out of consideration for the children's experience of security, since they will not have to go past "bullying zones" with older children.

[2] Building Research Establishment Environmental Assessment Method

4.3. Example 3: A primary school in a large municipality

The school has had a special particular focus on auditory environment and exhibits an extensive use of colors to facilitate different functions, while at the same time meeting the requirements for contrast. The school has a separate area for children with autism.

One of the informants has many years of experience as an occupational therapist for children and has been involved as UD advisor in the planning of many schools. She is part of a resource group for UD with 7 employees, which forms a favorable professional environment in the municipality. She has been a driving force in putting the acoustic environment on the agenda as an important part of UD and is clear that the official regulations for sound are not compatible with the goal of an equally designed school. A separate document with municipal requirements for schools is under completion. This will have stricter requirements than the official regulations, especially for acoustics.

She points out that only a small proportion of students need accessibility measures, while all users of the school, not just the hearing and visually impaired, can benefit from a good sound environment. According to her, children with reduced mobility also need a good sound environment, because they more often experience mental challenges and need more energy in meeting their fellow students. The same goes for students for whom Norwegian is as a second language.

5. Results and discussion

5.1. Understanding of universal design

The interviews show varying approach to universal design both in the municipalities and among designers. The understanding of what universal design implies also varies. There is a significant difference in the municipalities' approach.

The study confirms Fuglesang's [2] findings about a traditional understanding of universal design but nuances it. Most stakeholders are primarily focused on meeting the minimum requirements of the regulations regarding accessibility for students and staff with reduced mobility, sight, or hearing. Contributors to the design process often understand UD just as a set of requirements beyond accessibility.

Nevertheless, the cases show several examples of schools aiming for the inclusion of broader groups of pupils, such as children with autism or other cognitive challenges. We have seen better sound environment than required in the regulations, floor plans with many small and accessible rooms or furnishings to meet the children's needs to withdraw. Two of the schools in the sample have special departments, which may have influenced the approach to universal design and accessibility for the rest of the school in a positive direction. We do, however, badly need new solutions and a new approach to meet the intentions of the building code and embrace wider than just meeting performance requirements for thresholds, width of doors, turning area and contrasts.

The cases show that new school projects usually fulfill accessibility requirements, but not always the intention of equal use for all. A compact and clear plan and a centrally located lift are highlighted by the architect in one of the cases, as it is stated in the regulations. However, in two of the schools, the entrance situation does not allow equal use. The children who need access to the lift must use another entrance than their peers. This is a typical problem in schools on two levels with a main entrance and decentralized

entrances to the various grade levels. Most schools have only one lift located near the main entrance.

Three different approaches emerge from the examples:

1) traditional and conforming to regulations
2) pragmatic and questioning the regulations and guidelines
3) ambitious and delivering solutions better than the regulations, often because of specific concerns

Pragmatic solutions as in example 2) are practically useful and appropriate, but they do not necessarily follow overarching principles or rules. There are several examples of trade-offs, based on constructive discussions. Not all result in solutions that meet the requirements, but they are well-founded and a result of a seeking approach in accordance with the UD principles. Most of the informants do not place qualities such as acoustics or daylight in the context of universal design. They do not relate flexibility and variation in the learning zones to universal design, nor do they relate the organization, number, size, design and furnishing of the group rooms to potential solutions for pupils with sensory challenges or concentration difficulties.

It would have been good news if considerations of varying user abilities were a normal part of the design process. However, there is still much left to meet the needs of other groups than mobility impaired students, such as children with hearing impairments, social anxiety, autism, or sensory challenges.

5.2. Sharing knowledge

The cases show that there is a great need to discuss both principles and innovative solutions for universal design. Interpretation of the requirements is a central question and both clients and architects demand sparring partners with whom they could discuss different solutions and concepts.

The municipalities consider conferences and network meetings as important arenas for discussing the learning environment and universal design, both indoors and outdoors. Reviewing examples and inspections of schools in their own or another municipality improves their competence considerably. Design teams are developing many solutions to accommodate children with a vast diversity of abilities, but there is no system to assess them. Experiences must be shared, but there are few fora for sharing experiences except for the municipal networks.

Acoustics and daylight often do not meet the requirements, even in new schools. The municipalities can carry out inspections on universal design during the design phase or when applying for a permission to use. Municipal inspection of luminance contrast occurs, but it is not known to us if acoustics have been investigated. Deviations from requirements for the acoustic environment are discovered only after schools are put to use if at all. One type of recommendation to be communicated more clearly to the municipalities is that they require sound and light measurements of their schools from qualified personnel, even where the building meets the current building standard.

5.3. Competence at the right time

It is a well-known problem that consultants with innovative expertise enter the design process too late to make important decisions. The cases show that this applies not only to the general competence in universal design, but also to lighting, acoustics and ICT. An early involvement of the consultants would allow interaction and discussions in line

with universal design considerations and thus improve the quality of the projects. The cases show that when expertise, i.e., an acoustician, is involved, it is because the school has auditoriums or sports facilities intended for use by the public. However, the sound quality should be just as important for the pupils and teachers in the teaching areas.

Gathering all the necessary expertise in the architect's firm may be relevant and feasible in the largest offices, which also employ consulting engineers. But for most other firms, increased awareness of expertise necessary to achieve universal design could be useful, for instance in the form of a tool i.e., a standard that describes the type of external competence needed at each phase of the design process.

5.4. Tools in use

The case study shows that although the standards for universal design are known to stakeholders, municipal builders and architects hardly use them. Only one municipality requires it for the design of school buildings. The case sample in the study is limited, so this should possibly be re-examined among a larger sample.

The standards used by consultants are those referred to in the regulations, such as standards for sound/acoustics in music rooms, or those referred to in the municipalities' specifications for schools. Neither has anything to do with universal design. Reasons why the standards for universal design are rarely used could be: 1) architects design in accordance with statutory regulations, and they primarily use the official website for building regulations, where they can easily check requirements and guidance. Nevertheless, they say that they would have preferred a tool that is both easier to navigate and provides more references and clearer requirements; 2) other documents, such as municipal guidelines, are perceived as more relevant than the standards. Guidance material from the Norwegian Association for the Blind and selected instructions in the Building Research Series are closer to use and include more considerations.

Standards for universal design may be more meaningful tools in small and medium-sized municipalities than the large ones. The municipality's requirements often go further than the national, statutory requirements (TEK) and they are specific to the schools, i.e., the architects find the information they are looking for more easily in the municipal documents than in TEK or the standards. The large municipalities have usually established professional environments with advisers in universal design. This enables them not only to set clear requirements, but also to provide advice to the various sectors of the municipality. For small municipalities, which rarely build schools, it will not be necessary to have own specifications for schools. The study shows that several municipalities rely on documents from large municipalities. For smaller municipalities, however, the standards could be a valuable basis for discussion.

The architects signal a wish for easier reference material, for example in the form of updated and comprehensive checklists for universal design, which include more than the requirements in the regulations.

5.5. Participation

The case study shows that user participation processes are carried out routinely in school projects, but they are usually about topics other than universal design. It emerges in the interviews that participation largely depends on the school management.

One of the advisors for universal design had some experience with thematic participation related to universal design. Some of the cases have "super users", such as

students with autism or other sensory challenges, foreign language students, students with reduced mobility or students with mental disorders, such as social anxiety and depression, but there have not been specific involvement processes with them. Their needs are taken care of in other ways, i.e., by special educators. Both the youth council and the council for disabled people usually participate. According to the informants, the councils are experienced, professional, and good at promoting their views. One of the clients thought it was reassuring to know that they were involved in the process, so that important considerations were not overlooked. However, the cases show that municipal councils for the disabled can generally be more involved in building processes.

With respect to the qualities for the users, the positive impact of participation was by large confirmed by the interviewees. Several believed that the quality depended on how much the developer was willing to invest in interaction with users.

6. Conclusion

The study confirms that competence is a key premise for a broad approach to universal design. There is a need for a mutual understanding of universal design among the stakeholders and enough knowledge to get external expertise at the right time. More experience with ambitious solutions for universal design in schools should be systematized so that they can be conveyed, both locally and nationally, to municipalities, designers, and consultants. Such experiences can form the basis for new tools or standards, which should apply to the early phase of the building process as well as to the completion, the use and operation. The field of universal design is relatively new and is constantly evolving. It should therefore be a goal to further develop standards for universal design so that they promote innovation, and do not hinder it, as some fear they may do. There is still much left to meet the needs of other groups than the mobility impaired, such as children with hearing impairments, social anxiety, autism, or sensory challenges. However, many of the needs of these pupils turn out to coincide with more general needs and preferences. All pupils and teachers will benefit from a sharper focus on the diversity of needs among users of school buildings. A big share of the solutions to meet the needs of students with hearing impairment and autism related conditions will have a preventive effect on stress, and in the long run also be profitable for the learning conditions at school.

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Towards a More Inclusive Learning Environment: The Importance of Providing Captions That Are Suited to Learners' Language Proficiency in the UDL Classroom

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Abstract. Captions have been found to benefit diverse learners, supporting comprehension, memory for content, vocabulary acquisition, and literacy. Captions may, thus, be one feature of universally designed learning (UDL) environments [1, 4]. The primary aim of this study was to examine whether captions are always useful, or whether their utility depends on individual differences, specifically proficiency in the language of the audio. To study this, we presented non-native speakers of English with an audio-visual recording of an unscripted seminar-style lesson in English retrieved from a University website. We assessed English language proficiency with an objective test. To test comprehension, we administered a ten-item comprehension test on the content of the lecture. Our secondary aim was to compare the effects of different types of captions on viewer comprehension. We, therefore, created three viewing conditions: video with no captions (NC), video with premade captions (downloaded from the university website) (UC) and video with automatically generated captions (AC). Our results showed an overall strong effect of proficiency on lecture comprehension, as expected. Interestingly, we also found that whether captions helped or not depended on proficiency and caption type. The captions provided by the University website benefited our learners only if their English language proficiency was high enough. When their proficiency was lower, however, the captions provided by the university were detrimental and performance was worse than having no captions. For the lower proficiency levels, automatic captions (AC) provided the best advantage. We attribute this finding to pre-existing characteristics of the captions provided by the university website. Taken together, these findings caution institutions with a commitment to UDL against thinking that one type of caption suits all. The study highlights the need for testing captioning systems with diverse learners, under different conditions, to better understand what factors are beneficial for whom and when.

Keywords. automatic speech recognition, captions, English language learners, foreign language instruction, multi-modality, universal design, universal design for learning, universal design and individual differences.

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1. Introduction

Captions (same-language subtitles) have been shown to be one of the tools for enhancing language comprehension and learning of content in diverse populations. Gernsbacher [1] summarizes the positive findings of over 100 published empirical studies that reported benefits of providing captions for children learning how to read, adults, learners with and without hearing impairments, and learners of a second language (L2). The benefits across different studies include improvements in listening comprehension, vocabulary acquisition, memory for content and literacy development. In some countries the use of captions in TV and multimedia products is regulated by law (see - for example - the 21st Century Communications and Video accessibility Act of 2010 in the US [2]) and implemented by national broadcasting channels (such as the BBC in the UK [3]). The use of captions in video content is also recommended by some Universal Design for Learning (UDL) guidelines [4]. Since diversity can be along many dimensions, including sensory, cognitive, and linguistic, it is suggested that providing captions is one of the options instructors have to turn unimodal (spoken) or bimodal content (video+spoken) into multi-modal content, thus increasing accessibility to lecture content [4, 5, 6]. Universities and institutions involved in Higher Education worldwide are increasingly adopting UDL guidelines to promote inclusion and to meet the needs of diverse student populations [7, 8], for example adopting the use of captions during live lectures [5].

In the field of second language learning (L2) and instruction, researchers have studied the effects of captioned video-content on second language learning for more than 30 years, generally finding positive effects [9]. Many studies point out how L2 learners benefit from captions, reporting positive effects on listening comprehension, vocabulary learning, and pronunciation [6, 9, 10]. Other researchers, however, caution against generalizing these results to all types of L2 learners, because of individual differences in second language proficiency. Currently, the existing data on the relationship between language proficiency and caption use (whether beneficial, neutral or detrimental) is mixed [11]. This motivated the current study. The aims of the study are twofold. First, we wished to assess if captions are always useful, or if learner differences - namely their proficiency in the language of the audio - play a role in the efficacy of the captions. To do so, participants were asked to watch an audio-visual recording of an unscripted seminar-style lesson in English retrieved from a university website [12]. Second, we wished to compare the effects of different caption types on viewer comprehension. We tested participants under three viewing conditions: premade captions provided by the host University (UC), automatic captions (AC), and no captions (NC).

2. Methods

2.1. Participants

80 non-native speakers of English participated in the study. They were Italian university students enrolled in an English as a Foreign Language course (L2 English) (age $M = 22$, $SD = 5$). Prior to participating, their English proficiency was assessed using the grammar portion of the Michigan Test of Language Proficiency (MTELP). This test consists of a set of 45 multiple choice questions that are presented aurally.

2.2. Experimental Task

To investigate whether learners with different proficiency levels benefit from captions, participants were asked to watch and listen to a 10-minute video of a seminar style lecture in English, under different viewing conditions (see 2.3). The material was an authentic video-lecture downloaded from MIT Courseware [12]. The video-lecture came with captions that could optionally be added. In the video, an instructor discussed a topic in linguistics (Creoles and Pidgins) and interacted with students. This type of audiovisual content is commonly used in English as a foreign language university programs, so the task was familiar to the participants.

2.3. Design and Procedure

The experimental design was a one-way factorial between-subjects design with three levels, corresponding to three viewing conditions for the audio-visual lecture: video-lecture with human corrected captions, available on the university's website (UC), video-lecture with automatically generated captions re-generated using YouTube (AC), and video-lecture with no captions (NC). Participants were randomly assigned to one of the three viewing conditions: AC, $N = 26$; UC, $N = 27$; NC $N = 27$. The language assessment test (MTELP) and the experimental task were embedded in Qualtrics XM and administered remotely. MTELP was administered first. After viewing the video-lecture, participants completed a 10-question multiple choice comprehension test on the content of the lecture.

3. Data Analysis

Our dependent variable was comprehension of the content of the video-lecture. Comprehension scores were computed for each participant by dividing the number of correct answers on the comprehension test out of the total number of questions (percent correct). To analyze the data we used a generalized linear model predicting comprehension. English language proficiency scores were numerical: participants received one point for each correct answer on the MTELP (maximum score: 45). MTELP scores were used as continuous covariate in our data analyses. The three-level viewing condition (AC, UC, NC), proficiency, and their interactions were entered in the model. Caption conditions (AC and UC) were contrasted with the no captions condition (NC), and follow up pairwise comparisons contrasted AC with UC.

4. Results

4.1. Proficiency

Participants' English language proficiency on the MTELP ranged from 15 to 45 (maximum score on the test). The mean score was 40.3 ($SD = 6$) and the median was 42, indicating that our sample contained a large proportion of higher proficiency speakers, corresponding to advanced B2-C1 on the Common European Framework of Reference for Languages (CEFR).

4.2. Comprehension performance

The graph in Figure 1 plots comprehension scores (percent correct) as a function of English language proficiency (MTELP score, 15-45) and viewing condition: captions provided by the university (UC, blue line), automatically generated captions (AC, red line) and no captions (NC, green line). Learners' comprehension of the content of the video lecture in English was modulated by proficiency. Learners who had higher proficiency scores in English, on average, performed better on the comprehension test, as is to be expected. The effects of viewing condition and caption type differed greatly between lower proficiency and higher proficiency speakers, though. This is best seen by inspecting the graph, where there is an indication of a cross-over interaction between caption type and proficiency (graphically: red line above the blue line at lower proficiency levels, crossing over to blue line above the red line at higher proficiency levels). Because the pattern of results is complex, we will go over it step by step, dividing the presentation by English language proficiency range.

4.2.1. Low-to-middle proficiency range (MTELP between 15-30, corresponding to lower B2 on the CEFR)

Those learners who viewed the video with the captions provided by the University website (UC, blue line) performed worse than viewers at the same proficiency level who were not given captions. Automatic captions, however, did provide benefits to these viewers (red line above both green and blue lines).

4.2.2. Mid-to-high end of the proficiency scale (MTELP between 35-38, corresponding to B2 on the CEFR)

The difference between viewing conditions disappears, and comprehension performance is not affected by viewing condition.

4.2.3. High range (MTELP > 38, corresponding to B2+ to C1 range on the CEFR)

For learners who had higher levels of proficiency, especially those in the MTELP 40-45 range, there is a numerical trend suggesting that they benefited more from the university captions (UC condition) than the automatic captions (AC) or no captions (blue line above the red and the green lines). This difference, however, is not significant.

Pairwise comparisons of estimated marginal means of linear trends confirmed that there is a significant difference between the AC (red) and UC (blue) lines' slopes (p <0.05). The positive estimate indicates that learners who were less proficient in English performed significantly worse with the captions provided by the university (UC) than with automatic captions (AC). In the same fashion, the negative estimate resulting from comparing UC and NC suggests that participants in the latter group performed better with no captions than with the UC, even though this was not statistically significant. The results of the pairwise comparisons are reported in Table 1.

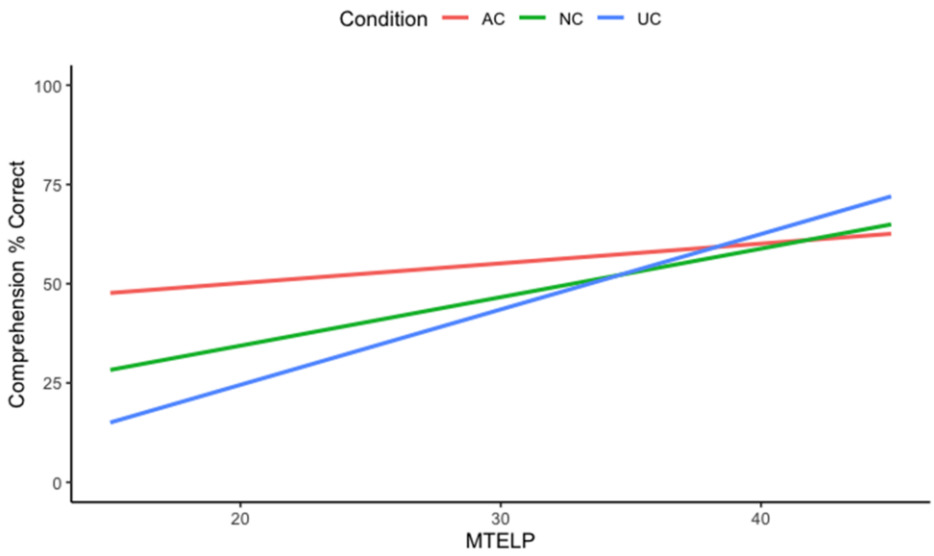

Figure 1. Learner comprehension scores when watching video-lecture under three viewing conditions (AC = automatic captions; UC = captions provided by the University; NC = no captions) as a function of English language proficiency scores (MTELP).

Table 1. Pairwise estimated marginal means of linear trends.

Comparison	Estimates	SE	DF	z ratio	p value
AC - UC	0.007	0.003	Inf	2.42	<0.05
AC - NC	0.003	0.002	Inf	1.44	n.s.
UC - NC	-0.003	0.003	Inf	-10.7	n.s.

5. Discussion and conclusion

Many studies have shown that captions (same-language subtitles) support listening comprehension, and learning of content in diverse populations [1]. Some of the UDL guidelines encourage instructors to adopt captions, promoting inclusion of diverse learners [4] as providing captions for lectures may help students with different cultural and linguistic backgrounds as well as diverse needs, and may support the learning process [1, 4, 5, 7, 8].

In this study we assessed the usefulness of captions in L2 English learners with different levels of proficiency, as learners' language proficiency is an understudied variable in the UDL literature, and results that consider this variable are mixed [11]. We also wished to compare the effects of different caption types (UC, AC and NC) on viewers' comprehension. We tested L2 learners' comprehension of a seminar-style lecture under different viewing conditions to examine how proficiency may interact with the type of captioning system provided.

Our comprehension results showed that whether students benefited from captions depended *both* on their language proficiency level and on the type of caption provided. In general, participants' language proficiency predicted content comprehension with a significantly positive correlation ($p < 0.001$). Captions had a larger impact on

comprehension at lower language proficiency levels, but their effect (whether positive or negative) depended on the type of caption. At lower proficiency levels, the captions provided by the University (UC condition) turned out to have a detrimental effect, whereas automatic captions (AC condition) significantly supported comprehension in comparison to the UC condition ($p < 0.05$). At mid and high proficiency levels, viewing condition did not affect comprehension.

We now turn to discuss why lower proficiency speakers did better in the AC condition than in the UC condition, and why the UC condition appeared to be so detrimental for low proficiency learners. In fact, perhaps surprisingly, the captions provided by the university (UC condition) turned out to make things worse for low proficiency speakers than not providing any captions at all. We propose that the reason for these opposite effects is to be attributed to differences in how the different captioning systems displayed content, which interacted with viewer proficiency. The one salient feature that differed substantially between systems was the amount and distribution of text on the screen relative to speech onset in the audio. In the AC condition text was presented in a word by word (incremental) format, closely synchronized with the speech signal (this is characteristic of automatic speech recognition systems) (see Figure 2a). The captions presented in the UC condition, on the other hand, presented a greater amount of text that appeared all at once, distributed over two lines (see Figure 2b). So, in addition to containing more text, UC captions were not synchronized with speech.

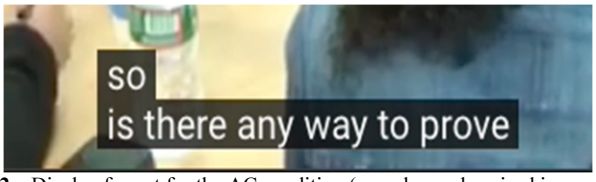

Figure 2a. Display format for the AC condition (speech-synchronised incremental format)

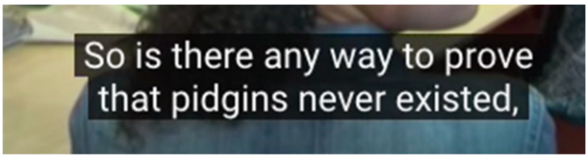

Figure 2b. Display format for the UC condition (two-line format)

We suggest that automatic captions facilitated speech segmentation and word identification because this system provided a better temporal alignment with the actual timing of spoken input [5, 6, 9, 13]. Conversely, captions in the UC condition were not aligned, and this may have resulted in cognitive over-load and hindered comprehension. Studies have begun to investigate the impact of different caption types on cognitive load, which is believed to play a role when it comes to processing multimodal input [14, 15, 16, 17, 18]. CL is defined as "the load imposed on the learner's cognitive system while performing a particular task" [14, p. 241].

An open question is whether students with higher proficiency in English had higher speech decoding and spoken English comprehension abilities, thus managing to integrate the information provided in the captions with the audio, or whether they simply ignored these captions all together, relying on the spoken input only. This question can only be addressed in studies that examine whether and how viewers are processing captions, such as eye-tracking studies. This is a topic for future research.

In summary, in this study we found that students' language proficiency in the language of the audio and the type of captioning system, are both important variables to take into account when choosing to provide learners with multi-modal material in the form of captioned video-lectures.

Two general recommendations emerge from this work: first, instructors need to be aware of the fact that variability in language proficiency in the language of the lecture will impact whether or not students find captions useful. Second, for low proficiency speakers captioning systems that are closely synchronized with speech may work better than ones that are not.

Author contributions

Shamira Venturini - conceptualization, formal analysis, investigation, methodology, writing
Michaela Mae Vann - conceptualization, formal analysis, methodology, writing
Martina Pucci - writing
Giulia Bencini - conceptualization, methodology, supervision, writing

Research Ethics Statement

The study was conducted following the principles of the 1964 Declaration of Helsinki. The experimental procedures were approved by the University Ethics Board at Ca' Foscari University of Venice (protocol approval number 1/2020). All participants provided their informed consent prior to participating.

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Universal Design for Learning at University: Technologies, Blended Learning and Teaching Methods

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Abstract. After almost 10 years from the first report on the diffusion of the Universal Design for Learning (UDL) in Europe, didactic planning related to the UDL is slowly spreading in Italy, while research is still in its infancy; there is a lack of documented experiences and impact assessments, especially for higher education. International research discusses the opportunities to redesign learning environments to create equal access to education for all in higher education courses. In this paper we report a university teaching experience based on multiple means of Engagement, Representation, and Action & Expression. We have experienced active and inclusive teaching methodologies in dual mode with second year students enrolled in a course on "Teaching and Learning" of the bachelor's degree program in Education. The proposal repeats, with some improvements, a previous university experience of Flipped Classroom in distance learning. The paper reports the first results of the teaching innovation in progress. It investigates the students' perception about: 1) the attractiveness of the proposal compared to more traditional approaches; 2) their own learning paths; 3) their motivation.

Keywords. Universal Design for Learning, higher education, active learning, ICT

1. Universal Design for Learning

1.1. Principles of inclusive teaching

The Universal Design (UD), as discussed within the *United Nations Convention on the Rights of Persons with Disabilities*, is an inclusive design approach from the very beginning, as it supports methodologies that put the final users at the centre of the process. This approach "broadly defines the user. […] Its focus is not specifically on people with disabilities, but all people" [1] and it does not imply a basic standardisation, but an enhancement of differences when proposing inclusive products, environments, and services. In the field of teaching, UD principles translate into Universal Design for Learning (UDL), that promotes flexible materials and alternative activities for students with different abilities. The goal of UDL is to improve and optimise teaching and learning for all people, by valuing everyone's learning styles and supporting their different motivations.

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In the 90's the Center for Applied Special Technology (CAST), a non-profit education research and development organization in the United States, theorised the three main principles of UDL [2]:

- support recognition learning: provide multiple, flexible methods of presentation (the "what" of learning);
- support strategic learning: provide multiple, flexible methods of expression and apprenticeship (the "how" of learning);
- support affective learning: provide multiple, flexible options for engagement (the "why" of learning).

By 2018 the Guidelines developed by CAST were translated into several languages, including Braille code. They have been updated on the ground of recent research in the areas of education, cognitive science, psychology, and neuroscience, so that the third principle has become the first one: in fact, research has amply shown the importance of engagement and self-efficacy in learning [3]. These principles aim to break down barriers to learning through flexible and diversified teaching methods and proposals: as in architecture, teaching accessibility consists in offering to students different, but equally valid ways to gain knowledge.

About "Engagement" the UDL Guidelines highlight that "there is not one means of engagement that will be optimal for all learners in all contexts" [4]: among the ten points of this guideline, for the experience described in this paper we emphasize the importance of "optimizing individual choice and autonomy" (checkpoint 7.1) and "fostering collaboration and community" (8.3).

About "Representation" the Guidelines highlight that "there is not one means of representation that will be optimal for all learners" [4]: among the twelve points, we stress the importance of "promoting understanding across languages" (2.4), "illustrating through multiple media" (2.5), as well as all the references of the Guideline 3 (named comprehension), which aims to build deep knowledge through an active process involving each student.

About "Action & Expression" the UDL Guidelines highlight that "there is not one means of action and expression that will be optimal for all learners; providing options for action and expression is essential" [4]: there are nine points for this guideline, but we report the importance of "using multiple media for communication" (5.1) and "building fluencies with graduated levels of support for practice and performance" (5.3).

How is this possible? As Rose and Meyer argue [2], methodological flexibility and content adaptation according to the characteristics and preferences of the students require multimodal instruments; in practice, the UDL implementation in educational contexts is possible through the use of digital technologies: hypermedia; modularity, variability and transcoding [5, 6] are the most important characteristics of digital media that allow content personalization and different language convergence.

1.2. Universal Design for Learning in Italy

In 2013, when one of the authors defended her doctoral thesis on UDL, there was already a good culture of UD in Italy, especially in the field of technologies and by researchers dedicated to inclusion issues. In the educational field, those years were characterized by the debate between the concepts of *integrazione* and *inclusione*, whose terms, in Italian, have specific cultural references: in Italy, in fact, the culture of inclusion in education has a 50-year history. However, the UDL approach was not known and there were no

documented experiences, except for a few descriptions of pioneer teachers in blogs or social web groups and except for the first academic studies [e.g. 7], as reported in the European study on the diffusion of UDL at that time [8].

Since 2016 several studies have been published in Italian by publishers known to teachers; scholars are integrating UDL's operational lines into the national cultural and educational landscape. At the same time, the Ministry of Education began citing UDL as a framework for the implementation of an inclusive school curriculum, and some refresher courses for teachers were started by universities and training centres.

Compared to other approaches, we believe that UDL is having a fair diffusion in Italy thanks to its operability and strong connection with technologies, that make it appreciable for those who believe in the digital school opportunities.

To understand this interest, it must be considered that in 2020/21 there were more than 300,000 pupils with disabilities attending Italian schools (3.6% of those enrolled), around 4,000 more than the previous year (+2%)[2]: these figures have been growing in recent years, due to the increase in medical diagnoses and disability certifications. This increase prompts the school system to look for strategies and tools for everyday teaching. Moreover, inclusive education is among the priority goals of the 2030 Agenda (Goal 4) to "ensure inclusive and equitable quality education […] for all": it is an important issue for Italy, where 23% of people in the 18-24 age range have either dropped out of school or finished it without acquiring minimum basic skills[3].

1.3. Application in higher education

Data on early school leaving prompt us to look for strategies to involve and include students in higher education. In 2008 the US Department of Education published *The Higher Education Opportunity Act* which refers to UDL to improve student outcomes and success. The document confirms the UDL principles, with some adjustments due to students being older than those originally imagined for UDL. The experiences documented in the literature and on the web concern the use of the UDL framework for teaching various disciplines, ranging from humanities to science and technology, not only for students with disabilities or learning disorders, but also to achieve each student's learning goals.

It is often thought that inclusion in higher education is mainly related to accessibility and that it is enough to offer accessible materials to students with sensory disabilities or learning problems. According to UDL, accessibility is a necessary but not sufficient condition for breaking down learning barriers: students must also be able to manifest what they have learned and also apply it. This means that courses must be designed with a variety of training proposals, in addition to lectures and the use of textbooks: technologies can help this process, but it is necessary to be aware that digital tools are a support for the students, not for the teacher (e.g., in the creation of multimedia materials).

For several years, students have been taking notes on their own personal devices, despite sometimes university classrooms are not properly equipped (electricity, appropriate desks, widespread connectivity); using computers to take notes encourages sharing and exchange between students, but also the personalization of study materials. The use of technology for personalisation must now be transferred from the level of the

[2] Source: Istat. L'inclusione scolastica degli alunni con disabilità a.s. 2020-2021.

[3] Source: INVALSI. La dispersione scolastica in Italia 2021.

individual student to the course design by teachers: UDL can provide a framework, especially now that many courses are delivered in dual mode due to the health emergency.

The *UDL On Campus* website developed by CAST provides guidelines for developing curriculum and inclusive lessons from the course syllabus. An UDL-oriented syllabus clearly presents the lecturer and the course through different media (text, images, videos, …). At the beginning, the lecturer makes explicit the accommodations, states each goal to increase students' awareness and motivation to learn, includes a variety of materials to increase the options of representation, provides clear assignments and assessments that consider possible barriers, states teacher's expectations and students' responsibilities. The website provides many other operational guidelines for designing a course according to the UDL perspective, e.g. on the definition of learning goals, on how to enhance learning by valuing its emotional dimension, on the evaluation of the learning process, on how to work on increasing the students' executive functioning, on how to promote peer learning, also in relation to the type of teaching environment (synchronous, asynchronous, face-to-face).

2. Universal Design for Learning in practice

2.1. Context

During a course on "Teaching and Learning" for the students of Education Sciences at the University of Bergamo, we have experienced active and inclusive teaching methodologies with students enrolled in their second year. The degree course is aimed at training professionals capable of accompanying the development of boys and girls in early childcare services: for the 2021/2022 academic year, 296 students are enrolled in the virtual classroom on Microsoft Teams, the digital platform used by our university to deliver courses in simultaneous dual mode due to the COVID emergency (some students attend in-person and others remotely). Among the students, there are people with a university personalised learning plan, students with Italian as L2, and working students.

The course consists of two modules for a total of 68 hours of lessons and workshop activities: this paper will focus on the first module "Methodologies and teaching in early childhood" (and workshop) which took place in autumn 2021. Among the general goals of the course: defining the concept of teaching, understanding strategies for the development of teaching with reference to the main collaborative and cooperative forms of organization of educational and teaching activities, exploring methodological and technological approaches for teaching, acquiring a scientific vocabulary in relation to teaching contents.

In addition to MS Teams, aimed at delivering lectures in synchronous mode and at archiving video recordings to facilitate working students or students with real-time connection difficulties, university lecturers may exploit the Moodle platform for e-learning course management. The critical health emergency and the possibility of dual mode lectures prompted most students to take advantage of distance learning, instead of attending lessons in person. This fragmented context imposed a flexible teaching approach and reflection on the quality of the use of digital tools in dual mode teaching.

2.2. Method

In the following we describe the teaching actions taken, based on the UDL approach at University: theoretical lessons supported by technologies; synchronous and asynchronous modes of attending lessons; use of different communication tools; active research on the website in real/virtual classrooms through a BYOD approach; sharing ideas and brainstorming activities; collaboration platforms; Social Networks.

The proposal repeats, with some improvements, a previous academic experience of Flipped Classroom (FC) in distance learning [9]. This time the FC methodology is envisaged as one of the teaching actions to propose different ways to support recognition learning, strategic learning, and affective learning. Others will be described in the "activities" section.

A quantitative and qualitative survey detected the students' perception of the teaching methods for this course, with main focus on the use of active teaching aimed at breaking down learning barriers, in the UDL perspective. The results deepen those of the 2020/2021 experience: at that time, 381 volunteer students participated in the FC project (out of a cohort of 513 enrolled) and 307 answered the questionnaire with encouraging results that prompted us to propose the experience to the students of the following year, with more focus on UDL practices. This year the students who took part in the FC project were 194, distributed in 56 groups; 163 volunteers responded to the anonymous questionnaire which was also open to those who did not take part in the FC-based group work (12 respondents among them).

The questionnaire proposed three questions about the learning experience: the first one investigated the students' perception of the effectiveness of the course in general through answers to 8 items on a 5-point Likert scale (strongly agree, agree, undecided, disagree, completely disagree); the second one investigated the perception of the students who participated in the group work regarding the effectiveness of this approach (8 more items, same Likert scale); the third question, free and open, on the opportunities or criticalities of the course. At the end, three profiling questions (gender, age, length of professional experience in education). The data we propose in the next chapter have been analyzed with descriptive intent.

2.3. Actions

In order to guarantee a sound UDL proposal, the course included four kinds of action: 1) frontal theoretical lessons to provide the fundamentals of teaching and the basic vocabulary (with an introduction to the UDL framework); 2) brainstorming on collaborative platforms to stimulate student participation on educational issues; 3) group projects, according to the FC methodology, to study and try approaches and educational actions aimed at children in the 0-6 age range; 4) seminars and workshops with education professionals: a nursery coordinator, an expert in art and museum services for children, a musician in nursery schools, two technology experts (coding and educational robotics, inclusive technologies).

In general, to ensure the variability of the media, we used a wide range of the Microsoft Teams functions (audio, video, chat, emoticons), and of the Moodle e-learning functions, as well as collaborative platforms (Padlet, Google Drive), and a virtual reality environment (ArtSteps). To foster deeper knowledge building (Guideline 3), we set up a multimedia collaborative summary map to summarise the course key concepts and link

them together; the concepts were illustrated through multiple media (checkpoint 2.5), also through web videos in English with Italian or English subtitles (2.4).

In this paper we focus on Action 3: in continuity with the experience of the previous academic year, the direct goals were to encourage active participation by students, to support their interests, and to enhance the participants' professional and extra-academic experiences. The indirect goal was to experiment with an active teaching methodology and assessing the students' opinions on the perceived increase in knowledge, research and digital skills and on the possibility of expressing themselves according to their interests and preferred modes of expression.

The students were invited to participate in a project divided into three phases: 1) definition of topics; 2) group work; 3) presentation and discussion. Participation was optional and provided for the availability to work in self-managed groups formed of 3 to 6 members: 194 students took part, divided into 56 groups.

Through computer-mediated brainstorming techniques [10] the students, with the teacher as facilitator, identified 8 project macro-themes relevant to the 0–6 age group and the didactic perspective as constraints: environment and animal world; body and mind; inclusion and interculture; verbal and non-verbal communication; storytelling and reading; art, music and technology; sport; history and territory. The students were therefore asked to independently form interest groups and to register via an online questionnaire by communicating a project title referring to one of the 8 macro-themes. This action was aimed at optimising the individual choice and autonomy (7.1) and fostering collaboration and community (8.3): despite the dual mode of the lessons, thanks to the informal networks among the students and their ease of communication through social media, no organisational barriers were perceived, and teacher interventions were not necessary in this first stage.

In the second stage the groups worked independently, outside of scheduled class hours, to focus on the chosen theme and deepen the related topics both from a theoretical point of view (research of sources, analysis of documents, etc.) and from a practical one, with the possibility of proposing or documenting educational and teaching activities aimed at children aged 0 to 6.

In the following weeks (third stage), the groups publicly presented their work using tools of their own choice (5.1): PowerPoint or Prezi presentations; videos of activities conducted with children; self-produced videos with examples of educational and teaching proposals; photographs of materials, environments, and activity-related settings. At the end of each lesson dedicated to the presentation of the works, the teacher encouraged discussion with questions, requests for clarification, narration of experiences, inviting participants to do the same. The chat proved to be the favourite tool for questions, comments, or observations from peers. The presentations of the first students served as a model for subsequent performances: the teacher's suggestions on communication style and adjustments to the content gradually helped the subsequent groups to design their own presentations (checkpoint 5.3).

3. Results

At the end of the first part of the course, 163 students answered the questionnaire: 95.7% are women; 85.9% are aged 18-24, 12.3% are aged 25-34, 1.2% are aged 35-44; 0.6% are over 45 years old; 31.9% currently work in the educational field. With reference to professional experience, 45.4% of the students reported that they have never worked in

education; 15.3% have worked in the sector for less than a year; 27% have 1 to 3 years of experience; 9.2% have 3 to 6 years; 3.1% more than 6 years. Compared to the previous year, this sample has more men among its respondents (+3.6%), a greater proportion of the 25-34 age group (+ 2.5%) and less work experience in the educational field (+7% have never worked or have only this year started a professional activity in the field of education). In general, the students of this course are a heterogeneous group in terms of age and professional experience, with a strong female component.

Students' responses regarding their perception of the attractiveness of the proposal, the self-assessment of their own learning paths and their motivation show a general appreciation for the approach of the course: for 93% of the students the course increased their knowledge and offered useful insights for their studies; for 85.8% the workshop approach through group work favoured the active participation of students and facilitated the attendance of the course (78.5% strongly agree or agree; 17% undecided): the topics chosen by the colleagues were stimulating (97.5%) and made it possible to discover new things (100%).

Regarding the idea that the teacher's role as mediator has been enhanced by this teaching approach, students are more undecided (11%), but most of them agree with this hypothesis (86.5%). 94.4% think that mixed teaching methodologies (lectures, videos, sharing platforms, workshops with multimedia tools) favoured their learning: this is an interesting aspect that we decided to investigate this year, and which was not considered in the previous questionnaire.

Specifically, for the group work 151 students responded: for 96% this proposal increased their knowledge and allowed them to deepen actions and didactic tools for children 0-6 years old. As far as the opportunities offered by group work to experiment with research actions and tools (defining the focus, searching for sources, etc.), 91.4% of the students agree, while they are not sure with the idea that this activity increased their digital skills (61.1% strongly agree/agree; 26.9% undecided; 11.8% disagree). Interesting results emerge from the perception that this method has enhanced the students' work and extra-university experience (78.1% strongly agree/agree; 18.5% undecided) and encouraged cooperation and discussion with colleagues (90.7% strongly agree/agree).

In percentage terms, the results of the questionnaire are in line with those of the last year, except for the data on the perceived increase in digital skills, for which it is possible to highlight a general decrease in the agreement in favor of slight increases in undecided or for those who disagree (-10.8% strongly agree/agree; +7.8% undecided; +3.7% disagree respect to last year); however, these differences are not statistically significant.

Two new questions, with more focus on the UDL framework, were added for the students who participated in the group work: "leaving space for my interests [the group work] kept my motivation high" (88.8% strongly agree/agree; 9.2% undecided; 1.9% disagree) and "[the group work] favoured personal and more functional ways of expression and communication for me" (90% strongly agree/agree; 10% undecided): these positive perceptions encourage us to continue these actions, addressing the improvable aspects that have emerged.

Among the challenges expressed by students in the qualitative section of the questionnaire: some respondents stated that some colleagues did not cooperate in the group work, some students would like more time for discussing the projects in the classroom, three students would prefer more face-to-face theoretical lessons and three others would prefer not so schematic slides, as well as their presentation according to the order of the book, others would like more student involvement.

We believe that some of these statements are conditioned by expectations that have adapted to a traditional way of teaching in higher education (frontal theoretical lectures, textbook, slides full of content, etc.), in any case, this once again demonstrates the variability of students and the challenge of findings solutions for all.

4. Conclusion

University students positively evaluate active teaching methods, both when the lessons are completely online (2020) and in dual mode (2021). The results show that active participation, discovery through confrontation with peers and freedom to choose the topics of greatest interest are significant aspects for students: this confirms the importance of the "engagement" and its variability, in UDL perspective. Even though all actions (both "presentation" and "expression") were technology-mediated, only just over half of the students recognised that the activities carried out increased their digital skills. Probably teacher mediation and metacognitive teaching activities could make some key competences more explicit.

The main barrier reported by the students concerns the context rather than the method: the short time available to the groups seems to be the main limitation of this active learning experience. We are aware that the UDL approach requires system changes, however we have experienced a different way of designing a university course, maximizing the opportunities of various technologies. We still need to experiment with an effective way of encouraging student-teacher exchange and monitoring progress along the way (checkpoint 6.4), to improve the sense of self-efficacy: the large number of students enrolling in a lesson and the time required for teachers to coordinate the activities can limit the diffusion of UDL practices in universities, but it is an approach we want to follow.

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The Future of eXtended Reality in Primary and Secondary Education

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Abstract. eXtended Reality (XR) technology has to some degree been used in primary and secondary education. However, XR technology has not gained widespread use in public schools due to challenges related to pedagogical content, expertise, digital infrastructure, funding, and a lack of universal design. In this paper, we present the results from focus group interviews with representative stakeholders from the private and public sectors, in which we investigated their practical experiences and opinions about XR technology in Norwegian schools. We summarize the practical opportunities and challenges of using XR technology in primary and secondary education. We compare the results with a previously conducted selective and weighted literature review and extract four major future research needs to increase the practical and systemic universal design of XR technology in primary and secondary education for all.

Keywords. Digital Learning; Information and Communications Technology (ICT); Accessibility; Usability; Digital Infrastructure; Expertise; Funding; Pedagogics; eXtended Reality (XR); Primary and Secondary Education

1. Introduction

Numerous implementations of eXtended reality (XR) technology – comprising both virtual reality (VR), mixed reality (MR), and augmented reality (AR) – in primary and secondary education have been trialed and tested in the past decade [9]. Even though many positive effects have been reported, widespread integration into schools is hindered by a significant lack of universal design, especially for students with disabilities and varying degrees of ability [8]. Furthermore, several practical and systemic barriers limit its universal accessibility and usability.

In this paper, we discuss facilitators and inhibitors for ubiquitous access to XR technology in primary and secondary education. Relevant data were collected from the literature and focus group interviews with selected stakeholders from the private and public sectors in Norway. We identify opportunities, as well as challenges related to pedagogical integration, expertise, digital infrastructure, and funding. Moreover, we discuss future research needs to advance the universal design of XR technology in education, allowing everyone access, regardless of individual needs or abilities.

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2. Methodology

We invited 12 representatives from the private and public sectors in Norway to participate in three focus group interviews: (1) companies that develop XR applications for education, (2) educators from public primary and secondary schools, (3) decision-makers from municipalities, and (4) representatives from user organizations for people with cognitive (e.g., dyslexia), sensory (e.g., hearing and seeing), and physical disabilities in Norway. We guided a discussion with 2 to 5 participants during each interview, in which we asked participants to share and discuss their experiences and opinions about XR technology in primary and secondary education. We asked participants to focus on XR technology's advantages, disadvantages, universal design, barriers, and solutions to said barriers. Moreover, we investigated their opinions about the technology's need for future research. Then, we compiled a summary of the reported opportunities and challenges (cf. 3. Results). Finally, we compared and discussed our results with the findings of our selective and weighted literature research that we conducted beforehand [9], and identified future research needs (cf. 4. Discussion).

3. Results

3.1. Possibilities

XR is first and foremost technology for mediating experiential learning. XR can offer experiences that students would not otherwise have had. Such experiences might include trips to foreign geographical locations, historic places, or situations. In addition, students can interact with objects in XR that are too large (such as planets and solar systems) or too small (such as atoms and molecules) to be experienced in the physical world. Focus group participants reported that XR had given them a completely different impression and experience of a topic than they had without XR.

XR can elevate the learning experience of students by presenting the curriculum in novel and more engaging ways. Many students find XR to be new and exciting, and thus feel more motivated and engaged with the learning content when presented in this format. The feeling of immersion can stimulate children to pursue a topic for longer. XR can transform learning from a chore into a pleasure. Especially some students with cognitive disabilities and other special needs might benefit from XR [8]. Likewise, this can inspire students in creative tasks such as writing because experiences in the virtual world are as real as those in the physical world. One participant recounted a case where students were given the opportunity to travel virtually to the geographical location of an assigned writing task. This facilitated the student's writing process greatly.

XR can enhance practical aspects of a topic or concept. In XR abstract ideas, concepts, and contexts like chemical reactions or gravity, can be visualized and interacted with. In virtual reality, students can for example look at 3D models they have previously developed on the computer or investigate anatomical body parts and their functions.

XR can stimulate social interaction and collaboration. Local connectivity and online features allow students to interact and collaborate remotely with fellow students both locally and globally. Moreover, many virtual experiences in XR can be shared with the educator and students on a screen, either simultaneously or post-intervention through a video recording. By sharing the experiences, educators and students can reflect and

discuss observations in a way that feels more real than when viewing them on flat 2D digital surfaces.

XR parallels the digitization of our society and is well suited to complement traditional teaching tools. XR technology reflects a world that is increasingly digitized, a process advanced by decision-makers like politicians, research leaders, and school leaders alike. The new teaching curricula in Norway focus on the need to increase digital competency in all children and encourage the use of digital tools that can mediate learning [12]. However, most educators emphasized that they did not want schools to base learning exclusively on digital teaching tools but wish to combine digital with traditional learning tools. Thus, XR technology should not replace traditional learning tools, but add a new element to the existing toolbox to enhance the curriculum and provide an opportunity to acquire knowledge by combining XR mediated with familiar learning. One participant presented the example of a textbook, in which virtual content was integrated through AR to create a pop-up book. The combination of virtual and traditional physical teaching tools is especially important for students with disabilities or varying abilities who cannot use XR as discussed in an article that has been reviewed elsewhere [8]. Thus, educators should have options for conveying the curriculum through different means to individualize learning.

XR can help improve digital skills in children. Considering the general digitization process in European countries, at least 90% of jobs in Europe require some degree of digital competency, but between 35 and 45% of the European population do not even have basic digital skills [1, 2]. Thus, the European Union (EU) aims to increase the percentage of its population that has at least basic digital skills to 70% by 2025 [2]. The Covid-19 pandemic has accelerated the digitization process: Schools established, for example, digital solutions and routines such as video conferencing systems for schooling at home. XR technology has become a part of this process, due to its improved availability to common consumers. Consequently, the use of XR technology has increased in various contexts, like gaming, traveling, or manufacturing. However, for schools to be able to take advantage of XR technology, their leaders and educators will need to be upskilled.

XR can advance alternative learning processes. The alternative learning model of *computational thinking*, promoted by the Norwegian Directorate for Education and Training (Udir), conceptualizes a learning process that encourages students to evaluate different steps to solve a problem [11]. This learning model aims to train students to learn and solve problems systematically by "thinking like a computer scientist" [11]. Students are expected to advance skills related to decomposition, logic, algorithms, patterns, abstraction, and evaluation through methods that involve trial-and-error, including playing, being creative, and troubleshooting, while also building endurance through collaboration and reflection [11]. XR technology is well suited as a complementary tool for mediating such learning processes via combining immersive technology with new ways of interaction, presentation, and experience through immersion. Computational thinking as a concept may also be transferred to educators. They may need to challenge themselves to become familiar and comfortable with when and how to implement XR technology in the best way: This includes becoming comfortable with not having the necessary knowledge and skill about the new XR technology. Similarly, students may learn that the learning process is more important than the results. One focus group participant pointed out that to succeed with XR technology and computational thinking, the educators themselves would have to experiment and trial-and-error with the new technology.

3.2. Challenges

Lack of educational content adapted to national curricula. Even though several Norwegian companies have developed educational software applications for the Norwegian market, there is still a lack of supply for most of the national curricula. Many XR companies in Norway are small start-ups with limited capacity and resources focusing on a few niche aspects or topics. Thus, some educators have found creative ways to reuse international software for their subjects. One educator reported using Google Arts & Culture [3] in writing assignments. However, some courses cannot be taught with international software because of a mismatch with the Norwegian school curricula or language barriers.

Educators lack digital skills in general and for XR technology in particular. XR is still new and, equipment and software are rapidly evolving. Hardware and software can seem complex and difficult for the beginner, and the focus group participants reported that manuals or guides were neither intuitive nor user-friendly. It takes time and effort to learn the setup, control, and navigate the software, and even more time to learn to customize it to suit one's individual teaching. Due to a high workload, many educators are not able to set aside time to learn about, experiment, or practice the usage of XR technology during normal working hours.

Educators with technology anxiety and skepticism towards XR technology. As mentioned above, XR technology is unknown to many educators and can seem complicated, complex, and overwhelming at first. Educators might experience that something goes wrong, they make a mistake, or that there are too many practical and technical uncertainties related to XR technology. Our focus group participants reported generational differences: On the one hand, younger educators were less afraid, more willing to try XR technology, and were not worried about needing to go through a phase of trial-and-error. On the other hand, the more mature educators expressed that they felt challenged in their role as educators, being afraid of losing face or control or appearing incompetent[2].

Systemic challenges due to the lack of digital infrastructure for introducing and maintaining XR technology in schools. XR has no institutional anchoring in primary and lower secondary schools to date. No national centers exist to support local and regional schools in getting started with XR projects, except for some regional centers [10]. Instead, many XR projects in schools are shouldered by highly motivated, enthusiastic educators. Once those enthusiasts leave their schools, their XR projects are put on the shelf. Moreover, there is no practical and technical infrastructure for XR technology in Norwegian school systems. There are no guides, manuals, or procedures for setup and maintenance. Login protocols often do not comply with school policies[3] which typically require a service for unified identity management in the Norwegian education sector called FEIDE [7]. Finally, the payment system of XR technology is not compatible with the accounting system of Norwegian schools, forcing many educators to pay for devices and applications out of pocket first before receiving compensation from the schools.

Costs related to the acquisition and maintenance of XR technology. XR projects require a substantial initial investment. However, there are vast economic and social differences between Norwegian schools, and many schools do not have budgets that allow

[2] We want to point out that there are elderly educators who have initiated and are leading XR projects and who, among other things, have learned programming for various XR platforms like Unity later in life.

[3] Oculus Quest II, for example, has previously required users to have a private Facebook profile to log on to the XR application leading to the creation of "fake profiles" [6].

for innovation and development of the scale needed for XR technology. In general, there are no established grants, structures, or schemes for financing XR projects. Some focus group participants pointed out that securing funds for digital projects was more challenging for primary schools than for upper secondary schools. Moreover, many XR platforms require the payment of ongoing licenses for maintenance. Likewise, some XR platform providers only offer enterprise solutions that are too expensive for public schools [5].

4. Discussion

4.1. Comparison between the literature and the interviews

The focus group participants emphasized that to make XR technology more accessible and usable for all, there was a need for further research and development to identify pedagogical opportunities and advantages, as well as disadvantages and limitations in a national context. A representative quote from an educator stated that *"to succeed with XR technology in the classrooms, a certain degree of time and patience is required"*. Moreover, the participants underlined the importance of developing practical guides, manuals, and procedures for the integration of XR technology into schools.

Our findings from the focus group interviews show many similarities with the findings of a selective and weighted literature search that we have conducted previously [9]. During this literature review, we found positive outcomes of using XR technology in education related to increased learning gains, improved social skills, improved self-image, facilitated emotional reactions, improved cognitive skills, and increased motivation, engagement, and interest [9]. Moreover, we uncovered challenges related to economic costs, physical space, health, pedagogy, editorial limitations, and lack of universal design [9]. On the one hand, the focus group participants mirrored positive aspects related to engagement, motivation, and interest. Furthermore, they gave practical examples of how experience-based learning can bring practical context to abstract educational content. On the other hand, the participants put a greater emphasis on challenges related to expertise, digital infrastructure, and funding, as well as accessibility:

First, technology anxiety and skepticism, and the lack of digital skills, experience, and familiarity with XR technology affect educator acceptance negatively. Low acceptance means in practice that educators are reluctant to try out or incorporate XR technology in their teaching. Thus, focus group participants emphasized the importance of developing guides with an educator of average digital skills in mind, rather than an early adopter. Moreover, traditional analog teaching tools must remain a viable option. XR technology should be an addition to, not a replacement of traditional teaching tools [8]. Second, financial, and digital infrastructure-related barriers might prevent educators from implementing XR projects in their schools. Many public schools have a limited budget, and digital tools compete with many other items for financial resources. Consequently, many schools will range the versatility of a teaching tool to be more important than potential gains in one singular topic. Thus, many schools will prioritize digital tools that can be used for various purposes, topics, and levels. Computers, tablets, or phones can be repurposed, while XR devices and applications today are limited and lack authoring capabilities. Likewise, the full potential of ubiquitous pedagogical integration and its effects remains under-researched. Some participants, however, suggested that the ongoing maturation and consolidation process of XR technology might diversify the possibilities and provide a larger range of XR devices and applications suited for education in

the future. Moreover, they argued that investments in new equipment will always be necessary during the introduction phase of new technology.

Third, representatives of user organizations for people with disabilities have pointed out the need for making XR technology more accessible and usable for all. These barriers of XR technology exclude a significantly greater number of students than other digital learning tools, especially if used in default mode only. Technological challenges related to the accessibility and usability of XR technology have been reviewed elsewhere [8].

4.2. Need for future research

To make XR technology more accessible for schools, we must solve challenges around pedagogical integration, expertise, digital infrastructure, and funding. We argue that these suggestions are transferable from a Norwegian to an international setting. Moreover, discussion of a fifth need for increasing accessibility, usability, and general universal design of both XR devices and applications is also of importance [8].

4.2.1. Pedagogical integration and effects

There is a need to highlight and communicate both the educational opportunities of XR technology and its limitations. There is a need for more research on the possibilities and effects of using XR technology in schools. There is, for example, a lack of widespread research that measures learning outcomes and the long-term effects of technology in schools on a national and regional level [9]. There is a need for research that identifies the practical benefits and limitations of XR technology, as well as solutions to mitigate the limitations and possible synergies between topics and teaching tools.

Moreover, there is a need for implementation research on how to streamline and integrate XR technology with national curricula alongside analog teaching tools. There is a need for diversification of software applications that fit the national curriculum, as well as the development of guides and manuals to smoothly integrate XR technology into national and local curricula. Likewise, there is a need to develop and implement authoring methods that allow for easy editing and adaptation of virtual content to different topics/subjects and the individual educators' needs and learning styles. Moreover, there is a need to investigate the benefits and limitations of XR technology for various student groups, as well as the conditions that facilitate benefits and mitigate limitations.

4.2.2. Skill development and acceptance

There is a need to develop and improve the digital skills of educators and decision-makers to increase acceptance for, as well as lower the threshold for implementing XR technology in schools. Supporting educators in their role as an educator is important. XR technology is meant to complement existing analog and other digital aids, not replace them. The educator should always feel to be in the driver’s seat, and that they are the ones deciding if and which XR technology fits their teaching style for any given purpose. To allow educators to become familiar with XR technology, it could be useful for schools to be able to rent equipment such that the educators can test the XR devices and applications. It can make sense, for example, to let educators first play an unrelated game like Beat Saber to learn how to navigate inside and interact with the digital world. Local, regional, and national science, technology, knowledge, and competence centers could realize the introduction to XR technology by offering schools the rental of equipment.

Moreover, such centers could exhibit permanent XR installations for classes and educators to visit to familiarize themselves with the technology. Likewise, the centers could arrange events at individual schools or organize staff training sessions for XR technology to develop the skills of the educators.

4.2.3. Digital infrastructure and manuals

There is a need to create a digital infrastructure that suits the national and local school systems both technologically and methodologically. An infrastructure for integrating XR technology in education should provide practical and technical solutions to common challenges such as login or payment, rigging, and setup. In Norway, for example, it should be possible to log in to XR devices through FEIDE, a service for unified identity management in Norwegian education, or the respective system in other countries. Likewise, payment procedures for licensing should be developed that can be easily integrated into the schools' financial routines and procedures. Moreover, a guide or manual should be developed detailing requirements, preparations, and instructions for the setup and initialization of XR technology. This guide should include background information about AR, MR, and VR technologies in general as well as specific devices and equipment and explain how educators can set up the technology physically, install software, and provide instructions on basic functions such as settings or controls. This manual should be co-created with the help of educators to guarantee universal design for all.

4.2.4. Funding guides

There is a need to address the financial needs required to fund the acquisition of XR devices and applications. Schools often lack a sufficient overview of necessary equipment and their costs, as well as available funding schemes. Thus, we suggest a guide or manual that supports informed decision-making in schools. This guide should detail potential equipment including their price and versatility. The guide should also sketch out the limitations, indicate possibilities for multi-purposing, and highlight combination possibilities with traditional teaching aids. Moreover, strategies for funding should be discussed based on the experience of existing or past XR projects including (1) prioritizing funds in the current budget, (2) project funding through applications for grants from public authorities and agencies such as the Norwegian Directorate for Education and Training (Udir), regional research funds, or the municipalities, and (3) sponsoring by local businesses in the community like local savings banks or medium-sized companies.

Moreover, there is a need to address the economical, ethical, and practical realities within our society that can influence the procurement of XR technology. The education systems in most European countries like Norway are based on the principle of providing equal opportunities to all students regardless of background, social or financial status. However, financial differences between individual schools exist. This difference is potentially larger within and between other European countries. Thus, relying solely on external funding might give schools in a wealthy neighborhood/country with good contacts and ties to the local business community an advantage in raising funds to acquire XR equipment compared to a school located in an impoverished neighborhood/country. Likewise, it can be challenging to solely rely on students' mobile devices for the use of AR. Some students from low-income families might not be able to afford an expensive AR-compatible smartphone. Likewise, some schools might recently have procured tablets or smartphones that do not support XR-related software or hardware.

5. Conclusion

There is no doubt that XR technology offers some promising opportunities for primary and secondary education: XR is an experience-based learning tool that can provide satisfactory visualizations of abstract concepts and ideas. At the same time, there are certain pedagogical, skill- and acceptance-related, digital infrastructure-related, and funding challenges that we discuss in this paper. Moreover, we present four major areas for future research needs related to pedagogical integration, digital skills, digital infrastructure, and funding to make XR technology more accessible and usable for all: (1) *There is a need for pedagogical integration.* This includes developing strategies for integration with national curricula, content creation for a wider spectrum of subjects, as well as evaluation of pedagogical long-term effects. (2) *There is a need for allowing educators to develop their digital skills for this emerging technology in a non-threatening environment.* (3) *There is a need for developing technological and methodological digital infrastructure to smoothly integrate XR technology into school systems.* This includes developing procedures to more easily set up and use XR projects at schools. (4) *There is a need for supporting schools in the procurement and funding process of XR projects.*

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Challenges in Implementing Universal Design of ICT Among Teachers in Higher Education in Norway

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Abstract. Equal access to education for all is a prioritized goal in many parts of the world and included in several national and international regulations. Universal Design (UD) of information and communication technology (ICT) can ensure accessibility of digital learning materials (DLMs). However, until recently the implementation of UD of ICT in higher education institutions (HEIs) has been lacking. This study investigates the practical implementation of UD of ICT of DLMs among teachers in HEIs, challenges experienced by them, and what support is offered by their HEI or what support they believe would be helpful when implementing UD in DLMs. Data was collected through interviews and an online survey from a total of twelve faculty members recruited from eight universities in Norway and analyzed using thematic analysis. Findings indicate that teachers in HEIs do not practice UD of ICT on their DLMs, and that they lack training, sufficient time, and practical support from their HEIs to make their DLMs universally designed. The paper concludes that although HEIs appear willing to provide the necessary support and actions to implement UD of ICT, there seems to be a lack of internal policy on UD.

Keywords. Universal design, ICT accessibility, digital learning materials, higher education.

1. Introduction

The current rise in the digitalization of education across many areas of the world and accelerated due to the COVID-19 pandemic has increased the use of digital learning materials among teachers in higher education. According to a 2021 European survey [1], an average 15% of students in higher education (HE) report having an impairment that limits them in their studies. Norway, with 23%, is one of the five countries in that survey with the highest share of respondents reporting they have a limiting disability (including chronic diseases). The right to equal access to education for all is stated in national and international legislation, including the United Nations Convention on the Rights of Persons with Disabilities [2], and reflected in the United Nations Sustainable Development Goal no. 4, Quality education [3]. The Norwegian regulations on universal design of information and communication technology (ICT) solutions [4] connected to Section 18 in the Norwegian Equality and Anti-Discrimination Act of 2018 [5]

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specifically includes DLMs. This indicates HE teachers' skills and practice in making their DLMs accessible are important factors for ensuring equal access to HE.

Existing research has shown that accessibility barriers present in DLMs are the most common hindrance for students in higher education in Norway [6], and that HEI teachers are positive towards UD and willing towards implementing UD in their teaching and learning materials, but they seem to lack time and sufficient training, and practical knowledge about how make their DLMs universally designed [7-8].

The study presented in this paper aims to extend previous research by investigating how teachers in HEIs cope with implementing UD of ICT on the DLMs used in the classes they teach, what challenges and barriers they experience when doing this in practice, and what support from their institution they think could be helpful in this process and towards meeting requirements for UD of DLMs. This is done through thematic analysis of data collected through interviews and an online survey involving seven faculty members teaching at eight HEIs in Norway. As the data collection was conducted in 2020, while the COVID-19 pandemic necessitated universities migrate to a digital mode of teaching almost overnight, it became particularly interesting and important to also include an exploration of how the university teachers in Norway handled this transition with regards to their efforts towards UD when making DLMs. By gaining a better understanding of how teachers in Norwegian HEIs implement UD in their DLMs in practice and exploring their views and experiences, the presented study proposes to contribute towards knowledge on how teachers in HE can practice universal design of digital learning materials in an effective and efficient way as well as offer insights into how the HEIs can support the teachers in this work.

The paper is organized as follows: Section 2 gives an overview of the methods used for data collection and data analysis as well as the recruitment of participants. The results are presented in Section 3, while Section 4 discusses the main findings and considers the limitations of this research. Section 5 concludes this paper and gives suggestions for further work.

2. Methods

This study used a qualitative approach with a combination of individual interviews and an online survey to investigate teachers' patterns of behavior towards and views on creating digital learning materials. Qualitative methods can offer a deeper understanding of a problem than quantitative methods [9]. Combining different qualitative methods can provide more in-depth insights into participants behavior and views regarding the topic of concern. Individual interviews were chosen for this study to better understand the experiences and challenges teachers face in practicing UD for DLMs.

Online survey was chosen due to a lack of teachers' availability to participate in individual interviews in relation to the transition to a digital teaching mode during the COVID-19 pandemic at the time of data collection. To lessen the risk that collecting data this way would affect the quality and richness of the data, measures such as offering more descriptions in the formulation of the survey questions were taken into consideration.

2.1. Participants and Data collection

Participants were primarily contacted through emails sent to the 23 different heads of department in 8 different universities in Norway. The participant recruitment criteria were faculty members teaching at Norwegian HEIs. The data collection was performed in October - November 2020. In total, 12 faculty members from 8 universities in Norway participated in the interviews or the online survey. Seven faculty members (2 males and 5 females) participated in the interviews. All participants gave an informed consent before taking part in the study. Only written notes were taken during interviews, and the collected data anonymized. Participants' subject areas for teaching covered the following areas: Computer and Information Technology, Social and Political Sciences, and Public Health and Nursing. The detailed demographics of these participants are presented in Table 1.

Table 1. Demographics of participants for individual interviews

Data type	Detail
Gender	Male (2), Female (5)
Age range	35-50 (3), 51-65 (2), 65+ (1), do not want to answer (1)
Faculty	Computer and Information Technology (3), Social and Political Sciences (2), and Public Health and Nursing (2)
Role (some with multiple)	Professor (3), Associate Professor (4), Research Scientist (3)
Teaching experience (in years)	5-20 (2), 20+ (5)
Use of computer and IT services (in years)	20-35 (5), 36+ (2)
Digital learning material development (in years)	5-15 (3), 16-25 (3), 26+ (1)
UD and accessibility knowledge	Expert (2), Knowledgeable (3), Some knowledge (1), No knowledge (1)
Main role (some with multiple)	Teaching (7), Research (7), Software development (1), Administration (2)
Area of subject (some with multiple)	Climate Change and Global Health (1), Health Care and Nursing (2), Research Methodology (3), Interprofessional Communication and Collaboration (1), Universal Design of ICT (2), Human Computer Interaction (1), Technology and Society (1), Software Engineering (1), Artificial Intelligence (1), Social and Political Sciences (2), and Theory About Disabilities (1)
Course level (some with multiple)	Undergraduate level (4), Master's level (7), and Ph.D. level (3)

Table 2. Demographics of online survey respondents

Data type	Detail
Gender	No answer
Age range	35-50 (4), 51-65 (1)
Faculty	Data Science (1), Public administration (1), Political Sciences (1), and Statistics (2)
Role	No answer
Teaching experience (in years)	3-10 (4), 10+ (1)
Use of computer and IT services (in years)	20-30 (3), 30+ (2)
Digital learning material development (in years)	2-10 (3), 10+ (2)
UD and accessibility knowledge	Expert (1), Knowledgeable (1), Some knowledge (0), No knowledge (3)
Main role	No answer
Area of subject (some with multiple)	Statistics (2), Research Methods (3), Data Analysis (1), Public Policy (1), Quality Improvement (1)
Course level	No answer

For the online survey, participants were recruited from the same faculties as for the individual interviews. Five faculty members teaching within the following subject areas participated: Statistics, Data Science and Artificial Intelligence, Political Science, Public Administration, and Biology. The online survey was open for responses for 4 weeks. The detailed demographics of the respondents to the online survey are presented in Table 2.

Participants were asked about their field of teaching, personal experience in their respective fields, the type of DLMs they usually develop, their way of creating video lectures and their knowledge about texting these videos, their expertise in using tools for developing DLMs, knowledge about UD of ICT and related, their thoughts on considering UD in higher education, and their intentions with supporting diverse students and practicing UD. Participants were further asked whether they knew if the tools offered by their universities are universally designed, and how their universities facilitate them in practicing universal design. In addition, they were asked about how they managed migrating to the digital mode of teaching due to the COVID-19 pandemic. Although none of the survey respondents answered questions about their roles and course level, many said in their comments that they have several roles and teach at more than one course level.

2.2. Data Analysis

The collected data consisted of unstructured notes based on participants' expressed experiences, knowledge, observations, interactions, etc. The notes were then structured and anonymized, while keeping the original context. A six-phase framework developed by Braun and Clarke [10] for thematic analysis was used for the data analysis. After three iterations, three main themes emerged from the individual interviews and online survey. These are: *Type of digital learning materials*, *Issues with implementing universal design of ICT*, and *Teachers' needs and the role of HEIs in the implementation of UD* as shown in Figure 1. Each of the main themes have subthemes that are detailed in the results section.

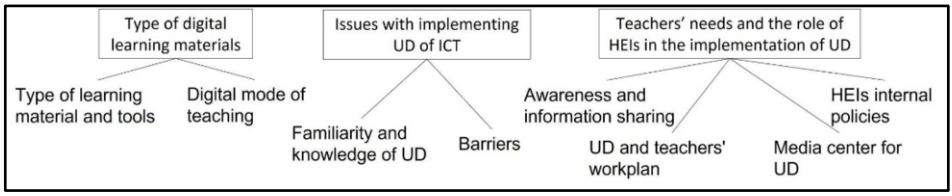

Figure 1. The three main themes with sub-themes.

3. Results

In this section, the main results and findings are presented. The results are organized into the three main themes that resulted from thematic analysis of interviews and online surveys. A table summarizing the main results is included for each main theme.

3.1. Types of digital learning materials

The first main theme relates to how teachers in HEIs develop and use learning materials in teaching, lecturing, and communication with students. This theme is divided into these

two sub-themes: *Type of learning material and tools* and *Digital mode of teaching*. The main results are summarized in Table 3.

Type of learning material and tools: All 12 participants reported they use text and written materials (documents, PDFs). Some also use videos of lectures or course-related topics, mathematical exercises, scripts, and LMS quizzes and discussion forums. Tools for developing DLMs included Microsoft (MS) PowerPoint, MS Word, LMS tools, Google Docs, Prezi, Excel, and RStudio and R programming language. No particular tools for making videos were mentioned by the participants.

Digital mode of teaching: All 12 participants used a digital mode of teaching. Ten said they had adapted quite well to the situation, although 2 were feeling more overworked than before the pandemic. All reported they received help from the university to conduct courses online. Nine said their preferred tools for online teaching were Zoom and/or MS Teams. Three reported the tools for online teaching were not fully accessible. The main challenges with online teaching were reduced interaction and less active students in online classes, and communicating with students through the LMS. The Norwegian regulations [4] require videos be texted if used as DLMs. Eight reported they did not know how to text videos, but two said they instead made the manuscripts available to students. The main reasons given for not texting videos were lack of time and no help with texting videos at the university.

Table 3. Summary of results Type of digital learning materials (N=12)

Sub Theme	Category	Participants reported	No. replies
Type of learning material and tools	Type of DLM	Textual/written materials (documents, PDFs)	12
		Videos of lectures or course-related topics	9
		Mathematical exercises, scripts, quizzes and discussion forums (LMS)	3
	Tools for making DLMs	Microsoft (MS) PowerPoint, MS Word, LMS tools	9
		Google Docs, Prezi, MS Excel, RStudio, R	3
Digital mode of teaching	Online teaching	Adapted/adjusted quite well	10
		Prefer Zoom and/or MS Teams	10
		Tools used for online teaching not fully accessible	3
	Challenges online teaching	Reduced interaction & less active students	3
		Communicating with students through LMS	5
	Texting videos – (knowledge & practice)	Does not know how to text videos	8
		Not done due to lack of time	10
		No help available from university	7

3.2. Issues with implementing UD of ICT

The second main theme relates to experienced issues when implementing UD on DLMs and what they know about UD of ICT, accessibility, and the Norwegian regulations [4]. This theme is further divided into two sub-themes: *Familiarity and knowledge of UD* and *Barriers*. The results for this theme are summarized in Table 4.

Familiarity and knowledge of UD: Nine participants showed partial or full knowledge of UD and would consider UD when making learning materials, while three reported they were not familiar with or have any knowledge of UD of ICT or any requirements on texting of videos for DLMs. Regarding UD practice, all 12 participants reflected that UD practice is important and must be considered and implemented within

the frames of the relevant subject field. Five with UD knowledge said UD is hard to practice, particularly the technical part of implementing requirements.

Barriers: The reported barriers mainly concerned the three main areas *technical aspects*, *awareness of UD*, and *organizational barriers*. All 12 participants expressed interest in learning more about the technical aspects of UD for digital tools and DLMs. The main challenges mentioned include overload of technical information and no time to learn the necessary technical aspects. Lack of UD awareness was stated by participants with no knowledge of UD as the main reason for not considering UD when developing DLMs. Eight participants reported they were not offered courses on UD or training on how to make DLMs accessible, although four had learned and adopted UD by their own initiative. Regarding organizational barriers, two participants reported that there is a lack of UD expertise in the university's public procurement.

Table 4. Summary main results Issues with implementing UD of ICT (N=12)

Sub theme	Participants reported	No. replies
Familiarity and knowledge of UD	No familiarity or knowledge of UD of ICT	3
	Partial or full knowledge of UD	9
	Considers UD for DLMs (participants with UD knowledge)	9
	UD hard to practice (participants with UD knowledge), especially implementing requirements	5
Barriers	Lack of UD awareness the main reason for not considering UD while developing DLMs	3
	Not offered UD course nor training on how to make DLMs accessible	8
	Learned and adopted UD by their own initiative	4
	University procurement lacks expertise in UD	2

3.3. Teachers' needs and the role of HEIs in the implementation of UD

The third main theme covers aspects such as what kind of support towards implementing UD teachers may need from their university, how HEIs are involved in the implementation of UD of ICT, and the institution's internal policies. This main theme is further divided into four sub-themes: *Awareness and information sharing, HEIs' internal policies*, *UD and teachers' work plan,* and *Media center for UD*. The results are summarized in Table 5.

Awareness and information sharing: UD awareness and information sharing was regarded as very important by nine participants, but requirements were not routinely considered. Two reported that accessibility support was available in the LMS they used. **HEIs' internal policies**: Five participants reported a lack of internal policies on UD of DLMs in their university, and one mentioned there were no initiatives regarding this from the university management. For advancing UD in HEIs, two suggested including UD in introductory courses for new employees and four said HEIs should provide UD experts to support teachers making their DLMs universally designed. **UD and teachers' work plan**: Ten participants said they need UD training and time for training, and all 12 said that not having the time to practice UD is a major issue. The help offered by the university for making DMLs universally designed did not solve the issue of not having enough time to practice UD. All 12 participants reported that they had no time in their work plan allocated to practicing or learning UD. **Media center for UD**: Five participants reported their university had a media center providing support with digital

teaching resources, while two reported UD support services, including help with video texting, were provided by third-party companies at their HEI.

Table 5. Summary of results Teachers' needs and the role of HEIs in the implementation of UD (N=12)

Sub theme	Participants reported	No. replies
Awareness and information sharing	UD awareness and information sharing important, but do not routinely consider the requirements	9
	Accessibility support is available in the university LMS	2
HEIs' internal policies	University lacks internal policies on UD	5
UD and teacher's work plan	Need UD training and time for training	10
	Help from university does not solve issue of lack of time for learning and practicing UD	8
Media center for UD	Media center available at university	5
	UD support provided by third-party company	2

4. Discussion

The findings in this study indicate that many teachers in HEIs in Norway do not practice UD on their DLMs, and that many lack awareness and knowledge of the UD regulations and requirements, training, sufficient time, and practical support from their HEIs to make DLMs universally designed. Practicing UD on DLMs is essential to ensure all students can access education, as demonstrated during the COVID-19 pandemic [11]. Further, the findings uncovered that most of the teachers in the study do not think that the guidelines are hard to follow when they are aware of the UD regulations and have enough time for practicing UD, but even then, many did not practice UD on their DLMs, which corroborates existing research [12]. Lack of time, UD knowledge and UD training are major issues that inhibits the practice of UD and confirms findings from previous research [7-8]. The results also indicate a lack of internal UD policy in HEIs, and that although HEIs may appear willing to provide their faculty members with necessary facilities and actions to implement UD of ICT, many HEIs seem to dedicate limited resources to media centers that can support the teachers in this area. The findings also indicate a lack of routines in HEIs for monitoring the tools available to teachers and students against compliance with universal design requirements.

Overall, the findings from this study suggest that HEIs effectively can prevent digital barriers by applying and implementing the regulations on UD of ICT and through adopting a top-down approach for implementing UD of DLMs in HEIs. In Norway, the HEIs and the authorities are important actors in promoting UD in DLMs and can help teachers in practicing UD when making DLMs. Corroborating with previous research [13-14], the present paper suggests that HEIs can do this by taking initiative through their internal policy, include accessibility as an integral part of the pedagogy, and making efforts towards practically promoting and ensuring that UD is being practiced in HEIs.

Limitations to this study include the relative low number of participants and that the study only covered HEIs in Norway. The former can partly be ascribed to the limited number of teachers in higher education institutions in Norway and the busy schedule of university teachers coping with the changes in teaching due to the COVID-19 pandemic at the time of data collection. Confining the study to only cover universities in Norway limits the usefulness of the study, although the situation for teachers in HEIs, their level of knowledge of UD, practice of UD, and experienced challenges when developing universally designed DLMs may be comparable to other countries in Europe.

5. Conclusion

This study investigated challenges faced by teachers when practicing UD of ICT and what support they might need from their universities to improve their practice of UD when developing DLMs. Based on the findings, we conclude that HEIs should prioritize UD of ICT in policies and ensure teachers get sufficient time and training on making universally designed DLMs. Further work within this topic could include evaluating whether ICT tools used in HEIs are equally accessible for teachers as well as students and extending the scope to also include HEIs in more countries. Finally, we would like to thank all participants that through the interviews and online survey contributed to the results of this study.

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Accessible University: Architectural Design for Special Needs Users Integration. Design Proposals for Politecnico di Torino

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Abstract. In Italian and international universities, more and more attention is paid to special needs users who are part of the student and academic community. The so-called special needs are students and employers with specific needs deriving from physical disabilities or cognitive difficulties of different nature and severity, for whom it is necessary to provide specific services for the ordinary carrying out of their activities forward their full inclusion in the university community. The problem of special needs full inclusion must be addressed by overcoming the idea that they constitute a separate group from the rest of the community. Indeed, there should not be a project for special needs, but all spaces should be inclusive and designed "for all". The paper describes the TAL, Turin Accessibility Lab research group, activities concern the accessibility of study spaces, within the perspectives of Politecnico di Torino Masterplan and with the involvement of the users themselves and in collaboration with the institutional actors who deal with users with special needs.

Keywords. Universal design, special needs students, university spaces, social inclusion

1. Introduction

During the pandemic, many students started their university careers without attending real spaces. Connected through online platforms from their homes, the students not only attended the courses but also worked collaboratively with their colleagues in group work and developed sociality with the academic community as much as possible. The organization of the virtual classrooms made it possible to continue with the activities in the emergency period and bequeathed an additional tool, now acquired by all, to make university activities more flexible, with some undisputed advantages. However, the return to in presence experiences, in classroom and university spaces is fundamental to make the university training experience complete. Indeed, it is not limited to learning but includes socialization, exchange, participation, and complimentary cultural activities that cannot be reproduced in the virtual dimension. The return to the classroom and to the physical space of the university is now more complex by blended teaching methods, which provide for extended accessibility to in presence users and to those forced into virtual presence. That leads to rethinking the quality of spaces and services and new needs of all members of the academic community are highlighted.

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The TAL - Turin Accessibility Lab - is a multidisciplinary research center of the Department of Architecture and Design of the Politecnico di Torino that deals with accessibility and social inclusion through research and teaching activities, working in networks with other accessibility labs set up by Italian universities. In the last few years TAL has begun a close collaboration with the university Special Needs unit which is the reference point for all users who experience difficult situations due to temporary or permanent disability problems, supporting them to overcome physical, perceptive, communicative, and cultural barriers. Among the services managed directly by the Special Needs unit, there is a one-to-one interview service, classroom for assisted study, and a rest area of the users with certified disabilities, in addition to the management of a community platform. The unit works together with other institutional figures such as the Diversity and Disability Manager, the Vice-Rector for Quality, Welfare, and Equal Opportunities, The Rector's Advisor for Social Assistance, Social Integration and the Rights of Persons with Disabilities and the CUG (Equality, Non-Discrimination and Anti-Harassment Committee. This team of institutional figures and operational units, dealing with complex and transversal issues, is constantly confronted with other parts of the organizational structure of the University, with skills and tasks in numerous areas such as logistics, culture, communication, construction, teaching. In this complex framework, the TAL offers an operative contribution to projects and new initiatives, proposing solutions to improve the physical and perceptive accessibility of spaces, considering the universal design principles [1].

2. The university development scenario

The development and progressive implementation of the University Masterplan projects is an area of close collaboration between TAL and the Special Needs unit.

The new projects under construction and planned expansion and reorganization of the University are integrated into the Masterplan, which is characterized by being a polycentric structure, not organized in a single campus, but characterized by a series of network structures in the city of Turin. The Politecnico community is made up of about 38,000 people, including 36,250 students, almost a thousand professors and just under 900 administrative and technical staff. It is a growing structure, with a forecast of 20% of students by 2024 and a growing increase in foreign students. Internationalization, openness to the territory, and intensification of collaborations with public and private institutions in the fields of engineering, design, and architecture are the programmatic lines of the University's strategic plan. These lines are reflected in the expansion model, which provides, in addition to the two campuses (Campus Engineering, in the headquarters of Corso Duca degli Abruzzi and Campus Architecture and Design, in the historic site of the Valentino castle), eight thematic hubs, in which teaching, research, and collaboration are integrated with external parties (fig 1). The polycentric structure has as its strong point the rooting with the city context and the triggering of numerous opportunities for urban regeneration and recovery of disused structures but poses the first complex problem: accessibility to the various university services corresponds in part to the urban accessibility, of the most complex accessibility challenges [2].

The development process of the Masterplan is supported by a work unit (Masterplan office) which has the task of giving a spatial configuration to the transformations to facilitate decision-making processes between the various stakeholders involved inside

and outside the University. These are not architectural projects, which are developed from time to time by specific professionals in charge, but qualitative and quantitative prefiguration that illustrate the results of the strategic choices of localization and redistribution of functions and services. In this context, the TAL has started a support activity that assists the Masterplan office to articulate the question, the preliminary studies and the prefiguration and subsequently, when the projects reach the definitive phase, the verification of the correct responds the accessibility requirements.

TAL collaborates with all these subjects by participating in thematic focuses on the various development initiatives of the Masterplan and at the same time involving the students of the university involved in the Inclusive design in engineering and architecture sciences course, the main users of the transformations in progress, in design experiments on the improvement of university services, accessibility and social inclusion. The activity proposed in the course allows you to deepen the users' point of view and better understand their needs and interpret them in the best possible way in the proposed projects, as in the reorganization of services for special needs and study spaces described below.

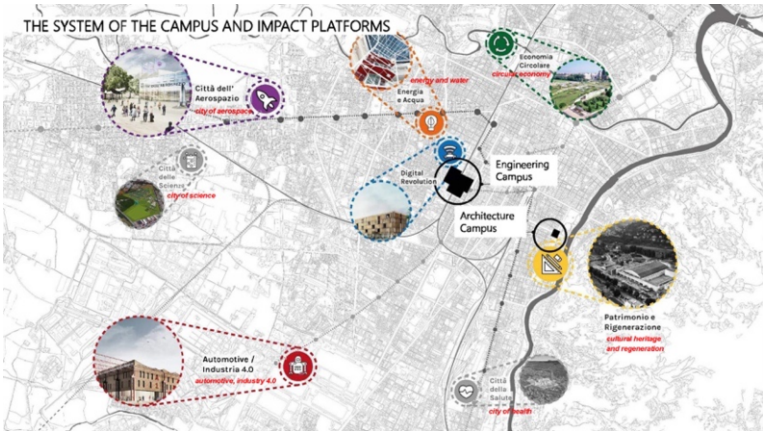

Figure 1. Development scenario of the Polytechnic of Turin according to a polycentric model that includes two campuses and decentralized thematic hubs (source: https://www.masterplan.polito.it/).

3. Inclusive design in engineering and architecture sciences

The course is among the free-credits of the University catalog, open to all 1st level Degree Courses of the Engineering and Architecture Area of the Polytechnic of Turin.

It aims to address and deepen, with a multidisciplinary approach, the issues of inclusion, usability and safety in the built environment, considered in a broad sense, with particular attention to the opportunities offered by IT.

The course includes teaching contributions on the following topics:

• overcoming of perceptual and physical barriers to improve the use of spaces;

• accessibility of communication and use of IT tools, aids and devices to improve accessibility;

• signage elements, visual displays, orientation.

During the course, students are involved in a multidisciplinary accessibility project on a complex theme in which they put into practice the contents learned in the theoretical

lessons through innovative solutions in different areas: the city, architecture, object of use, home automation systems, wayfinding, communication, web services, the internet of things, services and processes to support people in difficult and marginalized conditions. The design methodology is accessible even if students came from different disciplines (fig 2) [3]:

- identification of the problem and decomposition into components;
- collection, organization and analysis of data and information also through the use of questionnaires proposed to their classmates
- creative project or concept proposal

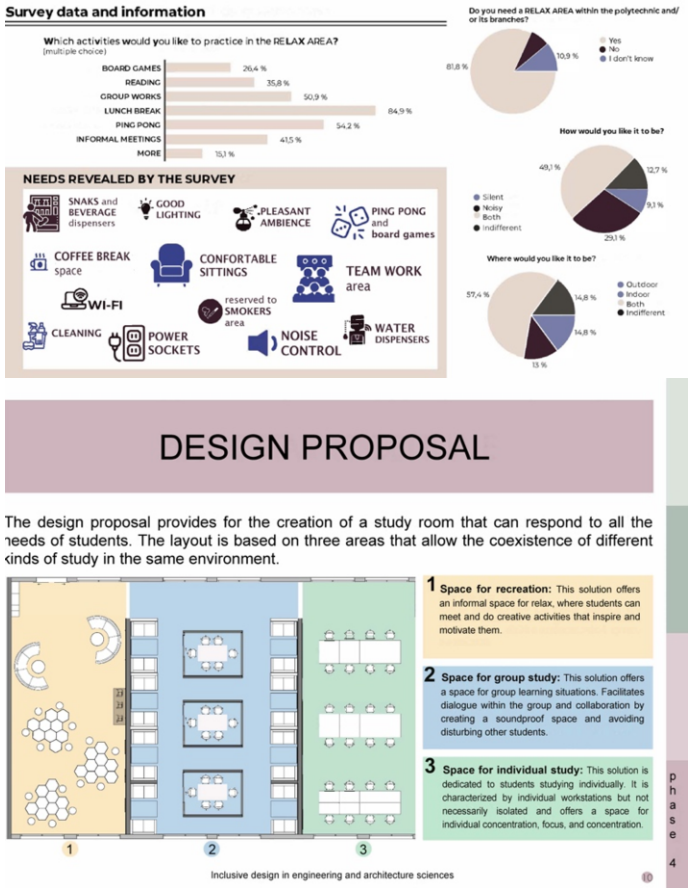

Figure 2. Examples of some elaborations of the students of the courses in Inclusive design. Above: data collection and analysis through questionnaires addressed to the student community. Below: concept for study rooms where it is possible to carry out individual or creative group activities.

The student thus learns to develop an analysis of the needs of different profiles of users and to correctly associate the project requirements and the possible performance responses referable to the territorial scale, external spaces, buildings, objects, communication tools, and technological and social systems.

During the last academic years, students were assigned the topic of accessibility by taking as a case study the offices of the Politecnico di Torino and the latest developments envisaged by the Masterplan.

The topics chosen and analyzed by the students concerned the spaces dedicated to study (multifunctional study rooms inside and outside the buildings), relaxation, leisure, physical activity, and religious functions, signage and wayfinding, reception, listening, and support services for students and University staff. The working groups are made up of students from different courses in engineering, architecture, and design

Each group chose a specific topic, proposing an innovative solution for improvement, adaptation, and expansion of functions and services.

For the study spaces, the students defined project needs and requirements according to the main study methods identified: individual and group [4]. In the first case, it is necessary to preserve silence, concentration, and privacy. In the second case, instead, dialogue and comparison between companions is necessary with an optimal choice and configuration of the furnishings [5].

They also pointed out the importance of having toilets and spaces, dedicated and acoustically isolated for relaxation, recreation, and refreshment, near the study rooms. They highlighted the need to more easily identify the location of the study rooms, the availability of seats, access control, and the possibility of extending opening hours.

4. Design proposals for Special Needs unit and study spaces

The design brief was defined starting from the analysis of the support initiatives that the Special Needs unit offers to students with disabilities or specific learning disabilities (SLD) during their training.

Having defined the activities and services that require a space of use, a detailed questionnaire made it possible to identify for each one the indicative number of people who use it, the frequency of use and all the requests related to the use of the spaces. In this way it was possible to outline a framework of needs and requirements to define the size of the spaces, the plant equipment, the furnishings and equipment and to identify the possible relationships between the spaces considering the activities that must be separated or kept close together or that it is also possible to superimpose in the same space at the same time or at different times (shared spaces).

The synthesis of the requests led to the identification of some spaces designed to respond to the specific needs of students with disabilities or SLD, such as rest and "one to one" interviews, while the study spaces were seen with a view to inclusion, thinking to flexible environments that facilitate the meeting between students and allow different forms of study: group, individual, assisted.

The following spaces were therefore defined:

- relax area: room equipped with 2 orthopedic beds, for the rest of the students with motor problems or specific needs
- one-to-one interview space: space dedicated to initial interviews and ongoing tutoring for students with disabilities and/or with specific learning disorders (SpLD) taken care of by the Special Needs unit
- counselling service: space intended for listening and psychological support for the entire student community

- waiting room: room in front of the listening space with a waiting and filter function, preferably with independent access to ensure privacy
- assistant's room: room intended to accommodate two health workers, when not involved in supporting people with disabilities present in the university
- special needs office: rooms for the staff of the service
- study room: study room, open to the entire student community, flexibly furnished, suitable for both individual study and group study
- individual study: space with individual workstations also equipped with dedicated software, hardware, and specific supports
- assisted study: space dedicated to students with SpLD who are accompanied in their studies by a tutor
- exams room: space intended for carrying out exams for students who require special conditions due to health problems or disabilities.

The second phase involved the definition of the guiding principles of the project, including fundamental (fig 3):

- short and long-term reversibility, and therefore the possibility of reconfiguring the distribution layout by adapting the arrangement of furnishings, workstations, partitions to different usage scenarios
- flexibility, meant to the availability of different types of work and study space: teamwork, individual study, informal activities, assisted study
- quality and comfort, that is, having comfortable spaces where the right balance between privacy and sociability is also guaranteed
- physical, perceptive and cultural accessibility: therefore, inclusive spaces, open and usable by all, recognizable and in which to orient oneself easily
- "values" communication.

In accordance with the indications of the masterplan, different design scenarios have been developed, taking into account some possible localizations of the University.

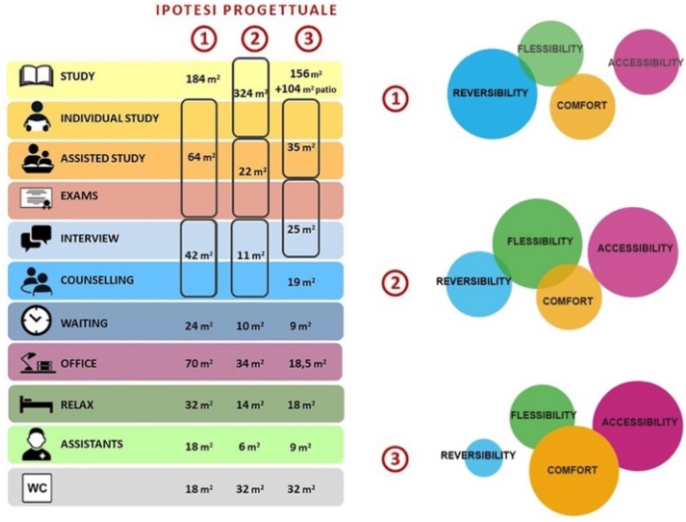

Figure 3. Comparison between the three design hypotheses and evaluation according to the established project requirements: flexibility, reversibility, comfort, accessibility.

Figure 4. comparison between the 3 distribution layouts developed in the refurbishment of the existing building to be adapted to a new pole for the Special Needs unit

One of the thoughtful areas is an external prefabricated building connected with the central corridor currently used as classrooms. It needs major redevelopment works because it is no longer suitable from a building and energy saving point of view. Three design hypotheses have been defined that respond to the project brief respecting the constraints of volumes and the structural grid (fig 4).

The three projects that follow an ever-increasing scale of commitment of resources, economic and working students, and offer different distribution and comfort solutions to be presented and discussed with stakeholders (decision makers, masterplan developers, and in the university community).

Particular attention is paid to study spaces, in which, in addition to the needs of students with special needs, the emerging needs of the entire university student community have been taken into consideration, including concerning recent innovations in the provision of teaching during the COVID-19 emergency period. In this regard, design hypothesis 3 proposes the creation of a patio that becomes an outdoor study area and an outdoor space where to transfer some socialization and collaborative activities [6-7] (fig 5). The different hypotheses were compared by considering the areas intended for individual activities in terms of dimensions, the coexistence of several activities in the same spaces in the often period of time or at different times (shared spaces) and the response to the principles of reversibility, flexibility, accessibility, quality and comfort, placed at the base of the project.

5. Conclusion

University campuses are often not suited to special needs users and interventions to improve their accessibility to services are generally limited to the regulation compliance, creating dedicated, but poorly integrated, spaces that generate barriers inside the university community. The problem of special needs full inclusion must be addressed by overcoming the idea that they constitute a separate group from the rest of the community. Indeed, there should not be a project for special needs, but all spaces should be inclusive and designed "for all" [8]. The special needs users' full inclusion can be achieved by applying the principles of design for all. For real accessible and usable university spaces, in addition to a strong top-down commitment by the university administrations, the overcoming of many procedural and procurement barriers that hinder the creation of works with a vision beyond simple "compliance to normative" is mandatory.

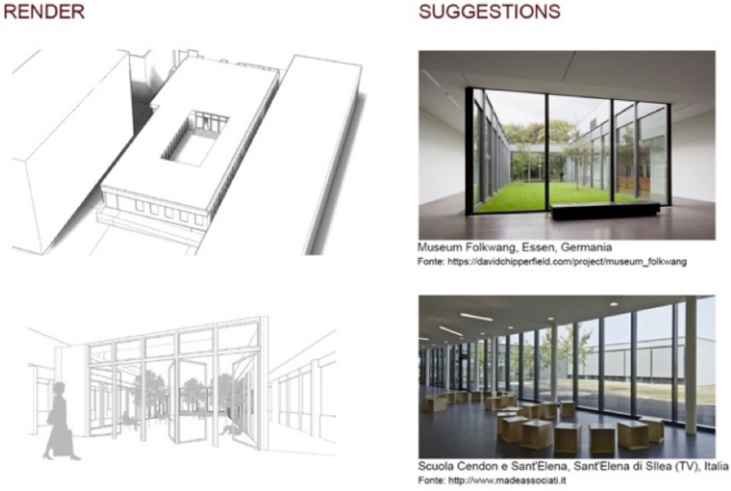

Figure 5. Hypothesis three with the patio that improves the indoor environment from the point of view of perception and natural lighting and that can be equipped for outdoor study activities.

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Higher Education and Universal Design in Tanzania. A New Model of Inclusion and Sustainable Development

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Abstract. The need to create a more inclusive society in Tanzania is confronted with a discrepancy between the aims of a regulatory framework, aimed at making Higher Education spaces inclusive, and the question of the right of access to built environments, particularly in universities. The study presents the pilot case of the RUCU's Learning Center for Disabilities to demonstrate that the combination of UDL, architectural accessibility and international cooperation can give impetus to new research and application themes, creating innovative models and good practices to be disseminated for a new shared awareness.

Keywords. Higher Education, Universal Design, Sustainable Development, Legal Framework, Low-middle income countries, Tanzania

1. Introduction

The emerging global human rights policy has identified the right to education as one of the tools for greater development of low- and middle-income countries. The perspective of this study focuses on the fourth goal of the 2030 Agenda, which addresses the question of the quality of education and the right to study in the United Republic of Tanzania: the creation of well-trained professors and the creation of an inclusive environment that allows access to high education, which is essential for the creation of an inclusive and in-development society. In order to respond to "the growing diversity of categories of students with special needs that increasingly exert pressure commitments on quality education for the quality of Higher Education (HE) offered" [1], it is necessary to consider the environment in which the specific programmes, seminars, workshops, the necessary assistance and the provision of the multiple services will be carried out.

This research intends to scrutinize the issue of accessibility right to the built environments in United Republic of Tanzania with a special reference to the spaces dedicated to HE. The study seeks to contribute to the implementation and strengthening of efforts aimed at making university spaces and educational offer more inclusive, with particular attention to students with disabilities, through the analysis of evidence on the availability and quality of services within representative university institutions, selected within the Tanzanian academic system. The research has employed review of literatures, legal documents and interviews with different stakeholders. Specifically, the research aspired to deepen the African documentary production (specifically Tanzanian) and, later,

to analyze some emblematic cases related to the most representative university spaces, trying to identify the main problems and which inspirational solutions related to Universal Design are able to interpret the local culture, suggesting appropriate strategies to improve inclusive education in HE institutions. The concertation of Universal Design for Learning (UDL), architectural accessibility and the reinterpretation of African construction languages, can represent the key to the creation of innovative models and good practices to be shared and disseminated not only in Tanzania but, with the necessary cultural declinations, also in the rest of Africa.

2. Higher Education and accessibility in Tanzania

The United Republic of Tanzania, a union of two countries – Tanganyika and Zanzibar, came into existence in 1964, following the independence of 1961 and 1964 respectively. In Tanganyika, the British regime passed political mandate to the nationalist government under the patronage of the Tanganyika African National Union (TANU).

In the then TANU manifesto (1971), education was embedded in the country's national building programme to rid the country from three enemies of development: illiteracy, deceases and poverty. Further, the Arusha declaration's policy of self-reliance, socialism and rural development were among others meant to promote people-centered development initiatives. Initially, the British colonial state had envisioned to establish the Faculty of Law in 1958. Nevertheless, the plan remained nebulous until October 25th, 1961 when TANU's aspiration of HE in Tanganyika became materialized.

At the initial stage, an emphasis was kept on having access to education, which meant, having infrastructure, human resource and teaching facilities: education was open to all, regardless of gender, ethnicity, race or disability. There was no specific attention to a certain minority group within the society: the focus was to serve the entire community. The Tanzania government as time went by, became aware of the legal developments at the international level, inviting governments to be conscience of the need for building inclusive environment in HE institutions.

Analyzing the situation at the international level, the same intentions are reaffirmed: the outcome document of the Second China-Africa Conference on Population and Development states that "The vision Africa We Want articulated in Agenda 2063 aspires an integrated, people-centered, and prosperous Africa, at peace with itself - leaving no one behind, reflecting particularly on inclusive growth and sustainable development. Furthermore, reports and statistics from the Tanzanian Commission for Universities (TCU), indicate an increasing trend in enrolment of students with disabilities in Higher Leaning Institutions. However, this positive trend does not correspond to the provision of quality services to people with disabilities, especially in the area of built environment.

2.1. Law and Governance of Inclusive Education

Julius Kambarage Nyerere, the first President of United Republic of Tanzania, in his speeches advocated for equality in community to broadly mean brotherhood (common good). His aspiration for brotherhood meant that education was destined to be by all account inclusive.

Inclusive education (IE) is not a new phenomenon in Tanzania but, while the government has worked to create and disseminate educational services (following the Nyerere's ideology), the built environment has presented more challenges because data,

and awareness of the existence of disabilities, have always been a very complex survey in Africa [2]. What explains the increased disability drop-out in education stemmed from the absence of a legal framework for IE. The United Republic of Tanzania has ratified the Convention Against Discrimination in Education, 429 U.N.T.S. 93 in 1979 and the United Nations Convention on the Rights of Persons with Disabilities in 2009. The government domesticated these instruments in principal legislations, including, The Education Act, Universities Act, The National Construction Council Act [3], etc.

This research sought to investigate the legal framework challenges in addressing inclusive infrastructure, with a focus on local tools. The National Education Policy 1999 vision 2025, is the roadmap of current education laws, including the Education Act [4], and Universities Act [5]. The Education Act is holistic legislation that provides general guidance on education, and how education should be primarily. The Law on Universities governs the registration and administration of HE institutions.

The existence of mentioned local legislation is continually improving the approach to Inclusive Education: from the advancement of teaching tools to the provision of accessible infrastructure to persons with special needs. Some of the achievements brought by the legislation include some fundamental points: the Universities Act ratified that people with special needs must form part of the decision-making organs (Senate and Council); buildings built under the auspices of the National Construction Council Act must provide for the insertion of elevators and accessible tools.

2.2. The University Infrastructure in Tanzania

The following University buildings were built between 1962 to 2008: University of Dar-es-Salaam (UDSM), Sokoine University of Agriculture (SUA), Mzumbe University (MU), Muhimbili University of Allied Health Science (MUHAS), Ruaha Catholic University (RUCU), Catholic University of Allied Health Science (CUHAS), Muslim University of Morogoro (MUM), and Mbeya University of Science and Technology (MUST). None of these universities have inclusive architectural environments.

In 1999 few aspects of IE were included in Tanzania National Education Policy to include Vision 2025. Ultimately, special education needs and disability became a prerequisite for infrastructural development in Higher Learning Institutions. In Tanzania, ratifying the United Nations Convention on the Rights of Persons with Disabilities in 2009, became mandatory for all academic buildings to be inclusive. The University of Dodoma was built when Tanzania started implementing the ratified laws in IE. Hence, being under that advantage, at least some aspects have met the required inclusive physical standards, including roads, paths, and the use of elevators in some buildings, responding to required standards in terms of realizing an inclusive environment.

2.3. Legal Framework

Universities in Tanzania are established under the Universities Act Number 7 of 2005. The Universities Act establishes TCU (Tanzanian Commission for Universities), an organ responsible to approve the establishment of the universities. TCU executes its functions in cognizance of the international, national laws and its own made guidelines and standards.

Tanzania has a total of 47 registered Universities and Colleges, in which 30 are fully-fledged Universities and 17 Colleges both private and public. TCU, in cognizance

that the current university architectural spaces do not meet the criteria of the UD, demands universities to self-assess themselves on the type and level of disabilities that can be accommodated on their premises. On the basis of the case history analyzed, many universities choose to admit students with specific disabilities, making an upstream sorting. The question, therefore, concerns the possibility of including students with disabilities defined as "critical" and their right to study. This paper intends to study the extent to which existing universities in the country satisfy and protect the right to inclusion in HE for people with special needs.

To ensure the effective functioning of a university infrastructure, TCU applies some requests which can be defined as a mandatory requirement. Section 24(2)(d) and (f) of the Universities Act provide: "(d) precise information on availability of library facilities, including the size, quality and quantity of the equipment provided in each programme of instruction by the institution; (f) an inventory of the physical facilities including land available for the exclusive use of the institution;", TCU requests universities to join the Convention Against Discrimination in Education, 429 U.N.T.S. 93, which entered into force on May 22, 1962, and was ratified by the United Republic of Tanzania on January 3, 1979. These conventions are reflected in the Tanzania Education Policy 1999 Vision 2025, which emphasizes access to quality education. Although many groups of people are protected by these conventions and the United Nations Convention on the Rights of Persons with Disabilities.

2.4. Universal design for Learning and architectural languages.

Speaking about inclusion in HE, and more generally to culture (SDG 4 of the 2030 Agenda addresses the issue of the quality of education and the right to study), is certainly a challenge that international cooperation is facing in places such as Africa. It is necessary to specify what is the approach, the language to be used to create a common ground for dialogue, a shared concept that can be deepened, translated, understood and then communicated thanks to a communion of purpose. An interesting analysis emerged during a summer school held in Dar Es Salaam and Berlin in 2016, with students of architecture, urban design and urban and regional planning programs at Ardhi University and the Berlin Technique University. "Collaborations between students from very different cultural backgrounds also meant facing semantic divergences: in Kiswahili, the translation of "heritage" is either *urithi*, which relates to material rather than intangible inheritance, or makumbusho, which is a memorial or a museum". In the end, the students decided to create a conceptual common ground by using the English term with a shared definition: "Heritage is what we inherit and what we keep" [6].

Translating this concept into UD principles it is important to underline that those ones must be related not only to material aspects but also to immaterial ones. In particular, by considering principle number four (Perceptible Information) [7] the immaterial factors must be linked to the concept of compatibility which also means to communicate, explain, and tell such that the meaning is immediately related to the culture of the place. Assuming that the concepts of UD are generally shared and, above all, understandable for all cultures would generate a misunderstanding that would entail an additional barrier [8].

While, as previously stated, numerous efforts are underway aimed at making the environments dedicated to HE inclusive, it is also true that in Tanzania the stigma of disability is still present and widespread, especially in rural areas. Hence the need to

include this theme in the fervent Afro-centric university debate regarding the architectural languages that are developing thanks to a new cultural awareness.

There are several studies, produced on the Tanzanian territory, aimed at contributing to the democratization of education through analysis of the evidence on the availability and quality of the services provided, as well as the role and functioning of Units for Students with Disabilities (SWDs) within selected Higher Learning Institutions [9]. A change of pace is currently detectable: an increasing number of Tanzanian universities have launched programs to include students with disabilities, thus demonstrating a progressive commitment to inclusion processes, especially in curricular programs. The training offer makes more and more use of elements also from the point of view of the built environment:

- Application of study programs using specific technologies for different disabilities: Assistive Technology devices, ICT, apps, specific programs and aids to facilitate the study
- Training dedicated to inclusiveness: creation of participatory programs thanks to international cooperation (agreements between universities, visiting professors, exchange of students etc...)
- Specific study of architectural spaces and resolution of architectural barriers working out projects that analyse the reachability of the universities' buildings and, therefore, their accessibility in relation both to every environment and to their connections.

To meet these needs, some universities have set up offices to support the educational offer and the accessibility needs of students with disabilities, introducing the use of new technologies and implementing study plans with methodologies related to UDL. “At the University of Dar es Salaam (UDSM), for example, there is a unit for students with disabilities coordinated by the School of Education (SoEd). The University of Dodoma (UDOM) has a bachelor’s programme in special education although there is no independent unit established at the university. At Mkwawa University College of Education (MUCE) a number of students with disabilities have been enrolled although there is no unit to cater for this group of students”. At RUCU University of Iringa, the training offer includes the use of some Assistive Technology devices, specific programs and aids as well as a team made up of professors specialized in UDL and support staff.

The methodology used to monitor the current state of universities, in terms of accessibility and inclusion, mainly uses mixed-method research approaches in which primary data is collected using questionnaires and semi-structured interviews with key informants including engineers, architects, property managers and owners, property users and academics of HE Institutions.

The findings demonstrate that, despite the potential for a sustainable built environment, key stakeholders have a low level of understanding. Other essential stakeholders did not have active roles in decision-making concerning building construction projects, while a few architects, aware of the basic design methodologies related to the UD and the need to create more inclusive environments, admitted to not including sustainability factors in their building design. Low levels of sustainability adoption (in terms of accessibility) in the built environment are due to a lack of a particular policy or policy statement on sustainable construction, high initial costs of

sustainable building, a scarcity of experienced professionals, and a limited selection of building materials [10].

The built environment that houses HE (especially the universities of Architecture, Design, Engineering and Education), where new professionals are trained, represents at the same time the place where the problems related to accessibility and UD emerge with greater strength and awareness, but also the laboratory in which to create new hypotheses and new effective languages that can be disseminated in the African territory.

3. The RUCU case

An example of this approach is the design of a pilot project of an Accessibility Centre for the RUCU University of Iringa (Tanzania) [1]. The development of this project at the Department of Civil Engineering, Architecture, Territory, Environment and Mathematics of the University of Brescia has led to the formulation of inclusive planning to be carried out in the City of Iringa, that allows exploring the accessibility of university facilities and create forms of support for students with disabilities, applying this investigation to the pilot case of the RUCU. Addressing the theme of UD and UDL has meant creating a new semantics, a new vocabulary to express the concept of inclusion: in a broader sense, accessibility refers not only to the removal of architectural and perceptual barriers, but also to the intelligibility of the entire environment. The concept of accessibility of a complex space such as a university cannot be reduced to individual buildings, access to certain classrooms or offices, overcoming internal elevations or creating bathrooms without architectural barriers. The fundamental element of this reasoning is the whole environment and primarily its reachability independently and without the need for aid, making people, all people, independent and self-sufficient: everyone must be able to access university spaces and various activities in order to perceive their belonging to the RUCU.

The main topics addressed were therefore the practicability of outdoor spaces, allowing access to different buildings and ensuring their usability, and the formulation of study and training plans for teachers thanks to the interaction of traditional learning techniques and the use of ICT that allow new visual, auditory and heuristic approaches. The result of the various intellectual, physical and linguistic efforts applied to this project, is the opening of a new methodological route that combines the different cultural realities through the realization of a physical, empirical and, above all, participated built environment. The possibility to share this compositional and design path with students and professors could be an additional element of deepening: being able to observe the reasoning, the analysis of the experience and university environments, found daily by those who have to teach and, on the opposite side, by those who must understand and assimilate, inevitably leads to new architectural and educational solutions. Methods and languages must necessarily be reconfigured in a long process of formulation, verification

[1] The stipulation of a MOU (Memorandum of Understanding), an agreement that established a partnership between the University of Brescia and the Ruaha Catholic University (RUCU) in Iringa, Tanzania, has started a research entitled: "The design of spaces in Higher Education and Culture in Italy and abroad in accordance with the principles of Universal Design, Universal Design for Learning and the ICF". The “Maria and Consolata Learning Center for Disabilities” project was developed at the Department of Civil Engineering, Architecture, Territory, Environment and Mathematics of the University of Brescia (granted by the Tovini Foundation and the Museke Foundation) by the architect Mariachiara Bonetti

and refinement, but the enormous potential of the on-site application due to the difficulties/opportunities present in the area, prepares for continuous experimentation.

During the research phase at the RUCU it was possible to create a discussion table with the different stakeholders of the university and, in particular, with the person responsible for coordinating the disability office, Prof. Salvius A. Kumburu, who specializes in inclusive teaching. During the interviews, some key questions emerged: the RUCU is composed of several faculties including the Faculty of ICT, the Faculty of Law, the Faculty of Arts and Social Sciences, the Faculty of Business and Management Sciences and the Faculty of Education that provides, among the others, a Bachelor of Education in IE. The combination of these disciplines allows to create a training environment in which the concept of UDL can be declined, deepened and communicated through different languages and educational specificities.

The importance of the implementation of this project lies in the fact that the current enrolment of students with disabilities in HE demands robust and rigorous projects that will among others provide evidence-based support to this group of students in their learning process. The RUCU's Learning Center for Disabilities, Figure 1. is expected to provide a conducive learning environment for students enrolled and other nearby universities.

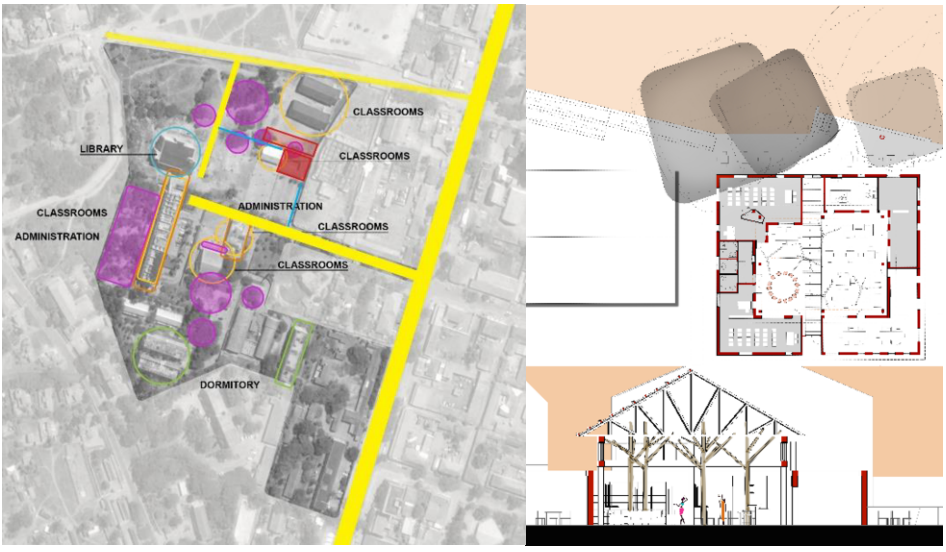

Figure 1. Project for the new RUCU Center: Analysis of the area and definition of architectural features.

4. Conclusions

There is therefore a regulatory system that indicates the need for inclusive architectural design for all buildings in Tanzania, both in HE and in public services in general. The question that remains unanswered is the extent of its implementation. There are many factors that hinder this implementation: the financial strength of HE Institutions, the available alternative, the lack of administrative will, the difficulty in building an Afro-centric architectural language that can be shared from the cultural point of view, free from xenophilic influences that are not adequate to the local value system and a

persistent cultural stigma against disability. New technologies and new ways of building will help the African continent mitigate the lack of inclusiveness, but it is also the matter of a more equitable global order, one which will truly see accessibility-conscious African architecture able to leave a tangible mark. By developing research and projects such as those carried out at RUCU it is possible to demonstrate that the combination of UDL, architectural accessibility and international cooperation can boost new themes of research and application, by creating innovative models and good practices to be shared and disseminated for a new shared awareness.

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UNIVERCITY. The University as a Metaphor for the City. Processes, Methods, and Tools for Contemporary Design

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Abstract. The university has always been the highest and noblest form of educational institution. Likewise, the relationship between the university and the urban setting has characterised the debate on the management and development of city policies. Cities and universities have been involved in urban regeneration processes, leading to profound changes. The progressive physical development of anthropised areas has gradually reached and definitively incorporated the oldest universities originally built outside the urban setting. This paper analyses the case of the university institution as a promoter of regeneration, inclusion, and development. We shall consider the close relationship between university, campus, and city, paying close attention to the recent evolution of methods for the planning and design of public spaces. The above is becoming a total social fact, a large field of application in which urban regeneration policies are reflected and in which the design dynamics of a resilient, accessible, inclusive, and sustainable city of the future converge.

Keywords. Urban regeneration, city, universal design, public space, university

1. Introduction. (Urban Regeneration, University, Public Space)

The term "*regeneration*" has imposed itself in cities with great ease in recent years and now leads a profound new analysis not only as far as planning reflection but also of many institutional actions and some "bottom-up" practices that should not be overlooked. The regeneration processes of unused or badly used city areas involve a series of actions that contribute to the improvement, adaptation. and revitalisation of infrastructures, services, and public spaces, while limiting as much as possible land consumption. Universities and University Campuses, great condensers of culture and community, are undoubtedly a part of these regeneration processes. The University is a focal point for the collective needs of transformation; its role is by no means as reductive and simplistic as being just a cultural organization, but rather, it is that of a place dedicated to expressing the life,

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education, and preparation for the world of work of the people who will transform the world in which we live.

Italy's Polytechnic of Milan is moving towards dynamics of this type, for example, with the intent of catching up with international *benchmarking,* represented by cases such as the Campus of the University of Delft and the Amsterdam University College, designed by Mecanoo, of Ostfold University College, designed by Reiulf Ramstad Arkitekter or the new Campus of the University of Malaga designed by Urban Ecosystem. In these cases, the project triggered and guided large urban renewal processes.

It is no longer a matter of elaborating innovative redevelopment plans for city areas or filling in the blanks of abandoned industrial areas, obsolete technological installations, degraded residential areas, undeveloped spaces, inexplicably surviving agricultural spaces, and so on.

Now it is rather a matter of coming up with new approaches for developing projects that will solve emerging urban problems, such as how urban intervention is conceived, the relationship between sectoral plans and circumscribed projects, building networks of actors that would include unconventional roles, and introducing new ways of understanding living arrangements by means of accessible, resilient, and sustainable practices.

Universities should be viewed as important nerve centres and primary actors in the contemporary scenario of the city, and as developers of urban and social regeneration and renewal strategies. Universities are osmotically dependent on cities and the services they can offer; with a trend of broadening and more international student populations comes the need for more services in terms of infrastructures, environments, businesses, social assistance, accessibility, and leisure facilities. Thus, Universities should be seen not only as places where culture is propagated, but also as pieces of infrastructure offering a plethora of new public spaces and activities available not only to students, as was the case in the past, but the community at large. From this point of view, the function of public spaces is for individuals to be able to gather, aggregate, and relate with others and thus share needs, desires, and knowledge.

"Public space is an indispensable component of the public sphere, where the exchanges and relationships, discovery and knowledge, action and interaction of all the individuals that are part of the public can take place and become visible […]. The public space is the symbol of the relational dimension of society, a shared value, beyond any nostalgia, any ideology, and any sense of belonging, whose project and care can really contribute to the enhancement of public life and, consequently, an improved quality of urban life for everyone." (Cicalò, 2010)

The purpose of our study is to investigate Campuses and Universities to show that they are indisputably an economic, cultural, and social driving force, all the more attractive today for their accessibility, visibility, and connectedness with other spaces. University facilities now provide physical public spaces for social interaction.

2. EVOLUTION and CHANGE OF UNIVERSITIES

"Architects fulfil their mission when they create better living spaces, perpetuating the humanistic force which has fuelled European cities and which we must pass on to future generations. Beauty as an antidote to conflicts is a value that enlightens us and helps us

plan the post-industrial society in which knowledge is the real material we want to help spread." (M. Botta, 2015).

The history of some European universities is almost millenary, which includes their architecture, such as the universities of Milan, Bologna, Oxford, Padua, Paris. Many prominent universities, including on other continents, date back to at least the 19th century. In most cases, the history of a university institution does not correspond to that of its current architecture; over the centuries, or at least in recent decades, the most prestigious universities have undergone changes as far as departmental headquarters, expansions, destructions, reconstructions, all the phenomena that a "living" environment can experience, especially one that accommodates a plurality of functions, an extremely variable number of users, and needs, handling the pressure of present reality while looking to the future.

Contemporary university architects are usually confronted with the redevelopment of a historic building or at least a wing, department, or library. Opportunities to design a university complex from scratch are rare, especially in Europe. Whatever is being built, there are guidelines to be followed, where the pedagogical value takes precedence over the functional and aesthetic. University architecture participates in an educational project which should stimulate a desire for knowledge, expressing creativity, and the awareness of study and research as a value for society. As a place dedicated to the production and use of knowledge and culture, a university should promote the development of social skills and contribute to the psychophysical well-being of its denizens while establishing a new link with the city. As qualified human resources, ideas, and innovations converge in a university, there is generally a great international openness and exchange of information and knowledge.

2.1. University, city, cultural sector

"The city has become a land of investigation and research, a privileged place for the study of society and its movements, [...] creating a strong link between architecture, urban planning, and the social sciences." (B. Secchi, 2005)

The traditional model of a city fragmented into parts and functions is now joined by that of the *multiple city*, a complex and multifunctional node in which local and global networks are intertwined. Some places in the city are now able to respond, with variety and dynamism, to the evolution of user demand and expectation; we are referring to real *city users*, together with a series of actors co-starring in the management, creation, and use of city structures. At the same time, the consolidation of the environmental culture, the changing economic dynamics, and the recent socio-cultural transformations have pushed the centre of gravity of the project from the *centrality of function* to the *centrality of place*, engendering new lines of research endogenous to the action of urban organization and the role of its constituent elements.

As a part of the city, a university should be perceived as one of its most important strategic nodes, though which the city can open and expand its borders towards a global knowledge market. As universities are especially dedicated to producing and circulating knowledge and cultural and technical information, they are catalysts for human capital, actively involved in technology transfer policies, and at the crossroads of global research, innovation, and development networks. However, the history of the institution has been changing towards a restructuring of spaces more open to and in greater connection with the surrounding urban infrastructure.

We shall now look at how European universities have been dynamically linked with the urban fabric since the very beginning of their history and throughout their evolution. Universities and cities experience a continuous dialogue, often explicit and constant, sometimes shy, or unspoken. Academic institutions are forced to consider and interpret socio-cultural changes to make the best of them. Unlike the experiences of other countries, where self-sufficient campuses are far from large residential agglomerations, the European story is an evolving one, as we mentioned.

Universities attract younger generations who are seeking improvement and the acquisition of intellectual and motivational tools to lead society into the future. The twentieth-century idea of the university as an ivory tower of splendid isolation survives only in the now dusty mythologies of certain political views and information based on hearsay and clichés. Universities that are part of an urban setting are becoming more open to diversity, whose purpose it is to welcome and give new and temporary citizenship to that which society initially perceives with distrust, providing it with a new and clearly recognizable guise.

Universities and cities have a shared destiny of continuous and inevitable exchange of knowledge, resources, and human capital, like the two sides of a magnet.

Today's universities attract younger generations who are seeking improvement and the acquisition of intellectual and motivational tools to lead society into the future. The twentieth-century idea of the university as an ivory tower of splendid isolation survives only in the now dusty mythologies of certain political views and information based on hearsay and clichés. Universities that are part of an urban setting are becoming more open to diversity, whose purpose it is to welcome and give new and temporary citizenship to that which society initially perceives with distrust, providing it with a new and clearly recognizable guise.

One of the objectives of this research is to promote greater clarity as far as the fields of action of university campuses connected to the city and the role they play in urban regeneration processes, to illustrate their meaning and define their strategies.

3. UNIVERSAL DESIGN: A NEW WAY OF UNDERSTANDING URBAN QUALITY and ACCESSIBILITY

Accessibility is a transversal discipline with far-reaching human, social, and economic objectives. Improved accessibility corresponds to more widespread *urban comfort*, leading to fewer sources of danger and situations of discomfort and fatigue for anyone. To organize the mental processes that normally go into the preparation of any project, we should start by considering this qualitative aspect together with the other specific sectoral disciplines.

The concept of accessibility, a qualitative characteristic that allows people in general to use built spaces easily and to the fullest, along with the equipment they provide, includes the fundamental aspects of safety and comfort, as is the case in projects for the public spaces of universities and campuses. Italy's Ministerial Decree 236/89 established in 1989 the meaning of architectural barriers by describing technical accessibility, adaptability, and visitability requirements. Therefore, we can affirm that accessibility is a universal discipline with far-reaching human, social, and economic objectives, to be pursued gradually and consistently, at all levels, and by any means.

Thus, the goal of accessibility is to maximise autonomy, including in contemporary Campus projects, no matter the psycho-physical condition of a person, be it temporary

or permanent, for a daily use of all facilities as effortless as possible for everyone involved. Improved accessibility thus means more widespread urban comfort and fewer sources of danger and situations of discomfort and fatigue for anyone.

3.1 Environmental accessibility and inclusion in university campuses

Environmental design draws from knowledge in fields such as accessibility, reachability, usability, comfort, user safety, communicativeness, mobility, and so on. Legislation has been citing the terms accessibility and *inclusion* more and more and in various ways, and so have guidelines that affect all areas of society (UN, 2006, Preamble). Accessibility expresses the level with which places, goods, and services guarantee that each person will develop their life (Lauria, 2012). However, *accessible environments* are not only a tool for personal development, but also a collective resource that can raise the social capital of a community. While expanding individual freedoms, social opportunities, and knowledge, accessible environments encourage everybody to participate in the life of a community and contribute to the growth of a society, leading to greater social and economic development. (Touche Ross, 1993; Buhalis et al., 2005; Darcy and Dikson, 2009; SL&A, 2013).

As an example, let us take places of cultural interest such as universities, where accessible environments promote a higher presence of visitors and students together with visitability and therefore higher increased vitality and attractiveness for local societies (C.A.R.E., 2006; Arenghi et al., 2015). The concept of accessibility has undergone a profound revision over time, mainly as a result of the evolution of the concept of disability, to which it is historically linked.

Nowadays, it is seen as the result of a complex interaction between "persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others" (UN, 2006, Preamble). Thus, we can see how, in contemporary campuses, accessibility went from being a technical-normative discipline to taking on the role of a planning discipline, expressing a plurality of civic values and cultural meanings.

Thus, from that of "place free of architectural barriers" or "in accordance with", the concept of "accessible place" takes on the broader meaning of *inclusive*, open, and sensitive to diversity, which can provide comfort and safety to people with different issues and differing degrees of freedom. According to this vision, removing architectural barriers is not enough to improve the degree of accessibility of a place, such as a university building, an adaptive process is required by which environmental qualities are introduced that may be lacking or absent, which may be contextual, social, spatial, functional, etc. An improvement in this direction would have to consider spatial and functional qualities that can guarantee a person's autonomy and well-being which did not come with the building and were not added later (Lauria, 2012). The concept of accessibility has evolved over the years, eventually including a greater number of users, largely based on requests from the community. This widening horizon has led to the superseding of the design approach based on special solutions—that is, creating environments with restricted accessibility and equipment intended for users with special needs—, by specific design methodologies of various types meant to make spaces accessible for a wide spectrum of population.

Among these methodologies is *Universal Design* (Mace, 1985; Mace et al., 1991), according to which products and environments should be "usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." (Center

for Universal Design, 1997), which definition has been adopted by the *UN Convention on the Rights of Persons with Disabilities* (UN, 2006, Art. 2).
This definition shows that collective space projects are commonly based on generalisation, which amounts to trying to understand phenomena and trends in their entirety and to set measures and solutions that will prove to be valid for most people. This scenario, as reflected in the world of universities, implies that Universal Design represents the most suitable and reasonable methodology for use in the collective space.

Therefore, the application of Universal Design in the collective space project does not so much aspire to define perfect solutions for a particular individual, as it tries to define solutions that are as compatible as possible with everyone's needs (Lauria, 2012).

4. UNIVERSITY AS A CITY. The Milan Polytechnic case

"The city is the place dedicated to the production and use of knowledge and culture. The University is the place where qualified human resources, ideas and innovations converge, where there is generally a high international openness favouring the transit of information, and knowledge." (P. Dilorenzo, E. Stefani, 2015).

The Campus theme certainly falls within the interests of modern architectural design, both in its more sophisticated building type aspects, and in terms of its urban value, creating a system of multiple scenarios, societies, and cities united by the changing values and functions which the university establishment has experienced over the years. The concept of campus developed in the United States for the management of primary university spaces and cloned from that of the English college, has naturally and constantly evolved, taking on different aspects (M.Biraghi, I. Valente, 2015). The relationship between city and university has also evolved with the concept of campus. The progressive physical-material development of anthropised settings has gradually reached and definitively incorporated the oldest universities, originally outside the city. The case of the Milan Polytechnic is a manifestation of how a campus no longer represents a closed place dedicated exclusively to culture, but rather proposes itself as an integrated, flexible, comfortable, and interactive entity capable of implementing the degrees of freedom of public space use. The border between the university and the city must become porous, or rather, non-existent. In a healthy knowledge society, the university becomes the city, and the city becomes the university.

Therefore, today's universities are important *urban protagonists* and condition inclusive development processes, accessible and integrated with the city, stimulating urban development and transformation processes, and creating new productive centralities in step with the demands and needs of contemporaneity. The Milan Polytechnic paradigm highlights these dynamics.

Since 2017, the Politecnico has launched an investment policy to modernise and adapt its facilities to international quality standards which are now indispensable to compete with European and world universities.

To this end, the VIVI.POLIMI strategic project has been launched, which involves the rectorate, professors, research fellows and architects, in designing the *campus of the future* with particular attention to the quality of social, relational, and study life in everyday actions. Said quality involves confined spaces, open spaces, gardens, avenues, squares, and places of aggregation and study, within a spatial continuum that unfolds between full and empty spaces, and categories of users.

This is a strategic project that aims to update the quality of the work, research, and teaching areas of the Milan Polytechnic, as part of an international logic increasingly open to interaction between the University, the City and Inclusiveness. After years of precise implementations, the project has now achieved the goal of outlining the design of the Campus of the future. The project activity of the working groups led to the definition of Leonardo's strategic Masterplan parallel to a similar project in the Bovisa area, which proposes to update and enhance the quality of life in indoor and outdoor spaces in an attempt to plan ahead for the needs of the new generations. The operations that were carried or are now in progress are inspired by the logic of environmental compatibility and sustainability, which factors represent the connection of an overall narrative. The Vivi.Polimi@green and Vivi.Polimi@health programmes, launched from the very first ideational steps, constitute the backbone of the Masterplans under construction; a cultural approach to the project in full harmony with the consolidated demand for Sustainability and Health.

5. CONCLUSIONS

Expanded usability, porosity of spaces and functions between city and university, and enhancement of the *campus-city concept* are the types of knowledge involved in environmental design most likely to consider real inhabitant needs and expectations. As a resource or environment easily available to any type of user, accessibility introduces an element of pure realism in the discipline of planning, the Campus of the future project in this case, responding to a need for equity and social inclusion while fragmenting into a plurality of needs the model according to which the great process of anthropisation of the world took place.

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Accessibility Improvement of Public Schools Through User Involvement in JAPAN

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Abstract. According to the amendment (2020) of the Act on the Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc. in Japan, public primary and junior high schools, which are newly built/renovated/extended, should be designed to be physically accessible for students with special needs. In addition, existing schools should also make efforts to improve accessibility. On this background, this paper focuses on the methods to effectively promote accessibility in schools that is achieved through user involvement for inclusive education. The survey subjects were all 164 public schools in Saitama city. A questionnaire to all schools was conducted to find out 1) the features of physical obstacles impeding inclusive education and 2) examples of user involvement in the planning stage of accessibility. In the results, accessible toilets have been installed progressively. However, inaccessible routes and spaces remained because there were no lifts in most existing schools. Regarding user involvement, a good practice was discovered in one case of restroom renovation which reflected parents' requests. In reality, because of the limitation of the budget of the municipality, it was obviously difficult to provide sufficient accessibility in all 164 schools in the short period. To achieve fully accessible schools for everyone, it is crucial to create short/mid/long-term facility management strategies and to share knowledge/skills regarding accessibility improvement among administrative officers, architects, and users, so that they can find efficient and effective ways to promote accessibility.

Keywords. Public schools, School buildings, Accessibility, User Involvement

1. Introduction

In Japan, public primary and junior high schools, which are newly built/renovated/extended, should be designed to be physically accessible for students with special needs, according to the amendment (2020) of the Act on the Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc., abbreviated as the "Barrier-Free Act". In addition, existing schools should make efforts to improve accessibility as well.

Before that, these obligations to guarantee the accessibility of schools were placed on only special schools, so that this amendment was evaluated as a breakthrough in the history of inclusive education. It can be said that the triggers of this progress were the ratification of the Convention on the Rights of Persons with Disabilities and the Tokyo

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2020 Olympic and Paralympic Games. Besides that, Japanese schools are expected not only to play a role as education facilities but a role as evacuation centres in the case of natural disasters. The recent frequent natural disasters, such as the huge earthquakes and flood disasters, make us aware of the necessity of the accessibility of schools as evacuation centres for everyone.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) conveyed a survey to clarify the actual situation of the accessibility of all public primary and junior high schools in 2021 and set the installation targets for 2026 regarding accessible toilets, step-free access, and lifts as shown in Table 1. Based on these targets, municipal governments need to manage their own school facilities to approach the goal. However, the practical methods and difficulties to improve the accessibility of schools under municipal governments are unclear. In addition, how to reflect user needs on school planning/refurbishment practically are also indistinct.

Therefore, this paper focuses on the methods of school facility management to effectively promote accessibility in schools, which will be achieved through user involvement for inclusive education.

Table 1. Targets laid out by MEXT for accessible public schools

Objective			2021	2026
Accessible toilets		School buildings	65.2%	All schools designated as evacuation centres (approx.95% of public schools)
		Gyms	36.9%	
Step-free Access	Gates to entrances	School buildings	78.5%	All schools
		Gyms	74.4%	
	Entrances to classrooms	School buildings	57.3%	All schools
		Gyms	57.0%	
Lifts		School buildings	27.1%	All schools where students with special needs enrol (approx. 40% of public schools)
		Gyms	65.9%	All schools where students with special needs enrol (approx. 75% of public schools)

2. Literature review

Legal systems to guarantee accessibility of buildings have some differences between countries. In Japan, accessibility of buildings has been stipulated in the Barrier-Free Act, not in the Building Act. The accessibility guidelines [1], which were created by the MLIT (Ministry of Landscape, Infrastructure, Transport, and Tourism), show details regarding how to design public/private facilities from the perspective of accessibility. There are also guidelines for managing the facilities of primary and junior high schools [2], including learning spaces for students with special needs, which were created by MEXT. Local governments seriously need to promote accessibility in their schools based on them.

As for international reviews, Bar & Galluzzo (1999) [3] elaborated the measures of Universal Design for accessible schools according to the Americans with Disabilities Act (ADA). Although the Barrier-Free Act is less enforceable than the ADA, it is quite suggestive in terms of planning the ideal school buildings. On the other hand, Francis & Joyce (2018) [4] in Ghana and Pastraporn et al. (2016) [5] in Malaysia examined the physical environments of schools in each country in terms of inclusive education and Universal Design. They attempted to reflect their results on political measures for better

accessibility in schools. In addition, Mualla & Selen (2012) [6] illustrated that the policies and specifications regarding physical environments for inclusive education in Turkey tended to be technical and complementary for students with disabilities. They attempted to apply UD principals to school planning for all students.

On the contrary, Japan still has fundamental problems of accessibility in schools, though there were several guidelines as mentioned above. Some papers dealt with physical environments for students with special needs in special schools [7][8], however recent papers regarding general schools for students with special needs are few. Junko & Satoru (2013) [9] showed the effective methods of restroom renewal for everyone through user involvement in general schools. It is expected that these methods will expand the target from restrooms to all school buildings which should be refurbished.

3. Methodology

As a case study, the research targets were all municipal schools in Saitama city, which is one of the biggest municipalities in Japan. In 2021, the population of the city was approximately 1.3 million people and there were 104 primary schools, 58 junior high schools, and two special schools. In the same year, Saitama city produced the rebuilding/refurbishment plan of the schools for the next 30 years and will review it each ten years. The points regarding updating school facilities were 1) efficient facility management, 2) enhancement as evacuation centres, 3) eco-friendly facilities, 4) adequate ventilation, and 5) accessibility for everyone. To proceed with them as planned, it is important to clarify the actual situation of each point and to find concrete measures. Of this whole plan, this paper focuses on accessibility.

The questionnaire was conducted at 164 municipal schools between October 21st and November 30th in 2021. The respondents were the staff of school management. Of the 164 schools, 95 responded (57.9%) as shown in Table 2.

Table 2. Details of the responses

	Target number	Responding Number
Primary schools	104	61
Junior high schools	58	32
Special schools	2	2

The items examined to evaluate accessibility were as follows;

- Facilities for physical accessibility: lifts, accessible toilets
- Routes for physical accessibility: Entrances to the school, classrooms, rooms for teachers and staff, and other facilities
- Facilities for students with intellectual disabilities, foreign students, and students with different gender identities: relaxation spaces, specific spaces for learning Japanese, specific spaces for changing of clothes, and toilets

In addition, the opinions of the respondents regarding the problems of school facilities for students with special needs and the necessity/challenges of refurbishment for better accessibility through user involvement will be disclosed.

4. Results and Discussions

4.1. Features of target schools

Firstly, according to the statistics of Saitama city in 2021, 1,044 (1.5%) primary school students out of 67,631 enrolled in special classes, and 407 (1.3%) junior high school students out of 31,742 studied in special classes. In addition, 56 students with profound and multiple disabilities enrolled in two special schools.

Regarding the status of special classes in target schools, all 93 primary and junior high schools, except one school, had one to four special classes. One special class was for students with low vision and the others were for students with intellectual or developmental disabilities.

In terms of physical disabilities, 19 primary and junior high schools (20%) had one student each who used a wheel chair or cane. Of the 19 students, 10 enrolled in general classes, seven in special classes, and two were unknown. In addition, five primary and junior high schools had one student each who needed medical care, such as suctioning and urethral catheterization. Three students out of the five enrolled in general classes and two students studied in special classes.

Secondly, considering the features of school facilities, the rebuilding/refurbishing plans of Saitama city mentioned the heavy financial burden for their management. Many reinforced concrete schools were built in the 1970's and 1980's, and the deterioration of these schools causes facility problems. In fact, as described in Figure 1, more than 60% of school buildings and 50% of gyms of the target schools were over 40 years old.

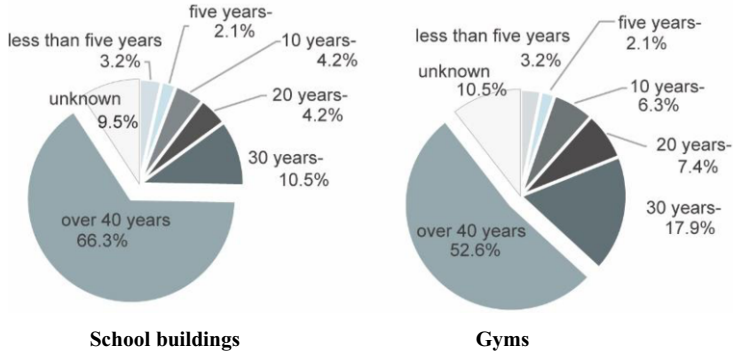


Figure 1. Age of school buildings and gyms of target schools

The amendment (2020) of the Barrier-Free Act is expected to provide accessibility steadily, especially in new schools, so the focus is the accessibility of most existing school facilities.

4.2. Lifts and accessible toilets

52 target schools (54.7%) out of 95 had lifts. However, 25 of which had lifts only for freight. Lifts which students could use had been installed into only 27 target schools. On the other hand, 34 target schools out of 43 which had no lift were built over 40 years ago. Thus, vertical accessibility still presented difficulties.

Regarding accessible toilets, 79 targets school (83.1%) had one or more. Comparing our 2010 survey results [10] of 45.1%, schools with installation of accessible toilets had

increased considerably. Half of the target schools have one accessible toilet on the ground floor and16 schools (16.8%) have one on each floor. The others had specific features, such as two accessible toilets on the ground floor or one in each school building.

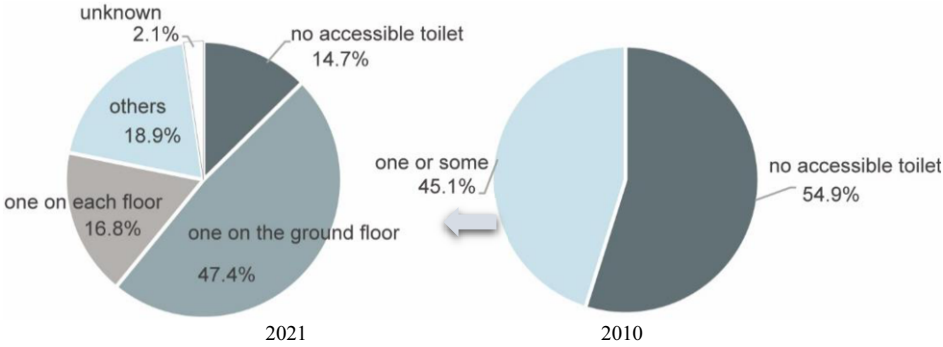


Figure 2. Installation of accessible toilets

4.3. Accessible routes not requiring assistance

According to Figure 3, first, regarding accessibility to the school buildings, approximately 80% of schools had accessible routes not requiring assistance from 1) gates of school sites and 2) parking spaces. The access to gyms also had similar high percentages. On the other hand, entrances for teachers and school staff at half of the target schools were inaccessible. It means that teachers and school staff who use wheelchairs almost never work at those schools.

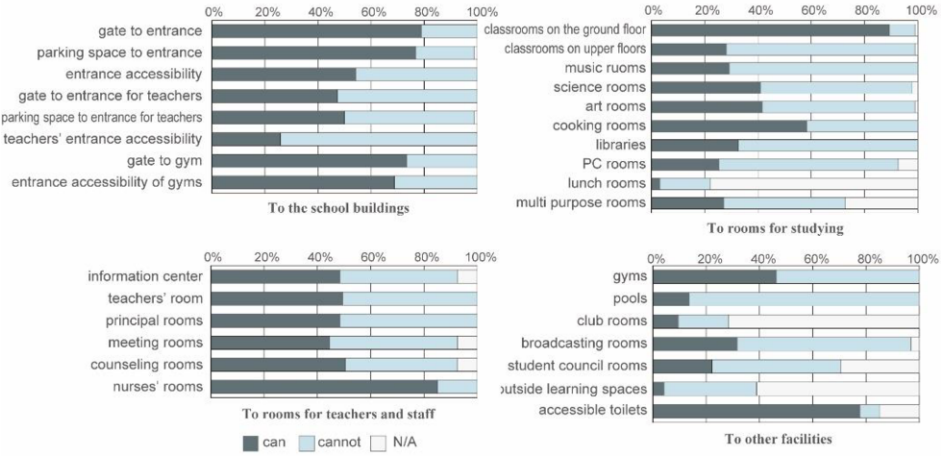


Figure 3. Self-access for students with reduced mobility

Second, as to rooms for studying, classrooms on the ground floor were the most accessible. However, more than half of target schools had difficulties in accessibility to classrooms on the upper floors, which included rooms for music, science, art and so forth. It is apparent that insufficient physical environments impede students' learning.

Third, the percentage of accessible rooms for teachers and staff stayed around 50%, except nurse's rooms which were generally located on the ground floor. It can be said that whether these rooms were accessible or not depended on their location.

Finally, regarding access to other facilities, e.g., gyms, pools, and broadcasting rooms, low percentages of accessibility were found except regarding toilets. These rooms are also important for the quality of students' school lives, so the accessibility of these rooms should be considered as well.

4.4. Facilities for students with intellectual disabilities, foreign students, and students with different gender identities

Moving on to facilities for students with other special needs, 26.3% of target schools had proper rooms where students with intellectual disabilities could be relaxed or relieve stress, such as play rooms, snoezelen rooms, and tatami rooms. It appears reasonable that the other target schools, which had inadequate (27.3%) or no such rooms (38.9%), also had the need for these kinds of rooms for their students.

Regarding specific spaces for foreign students to learn Japanese, 20 target schools had such spaces. In addition, instructors for Japanese supported them a couple of days a week. However, 27 schools which had some foreign students didn't provide any specific rooms or support. This result needs to be more investigated whether those foreign students need support for Japanese or not.

As to facilities for students with different gender identities, more than 80% of target schools answered that they took gender identities into account when those students use toilets and change clothes. In many cases, they could use accessible toilets. However, one of the schools added comments that it was inconvenient for them to use because of the distant location from their classroom.

4.5. Problems of school facilities for students with special needs from the viewpoints of the school management staff

According to the free answers, low-quality facilities because of deterioration were considered common problems. They had many facility problems of whole school buildings, toilets, and gyms not only for students with special needs but for all students. In addition, in terms of roles as evacuation centres, planned maintenance and bottom-up management were strongly required.

Cost of refurbishment was also a fundamental issue. In particular, difficulties to install lifts or stair lifts were often noted. Some of the answers argued that it was hard to gain the understanding of parents about installing a costly lift for one student. However, it can be pointed out that this is a misunderstanding. The lift will be for future students/teachers/residents with reduced mobilities. Such viewpoints are still insufficient.

One of the respondents answered in detail. "Students need to enter the school site from an inclined road or stairs. The school has a stair lift, though students need staff support to use it. The room doors are hard to open for wheelchair users. The narrow aisles in rooms and the high sinks are also difficult for them to use. Eventually the refurbishment of whole buildings will be needed." In this case, each facility problem can be divided into the following categories; 1) minor refurbishment within a year or so, 2) refurbishment that needs a few years' plan and 3) major refurbishment that takes a couple of decades to do. Thus, it is important to make these lists of facility problems and figure out the right timing to update the facilities.

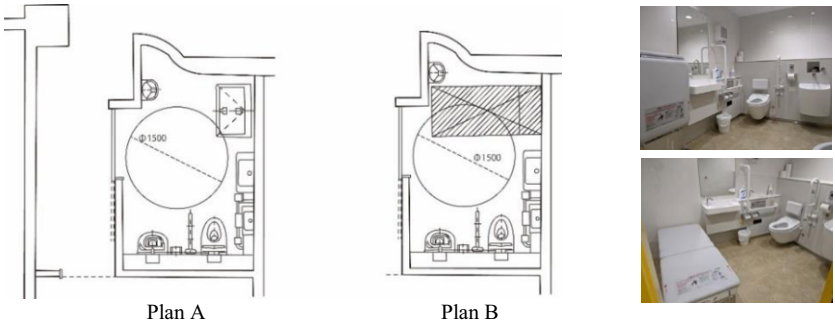
4.6. Necessity/challenges of refurbishment for accessibility through user involvement

In terms of user involvement, 48 respondents had their working areas refurbished for accessibility. However, 27 of them had no occasion to ask opinions from students or their parents. Whether users were involved in refurbishment plans depended on schools or school management staff.

Challenges of refurbishment with user involvement were revealed from free answers. Main concerns were lack of knowledge and experience regarding refurbishment. One of the respondents answered, "Though I obtained advice from teachers for special education and contractors and visited some schools to study good practices of refurbishment, it was difficult to judge whether the refurbishment went well." In addition, another respondent noted, "Students' requests can be reflected on refurbishment plans. However, there are concerns regarding versatility." It means that the best refurbishment for a student is not always the best for another.

Another respondent noted that there had been a refurbishment for a new student who uses a wheel chair. Several meetings were held with a principal, teachers, administration officers, the student, and the parents to discuss how to refurbish the school according to the needs of the student. Consequently, the refurbishment was minimal because of financial boundaries and physical restrictions of the school. However, it can be said that such discussion before the enrolment cultivated a better understanding of the student's needs among them and helped them discover reasonable accommodations.

As one of the examples of user involvement, X school, which had no accessible toilet, planned to install one for a new student, who used a wheel chair and had a mild intellectual/hearing disability. At the planning stage of the toilet, school management staff showed his parents Plan A, which was a typical plan in public facilities of Japan, as shown in figure 4. They found out that there was no bed, except a baby changing station. The student usually needed support to change his diapers, so his parents requested the school to install a bed which he could lie down on as Plan B.



Plan A Plan B

Figure 4. Plans for an accessible toilet in X school

This example demonstrated that it was not enough to simply follow the accessibility guidelines for public facilities. The types of users at the schools should be taken into consideration. In addition, the installation of a bed into an accessible toilet will also be useful for elderly people when schools play the role of evacuation centres.

5. Conclusion

The low vertical accessibility remained due to the deterioration of existing schools which were over 50% of all schools in Saitama city. The municipality faced the financial burden of big-scale refurbishment as in many others municipalities. To improve their accessibility efficiently, short/mid/long-term facility management strategies are needed. In addition, refurbishment of schools which have no lift but have students with special needs should be a priority. It is also essential to take soon-to-be students with special needs into consideration and prepare adequately accessible environments for them, so that they can enter schools without anxieties of accessibility.

It will be meaningless if a refurbishment doesn't meet user needs. At a planning stage, school management staff should ask opinions of users, assume various users/situations in schools including the need for evacuation centres, and get advice from experts on the plans. These measures will nurture knowledge and skills of school management staff to update school facilities and to provide reasonable accommodation. It is also crucial that these experiences are shared between different schools to be able to take advantage of other school refurbishments. Establishing organizational methods which ensure sufficient discussion of accessibility improvement in schools will contribute to creating an inclusive environment and inclusive education.

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Evaluation Methodology for Inclusive Schools Environments. A Comparative Analysis Towards Goals and Strategies for Urban Design

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Abstract. The paper deals with the issue of social inclusion in the scholastic environment where children begin to learn the set of rules that manage social life. The design of the spaces impact on people and becomes crucial to address a community behavioural change in terms of social inclusion. In line with Universal Design strategy, the paper presents a method developed for evaluating the degree of inclusion of primary schools' spaces, which consists of the definition of an evaluation matrix. The matrix makes possible to analyse quantitative-qualitative characteristics for each school and compare them objectively. It asses the level of accessibility and inclusion of the schools through four main categories (Outdoor space, Orientation, Movement, Spatial quality) and related criteria and indicators. The reliability of the evaluation matrix has been verified through its application in seven case studies (Italian and EU), and the analysis of one of them is described in the results. The present study proposes a basis to introduce a method able to support designing educational spaces that satisfy the needs of a wide range of users according to Universal Design strategy.

Keywords. Inclusive design, Universal Design, school, assessment method, evaluation tool.

1. Introduction

The school represents a socialisation environment, a crucial space for didactic and relational learning, where children 'absorb' behaviour and learn by looking at the reality around them. In particular, primary school is considered the first environment where children begin to understand the norms and rules that govern life. The paper considers the school as the institution to initiate the first step for a fundamental change toward social inclusion, promoting a fair community without discrimination and based on equal rights. Nowadays, Italy presents itself as an inclusive country in terms of schooling. However, as we can see from the research carried out by Merlo [1], there is again a

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growing trend of 'special schools'. Those institutes has its roots in the 16th century, recognising for the first time the right to education for people with sensory disabilities, and then extending in the 20th century to those with psycho-physical disabilities. However, those schools refer only to special children education, meaning people with physical, sensory and cognitive impairments. Nowadays they should be replaced by inclusive schools to embrace differences and create an environment where every student can learn regardless of any diversity, culture, ability, or disability.

Currently, special schools are still chosen because of the lack of supply and support from traditional schools. Despite this, many schools still have architectural and sensorial barriers in the facilities. There is a need for a radical change, where Universal Design (UD) [2-3] becomes the means by which inclusion can be affirmed. In the 21st century, the concept of UD has been defined by Mace providing a new concept of designing to the greatest extent possible of people, without the need for adaptation or specialized design. Disability can be permanent, temporary (limb injury, pregnancy, carrying heavy objects), or caused by the context (inaccessibility to services, not understanding language, etc.). For this reason, the design process should create an inclusive space where each user feels represented and can experience it without discrimination.

Social inclusion is a topic addressed by many scholars. However, they have always dealt with the pedagogical and not the spatial and design aspect of schools. They have mainly analysed the tools to support teaching (expressive, technological, and symbolic) and the strategies for learning, summarised by the *Universal Design for Learning* methodology [4].

A few research has approached the topic from an architectural and urban design point of view, proposing more or less specific solutions. Abouelsaad and Shafik [5] suggest different design strategies according to the needs and characteristics of each child. However, they do not provide a univocal space organization, but the solutions always remain categorised according to the users' needs. This limitation is also found in two other research concerning the design of schools for autistic and intellectually impaired children [6, 7]. Despite their excellent and interesting proposals, these studies consider the architectural solutions typical of special schools without adopting a UD approach. At last, Agarwal [8] reports on the research project developed by UNESCO on the design of inclusive schools in India.

The research carried out in 2021 at Politecnico di Milano, studied social inclusion within the school environment. The output is an assessment tool for spatial inclusiveness in schools developed. The aim is to assess quantitative and qualitative aspects of the environment, including physical accessibility, orientation, and sociability, which are key factors in assessing inclusive environments [9]. A matrix is a potential tool to evaluate the degree of inclusion of schools objectively be used both during the design phase of school buildings or test possible improvements during the rehabilitation of existing buildings. Using the matrix would allow one to be aware of the most deficient categories in the field of spatial inclusion in the school and, therefore, improve them following the proposed indicators.

2. Methodology

The research work has been set in three macro-phases: i) preliminary phase: state of the art definition, through the comparison with reference scientific bibliography; ii) proposal phase: calculation of the evaluation matrix to evaluate the degree of inclusion of school;

iii) empirical phase: application of evaluation matrix in seven case studies. Although the UD topic is currently known and investigated in different researches, the literature review shows the lack of specific tools in the school context.

In the second phase, an 'evaluation matrix' (Figure 1) was developed through the analysis of the literature, referring to the *Accessibility in Building Design Guideline* [10] and the *Principles* [11] and *Goals* [12] of UD. The evaluation matrix includes four categories:1) Outdoor space, 2) Orientation, 3) Movement, and 4) Spatial quality.

The categories summarise users' needs to use a building independently: to be reachable from the outside, to enter and use each space equally. Aspects such as accessibility to the area by public transport, parking near the entrance, overcoming morphological differences, and orientation support are considered in the matrix to assess spatial quality. In addition, the categories Orientation and Movement have been evaluated for both indoor and outdoor spaces, only the mathematical average between the two values being reported in the matrix Each category presents different criteria, and each criterion is composed of four indicators for defining the degree of inclusion of school environments. The presence or absence of indicators determines the score for each criterion (evaluation from 0 to 4).

In the third phase, seven case studies were analysed through the evaluation matrix. The 4 Italian case studies are: Scuola Primaria A. Volta (Chiarano, TV), Scuola Primaria R. Mazzetti (Loiano, BO), Scuola Primaria Bassi e Graziani (Zugliano, VI), Scuola Primaria G. Parini (Camparada, MB). While the three European case studies are: Kirkmichael Primary School (Scotland), UK Marlborough Primary School (London), UK Unterdorf Elementary School (Höchst, Austria).

Each case study was also mapped using descriptive sheets. The 'descriptive analysis' is made up of aspects that report objective data about each school, such as access to the building, number of students, shape of the building, number of floors, classroom layout, and open space. It allows a more synthetic reading and framing of the space outside and inside the building, based on architectural specific criteria. It is essential to give an idea of the size of the building concerning its use (the number of common areas, bathrooms, distribution components, etc.).

3. Results

3.1. Categories and criteria of the Evaluation Matrix

Categories and criteria of analysis are based on the users' needs (children from 6 to 11 years old). In this age group, children begin to develop their first basic skills in school (reading and writing) and in life (starting to orient themselves, moving independently, and expressing their needs). The supports and stimuli offered by the school must accommodate as many of the user's characteristics as possible. These characteristics are linked to different learning times and where the child comes from, whether he/she speaks a foreign language, etc. Moreover, it is crucial to ensure that the child can express his/her needs at the right time. In addition, physical, cognitive, and sensory characteristics must also be considered, including different types of abilities. The result is a design capable of taking into account the different needs without thinking of specific solutions that only highlight the differences between non-disabled and disabled people. Based on these assumptions, the categories chosen (Figure 1) refer to areas that are indispensable for school design, while the criteria ensure that they are developed inclusively.

	CRITERIA	INDICATORS	CHECK OF INDICATORS	GRADE OF CRITERIA	GRADE OF CATEGORY	
CATEGORY 1 \ OUTDOOR SPACES	ACCESS ARRANGEMENTS	At least one **public transport** system (bus, tram, metro, train) supporting fragile families to reach school	Yes/No	0 to 4	Mean of the criteria's grade (0 to 4)	GRADE OF SPATIAL INCLUSION Mean of the categories' grade (0 to 4)
		At least one **public transport stop within 100 m** from the school to limit physical effort and ensure children's safety on the way to school	Y/N			
		Public transport stop should be easily recognisable with sign that use symbols, images or audio message even for children who cannot read or have cognitive difficulties. The height of the information should allow children to be seen.	Y/N			
		A **cycle and pedestrian paths** are present allowing to reach the school walking or cycling.	Y/N			
	PARKING AREAS	**Presence of parking spaces** just for the school in order to facilitate people with limited abilities to reach the building comfortably. (e.g. a parent with more than one child).	Y/N	0 to 4		
		There are **continous walkways** with marked crossing wherever the pedestrian route crosses a vehicular way for children/adults to **safe reach the school entrance.**	Y/N			
		Parking for people with disabilities or fragile users (elderly, pregnat women, etc.) **should be within 10 m from the main entrance**, to limit the physical effort of the children/adults who require it.	Y/N			
		There is a **1:20 ratio** between parking lots (4.5 m x 2.3 m) and accessible parking lots, supporting children/adults whit physical disabilities.	Y/N			
	ENTRANCE	**Recognisable doorway** are used including for children with sensory and cognitive impairments (e.g. colored/symbolic/audio/tactile design solutions, color contrast, totem etc.).	Y/N	0 to 4		
		Entrance design solutions protect against the weather creating a suitable and safe place for children/parents/caregivers/teachers wayting.	Y/N			
		Gathering shaded and unshaded areas with seats and vegetation are present in front of the entrance to create a safe and enjoyable place for children/parents/caregivers/teachers wayting	Y/N			
		Recognisable secondary service entrance so that children are not mistaken when entering the school.	Y/N			
CATEGORY 2 \ WAYFINDING	MATERIALS AND COLOURS	**different materials for walls and floors** according to the room's function help orienting children, even those with visual impairments (e.g. a tiled floor for the classrooms creates a sharp contrast to the wooden floor of the corridors, making it easier to distinguish the two areas)	Y/N	0 to 4	Mean of the criteria's grade (0 to 4)	
		different colours, tonal contrast and images for walls and floors according to the room's function help children to identify spaces, regardless of cognitive ability (e.g. a warm colour for classrooms and a brighter one for commor areas)	Y/N			
		different materials of doors/furnishings help children, even those with visual impairments, recognise rooms' entrance according to their functions (e.g. wooden door for toilet and a glass door for classroom)	Y/N			
		different colours and tonal contrast of doors/furnishings help children, regardless of cognitive ability, recognise rooms' entrance according to their functions (e.g. blue doors for labs and red door for the gym)	Y/N			
	ENVIRONMENTS SHAPE	Different **architectural solutions** are needed according to the functions (e.g. distinction between classrooms and services, collective and private spaces), in order for the **child to recognise the space** (e.g. alternating opaque and glazed walls, projecting and recessed elements, different windows position or shape, different materials, a circular design for classrooms while a more square shape for common areas, etc.).	Y/N	0 to 4		
		Function-based floor plan and distribution system helping children's orientation through an organised mental map of the school.	Y/N			
		Hierarchical interior spaces avoiding confusion in the use of rooms by the child.	Y/N			
		Symbolic design building helping children to recognize the school from a distance (e.g. prominent entrance cover, materials, etc.)	Y/N			
	SUPPORT SYSTEMS	At least **two support systems** among tactile, visual, auditory and symbolic are present.	Y/N	0 to 4		
		Clearly visible signs and lettering (e.g. color contrast between lettering/symbol and background) are used.	Y/N			
		Simple and intuitive language reduce ambiguity in the child's understanding is used.	Y/N			
		Placement of support systems at different heights helping children to read them is adopted.	Y/N			
CATEGORY 3 \ MOVEMENT	USE OF SPACE	**Paving materials** in collective areas support children/adults with reduced mobility (e.g. alternation of green and paved materials in courtyards, auntitrauma for playgrounds).	Y/N	0 to 4	Mean of the criteria's grade (0 to 4)	
		Distribution of functions according to the principle of limiting the **child's physical effort.**	Y/N			
		Distribution of functions supports organising and rationalising **users's flows** reducing the confusion.	Y/N			
		Shared toilets for children and disabled-children are present improving the equal accessibility.	Y/N			
	VERTICAL DISTRIBUTION	**Indoor and outdoor space are at the same level of the ground** to facilitate children's entry/exit.	Y/N	0 to 4		
		Different types of lift systems (lifts, elevating platforms, escalators, ramps) avoiding discrimination between children	Y/N			
		Equal arrangement of lifting systems placed next to each other and related to each other allowing children to take the same paths	Y/N			
		Arrangement of the lifts to limit the physical strain on children from/to the classrooms	Y/N			
CATEGORY 4 \ SPATIAL QUALITY	FLEXIBILITY	**Calm and relaxing spaces** are integrated in collective areas both for children, especially with cognitive impairments (e.g. autism disorder), and for teachers to have privacy and rest.	Y/N	0 to 4	Mean of the criteria's grade (0 to 4)	
		Presence of **multiple outdoor areas** (with or without facilities) that allow everyone to enjoy external space at all floors of the building (courtyards, gardens, terraces, balconies etc.)	Y/N			
		Classroms have **flexible layout** and furniture to guarantee different activities for children with different needs	Y/N			
		Combined furnishing of **different height** support children of different statures (e.g. double handrails, sanitary facilities height, windows, tables).	Y/N			
	OUTDOOR/INDOOR RELATIONSHIP	**Location of the school in areas with high environmental quality** (e.g. vegetation) to ensure psychological well-being for the children.	Y/N	0 to 4		
		Classrooms have at least one external views on landscape/vegetation to guarantee a contact with the nature to ensure better psychological well-being for children and teachers.	Y/N			
		Collective spaces have at least one external views on landscape/vegetation to guarantee a contact with the nature to ensure better psychological well-being for children and teachers.	Y/N			
		Rooms must benefit from **natural light**, provided by large windows, skylights or internal shafts	Y/N			

Figure 1. Evaluation Matrix.

Category 1 \ Outdoor Space. The category analyses the environment around the school about making it fully accessible and inclusive. It is the first physical space where the child relates to the school environment. The related criteria are as follows:

- Access arrangements. The presence or absence of public transport service is studied, and the distance and quality of the routes from the stop to the school entrance (the presence of sidewalks, green spaces). To increase the child's independence, it is necessary to guarantee the possibility of reaching the school freely, with efficient transport and the stop located close to the entrance, to protect the user on his/her way.

- Parking areas. The presence or absence of a parking space is assessed, specifically the presence of parking spaces for fragile categories (disabled people and pregnant women) and the distance and quality of the connecting routes to the school entrance. It facilitates the carer and the child, reducing physical effort.
- Entrance. The analysis focuses on the entrance's design, which must be recognisable by its shape, regardless of whether orientation and signage are provided. The hierarchy of spaces includes a distinction between primary and secondary entrances, always evaluated from an architectural point of view. A gathering space promotes aggregation and meeting between parents and children, favouring inclusion, which is also functional as a waiting place.

Category 2 \ Orientation. The category facilitates the child's understanding of the school space. It is based on the ease with which the different areas of the building can be reached, making movement as autonomous as possible. In addition, the presence of multiple orientation support systems (visual, tactile, sound) facilitates all children, even those without specific needs. Its criteria are as follows:

- Material and colour. Different materials and colours can help the user orientate in space, associating them with functions or environments.
- The environment's shape. The space layout is assessed and must be clear and intuitive concerning the function it houses.
- Support systems. Support devices are sought that provide functional and spatial indications (tactile maps, use of symbols and/or writing, auditory aids, tactile-plantar routes, vertical signage). The language used should be intuitive and straightforward, reinforced by multiple types of expression.

Category 3 \ Movement. It is understood as the possibility for the child to use the space autonomously, without depending on external help. Ensuring independence is not easy, but it is fundamental for an inclusive school. It is achieved by providing the child with the possibility to move, play and relate to others by eliminating impediments and obstacles (physical and sensory). Its criteria are as follows:

- Use of space. Free movement within the floor is preferred, without differences in level. If there are any, they must be surmountable by everyone. The choice of material can also limit or help the user move through the space.
- Vertical distribution. The presence or absence of differences in level is analysed and how they are resolved. It is necessary to have at least two lifting elements, at least one of which everyone can use.

Category 4 \ Space quality. The quality of the environment is essential for the child to experience the school space well. It translates into the possibility of meeting children's needs in relation to their growth, through areas that can be modified over time. At the same time, ensuring that everyone has the same experience through inclusive design (double handrails, coat rails at different heights, etc.). The criteria are as follows:

- Flexibility. The spaces must adapt to the needs and characteristics of each individual, leaving freedom in the choice of use. The spaces created are designed to respond fairly to different needs without discrimination or limitations. The design of the spaces must guarantee the possibility of reorganising them according to the functions and conditions of the moment, preferring simple shapes.
- Indoor-outdoor relationship. Regarding the pupils' educational needs, the visual connection with the outside space is essential, as it promotes learning and

stimulates the learner. Spaces are assessed according to the windows' orientation, size and positioning, the quality of the view, and the panorama.

3.2. Indicators and scale of values

In order to make practical use of the evaluation matrix, each of the ten criteria identified was evaluated using a scale of values in ascending order: insufficient (0), sufficient (1), fair (2), good (3), and excellent (4). Scoring is based on the presence or absence of the identified indicators. Four indicators have described each criterion. Therefore, for example, if the criterion 'access arrangements' (category: Outdoor space), gets three out of four indicators, then the evaluation assigned to this criterion will correspond to a good grade (value 3) (Figure 2).

CRITERIA	INDICATORS	CHECK OF INDICATORS	GRADE OF CRITERIA
ACCESS ARRANGEMENTS	At least one **public transport** system (bus, tram, metro, train) supporting fragile families to reach school	Yes	3
	At least one **public transport stop within 100 m** from the school to limit physical effort and ensure children's safety on the way to school	Yes	
	Public transport stop should be easily recognisable with sign that use symbols, images or audio message even for children who cannot read or have cognitive difficulties. The height of the information should allow children to be seen.	Yes	
	A **cycle and pedestrian paths** are present allowing to reach the school walking or cycling.	No	

Figure 2. Example of 'Access arrangements' criterion evaluation.

The attribution of a scoring scale allows evaluating the qualitative aspects found in each case study and comparing them objectively. The final evaluation of the four categories (Outdoor space, Orientation, Movement, Spatial quality) is derived from the arithmetic mean of the scores attributed to each criterion (Figures 2-3). It is therefore possible to define the average evaluation of each school and mode evaluation of each criterion to compare the level of inclusion schools analyzed (Table 1).

3.3. Applying matrices to a case study

The reliability of the evaluation matrix has been verified by applying it to seven case studies. The tool helps to analyse existing buildings and check their degree of inclusion.

The case studies were selected according to the following characteristics. Only primary schools declared to be innovative (published in architectural journals or websites, mentioned in competitions, or awarded prizes) have been selected, to understand if innovation includes or expresses the concept of inclusion. The selected case studies had to respond in whole or in part to the ten parameters taken from the literature on UD; and had sufficient material for their evaluation (plans, sections, photos, and descriptions). Starting from an initial selection of 40 schools, the criteria reduced the number to seven. The analysis of the case study can take place directly through inspections or through supporting elements such as photographs, project drawings, descriptions, and articles.

Analyzing each school, the tool results particularly useful in identifying the most urgent areas for improvement. For example, the analysis of the school no. 1, clearly shows that it would be important to improve with design interventions the following criteria: Entrance, Support system, Use of space and Vertical distribution (Figure 3). Therefore, the evaluation matrix can represent a design support tool as well.

The same evaluation method was applied for all the case studies. In this way, it was possible to draw up a comparison matrix to compare the results obtained. In particular, the method allows to identify which criteria are more reached or neglected, in addition to highlighting the best schools (no. 5 and 7) (Table 1).

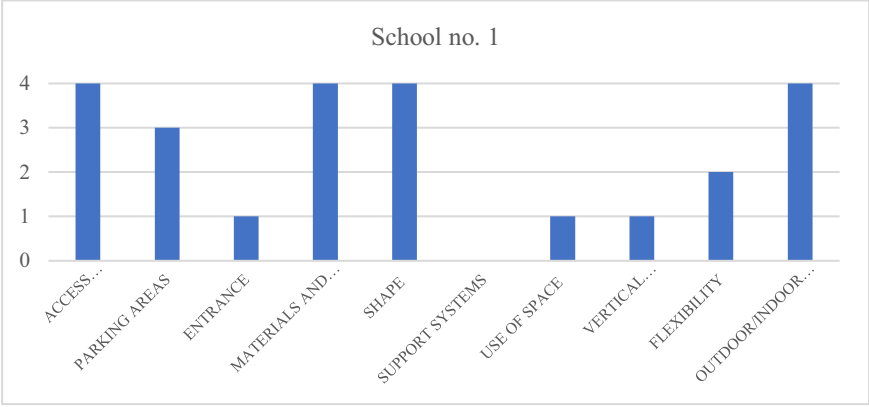

Figure 3. School n°1 results

Table 1. Average evaluation of each school and mode evaluation of each criterion.

Categories	Criteria	School (no.)							Mode of criteria
		1	**2**	**3**	**4**	**5**	**6**	**7**	
Outdoor Spaces	Access Arrangements	4	3	1	3	2	4	3	**3**
	Parking Areas	3	1	3	3	4	1	3	**3**
	Entrance	1	3	3	2	2	4	4	**3**
Wayfinding	Materials and Colours	4	2	3	4	3	4	2	**4**
	Shape	4	2	4	4	3	2	3	**4**
	Support Systems	0	2	1	3	4	2	1	**2**
Movement	Use Of Space	1	3	3	2	4	4	4	**4**
	Vertical Distribution	1	2	4	2	3	3	3	**3**
Spatial Quality	Flexibility	2	4	4	3	4	4	4	**4**
	Outdoor/Indoor Relationship	4	4	3	3	4	3	4	**4**
	Average of School	**2,3**	**2,5**	**2,9**	**3**	**3,5**	**3,4**	**3,5**	

This matrix highlights, for each school, the positive and negative aspects inherent in the individual analysis criteria. The degree of spatial inclusion in schools never reaches an excellent or insufficient rating, recording an average that fluctuates between fair and good. Above all, the criterion 'Support systems' of the 'Wayfinding' category resulted the most inadequate (column Mode in Table 1). The lack of practical communication elements and unsuitable materials prevent a complete and equitable use of space. Another important aspect to highlight is that only the category Spatial quality reached a high average score, which, however, is the category least connected to UD, while most related to new design needs.

The drafting of a comparison matrix, allows to highlight the poorest areas in schools and to be able to intervene to improve them. Furthermore, the innovative solutions

proposed by each case study can represent possible design strategies for the realization of inclusive schools.

4. Conclusions

The evaluation matrix has different potentials. It could be used for various purposes:

- for study and research, it allows to make statistics and evaluate the degree of inclusion of one or more schools;
- for analysis and design applications of existing schools;
- as design support contributing to the definition of an inclusive school.

Limitations of this study are mainly the number of the case studies that should be increased to validate to matrix in different school environments. Therefore, the developed matrix will be tested, in future research, in relation to the following uses: both to support the project and as an analysis tool to assess the degree of inclusion.

The proposed method highlights the strengths and weaknesses of projects, however the analysis can be done also together with surveys with final users, to have both an objective and subjective feedback. Future research can investigate the comparison of these two methods to validate the tool with an evidence-based approach. In the Italian context, it could be a useful method to identify the elements to be modified to increase inclusion in existing schools, in relation to PEBA *Piani di Eliminazione delle Barriere Architettoniche* protocols used by the municipalities to evaluate the accessibility level of cities.

This research represents the basis for the development of an evaluation and support tool for designers in understanding the quality of the space according to UD principles. The research has been applied to primary school buildings to create inclusive environment from an early age. It aims to raise the awareness on this issue to design educational spaces that satisfy the needs of a wide range of users.

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