INSPIRING ARCHITECTS IN THE APPLICATION OF DESIGN FOR ALL: KNOWLEDGE TRANSFER METHODS AND TOOLS

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Abstract: Accessibility is often translated in design practice by means of a prescriptive approach, focusing on legislation's application, instead of understanding the real needs and wishes of users. On the contrary, the descriptive and performance-based approach of Design for All can help architects in designing inclusive environments. Therefore, it is fundamental to translate the existing knowledge into information that meets the architects' needs to link knowledge and practice. This study focuses on methods to inspire and support architects applying a Design for All strategy by gathering information and advice. In particular, the paper demonstrates a literature review to identify how to transfer design information to architects. Based on the analysis of the included papers, four criteria were defined to translate Design for All information from users' needs into design strategies for architects in a descriptive way. The current results will provide the basis for developing a tool to inspire and create awareness for architects on Design for All in architectural practice.

Keywords: Design for All, inclusion, knowledge transfer, tool, architecture, design criteria, prescriptive and descriptive approach

Introduction

In recent decades, the attention for design solutions in architectural practice moves from services' functionalities, to social aspects as safety, inclusion, well-being and comfort (Kapedani et al. 2017, Buffoli et al., 2014, Capolongo et al., 2014; Capolongo et al., 2016). At the same time, the concept of architectural barriers is gradually shifting to the design usable and enjoyable spaces that can be used independently from the greatest number of users as possible (EIDD 2004, Afacan et al., 2009). In line with this perspective, Design for All (DfA) was defined as "the design for human diversity, social inclusion and equality" (EIDD, 2004). The purpose is to provide the same experience of the space, even with various solutions, to different people, regardless their abilities, disabilities, age, sex and culture. The application of Design for All concerns the involvement of a plurality of stakeholders (both experts and final users) from the beginning of the design process (Buti, 2018).

In line with this, DfA is gradually being considered as a fundamental strategy by European policy makers, supported by the international federation *Design for All Europe (EIDD DfA Europe),* which strives for a common goal: a common inclusive Europe for everyone. By the introduction of the *European Disability Strategy 2010-2020: A Renewed Commitment to a Barrier-Free Europe* (European Commission, 2010b), many European countries started to update their laws. These originated from the wider strategy to boost the European economy called *Europe 2020: A Strategy for smart, sustainable and inclusive growth* (European Commission, 2010a). At the same time, the *European Committee for Standardisation* (CEN) and the *European Telecommunications Standards Institute* (CENELEC) are working on standards to support European policies as different Mandates on accessibility, including DfA strategy. However, in the context of architectural practice, attention is often given to rules followed in a strict way by following a "prescriptive" approach, without necessarily considering the real interests and needs of users for issues related to sources, time and knowledge (Afacan and Erbug

2009, Froyen, 2012, Sanford 2012) On the other hand, Design for All is inherently categorized as "descriptive" approach, in other words, it is performance-based and requires an individual understanding, which is necessary for critically analyzing the situation and considering the requirements of a range of individuals with different ability levels (Sanford 2012; Froyen, 2012; Mosca et al. 2019a). If the prescriptiveapproach brings to the fore a mechanical application of codes and norms, the latter allows designers to find a proper solution for their own individual projects.

Whereas it is necessary to use legislation as a starting point in the design process, likewise it is imperative to look beyond the prescriptive approach, and shift focus towards descriptive information and performance-based approach of a DfA strategy (Preiser 2010 p. 38.4; Mosca et al. 2018; Mosca et al. 2019a).

In order to implement a DfA strategy together with the existing laws into architectural practice, the knowledge transfer process needs be improved (Ielegems et al., 2015, McGinley et al. 2015, Afacan et al., 2009). Indeed, while theoretical studies and knowledge in DfA are growing, ways to link knowledge and practice is still inadequate (Ielegems et al. 2015). There is a lack of methods and tools presented in the literature to identify and express user needs within the built environment (Afacan et al., 2009), supporting designers in the application of design solutions and space quality' assessment (Bottero et al., 2015; Capolongo , 2016;; Mosca et al., 2018). Accordingly, in order to have insight in the gap between theory and practice, a literature review has been conducted in order to identify the currently existing methodologies that propose ways of transferring knowledge to practice.

Methodology

Review protocol

A literature review was conducted with the main aim to determine the most suitable way of transferring knowledge from users to architects. In particular, the analysis aims to address the following research questions:

RQ1 Which methodologies and instruments in applying the DfA strategy to architectural practice can currently be identified?

RQ2 Which information should be considered in knowledge transfer to architects regarding the design of inclusive environments and users' needs?

RQ3 How is it possible to transfer descriptive knowledge stemming from the DfA strategy to designers?

By answering these three research questions, the current study strives to provide a meaningful contribution to the field in a three-fold manner. In order to provide an answer RQ1, the existing body of literature on the instruments used in applying DfA strategies to architectural practice is reviewed. In answering RQ2, new criteria are defined that are based on recurring items appearing in the studies reviewed. Finally, in an attempt to answer RQ3, the study seeks to understand the transfer of the DfA descriptive knowledge to actual use combined with legislation.

Figure 1. Phases of the literature review. Source: authors
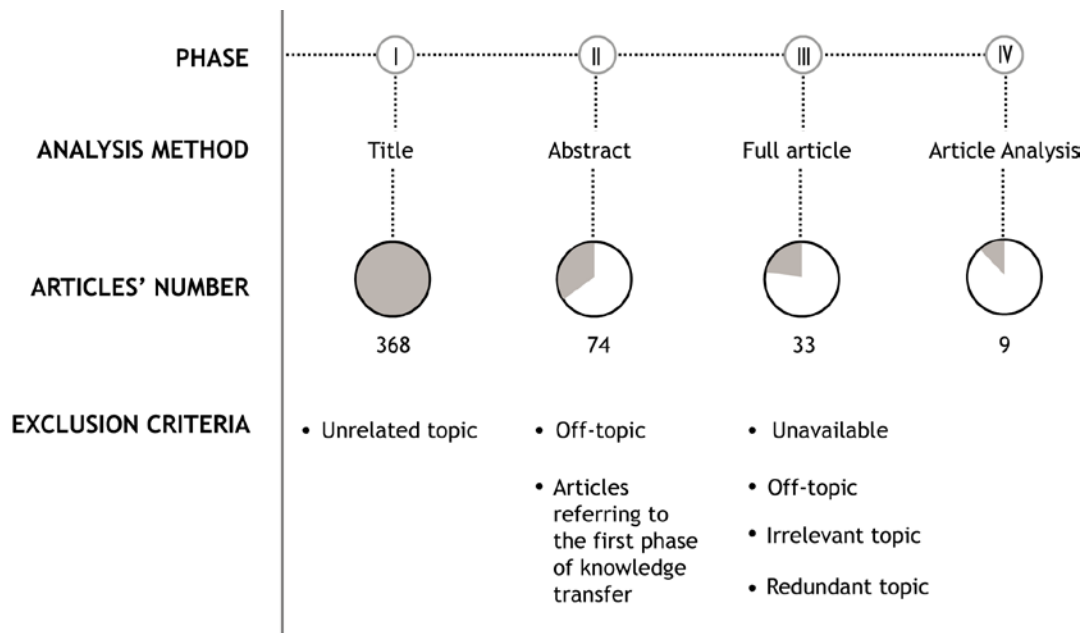
At the first-level screening, on-line databases (Scopus and PubMed) together with grey literature were consulted. In the analysis, ad-hoc keyword strategy was adopted including the following terms: "Design for All," "Universal Design," "Inclusive Design," "knowledge transfer," "disability," "user," "design practice," "design guidelines," "design method," and "built environment." This search produced 368 articles, 322 from the keywords analysis and 74 from other sources, that underwent three different stages of study selection and for which different inclusion and exclusion criteria were devised.

Study selection process through title review

In the first phase of the study selection process, which is based on the analysis of article titles, the article relevance is determined by applying one exclusion criterion. The following criterion is applied to identify a study as irrelevant:

- UNRELATED TOPIC: This criterion excludes all articles with irrelevant topics (for example not related to Design for All, Universal Design or

Inclusive design), or articles that relate to a domain different than architecture, such as, medicine, education, or technology.

74 articles remained for the second stage of the selection process.

Study selection process through abstract review

Figure 2. Knowledge transfer's phases from users' experience to the design. Source: author
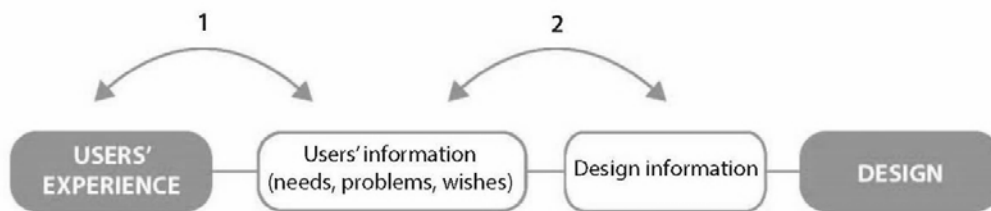
After a first selection round, the papers are investigated in a more detailed manner, by means of analyzing abstracts. While examining different publications, it became clear that two phases in knowledge transfer can be identified (Fig.2). The first is the result of the experience of users, and it generates information relating to their problems, needs, and wishes. Moreover, this first group of articles primarily focuses on users with some forms of disability. The information presented in this type of research is obtained through a direct approach stemming from the observation of user involvement (Ielegems et al. 2015). These studies only summarize the needs, problems, and wishes of users in specific situations, but they do not include design information. The second phase of the knowledge transfer (Fig.2), on the other hand, enables the transformation of the information provided into design indications. The respective articles focusing on this phase, describe strategies, methods, or tools, which architects can use as inspiration and support in applying a DfA strategy. In this phase, therefore, the information is obtained indirectly, instead of through direct user involvement (Ielegems et al., 2015). Consequently, due to its relevance, the respective second group of articles deserves to be brought to the fore in the present literature review. Thus articles belonging to the first phase of knowledge transfer are

omitted from further analysis. The abstracts of the articles were analyzed further based on the following three exclusion criteria:

- OFF-TOPIC: studies investigating topics unrelated to the research objective. These topics include practical tools: practical tools/objects intended for disabled people and not for architects, and topics unrelated to Design for All, Universal Design, or Inclusive Design.

- ARTICLES REFERRING TO THE FIRST PHASE OF KNOWLEDGE TRANSFER (Fig. 2): articles whose topics belong to the first phase of knowledge transfer (i.e., articles explaining the ways of obtaining information from users, instead of ways of transforming user information to design information relevant for architects).

The abstract review resulted in excluding an additional 41 out of 74 articles.

Study selection process through article text review

Finally, the aim of the article text review was to identify those items considered useful in the development of a support tool for architects, one which would assist in developing design indications, based on user needs. Thirty-three articles were analyzed based on these exclusion criteria:

- UNAVAILABLE: the article is not available, or acquisition cost is prohibitive.

- OFF-TOPIC: studies investigating topics unrelated to the research objective. These topics include tools/objects intended for disabled people and not for architects, and topics unrelated to Design for All, Universal Design, or Inclusive Design.

- IRRELEVANT TOPIC: articles relating to Design for All, transfer of knowledge, or design practice, but lacking relevant information to the development of the research tool.

- REDUNDANT TOPIC: articles addressing similar topics to previously selected articles. The respective articles contain more detailed information on an existing topic and are often written by the same author.

Finally, 24 out of 33 articles were excluded, and nine articles were selected for further analysis.

Analysis of the selected articles

The present review is based on nine studies (Appendix 1) that include methodologies and tools useful in identifying the items fundamental in user-designer knowledge transfer and for the development of a tool that can inspire and sensitize designers to the application of the DfA strategy.

The nine studies selected for the present study are divided further into two categories: theoretical (3) and practical (6), with one study relating to both categories. On the one hand studies characterized by means of adopting a "theoretical" approach in a more speculative manner demonstrate theories, strategies, or methods in transferring design knowledge. On the other hand, the "practical" category includes studies that introduce practical proposals, such as tools, design indicators, and parameters, which are more closely related to the aim of the current study. Even so, the studies belonging to both groups are deemed essential, considering that theoretical articles assist in gaining a clearer understanding of the needs of architects and of the knowledge transfer process in finding design solutions.

In this last phase of the literature review, articles were analyzed in order to understand the common characteristics of both methodologies and tools that aim to transfer DfA knowledge to architects. The results of this investigation are described in what follows.

# Results: the DfA knowledge transfer criteria

Figure 3.Main topics underlined by the literature review on knowledge transfer in inclusive and accessible design. Source: authors
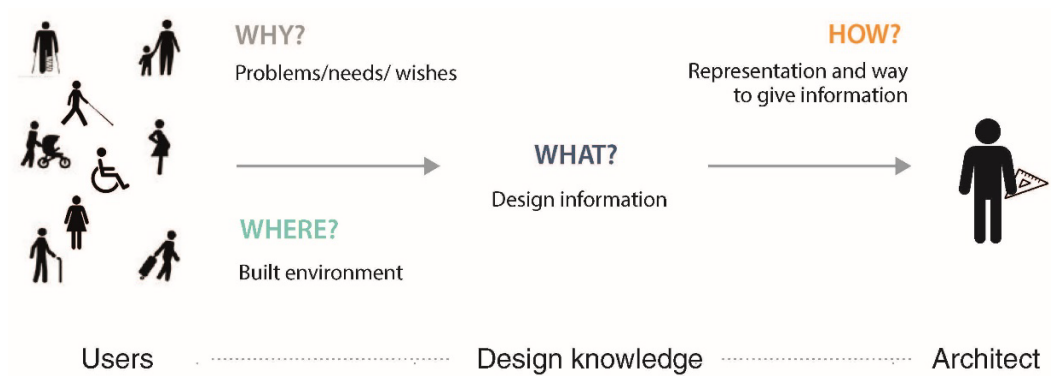
Based on the literature review, four recurring topics and questions of knowledge transfer were identified (Fig. 3). For instance, design information transferred to architects can be deduced from the combination of user needs in specific circumstances of the built environment. Afterwards, it is fundamental to consider the way of transferring design indicators through representation methods suitable for the architectural design process.

Based on these findings, the current study proposes four criteria relevant to the development of tools aimed at inspiring and supporting architects in practically applying a DfA approach (Fig.4).

Figure 4. Scheme of the four criteria to develop a DfA tool able to transfer knowledge from users to architects. Source: authors
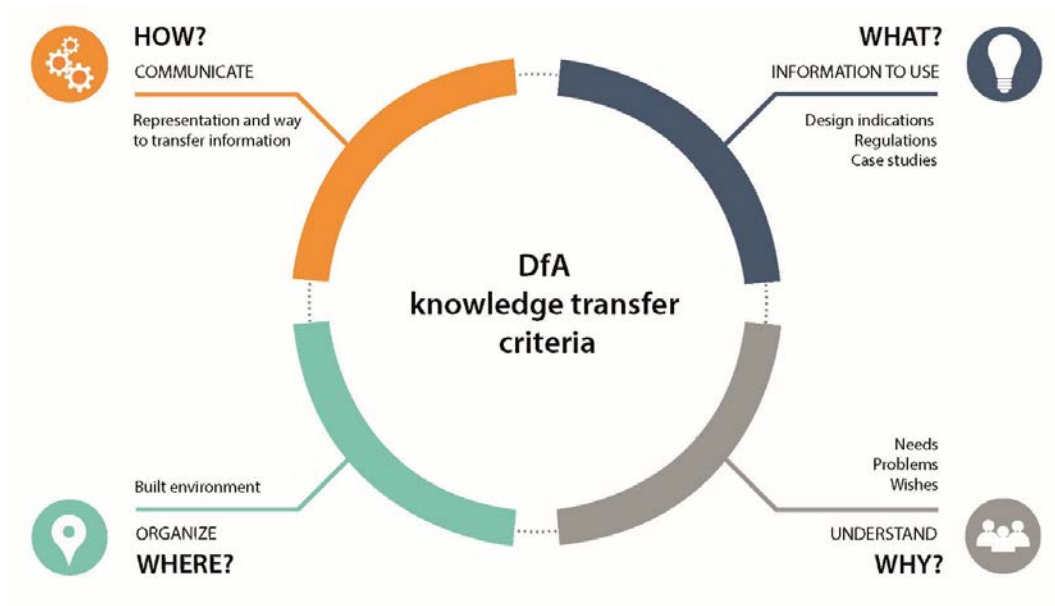
HOW? Effective communication

The development of a tool for transferring descriptive knowledge from users to designers requires insights in the way architects think and work in order to provide them with useful design indicators (Goodman et al.,2006). E. Lawson (2005) pointed out that designers draw not only in order to share information; drawing also constitutes a part of the thinking process, and consequently the design process is referred to as "design by drawing" (E. Lawson, 2005, p.26). Since drawing comprises a part of a designer's way of working and thinking, graphic or visual representation methods should be considered as basic requirements in providing information to architects.

In relation to this, Goodman et al. (2008a) analyzed the representation methods used by designers in different phases of the design process, in order to develop a methodological framework for supporting designers in understanding user needs. According to this group of researchers, architects require, more affordable. light-weight and flexible methods (Goodman et al., 2008a; 2008b). At the same time, Ielegems et al. (2015) point out that designers prefer visual information and 'Just-in-time' data "which contains
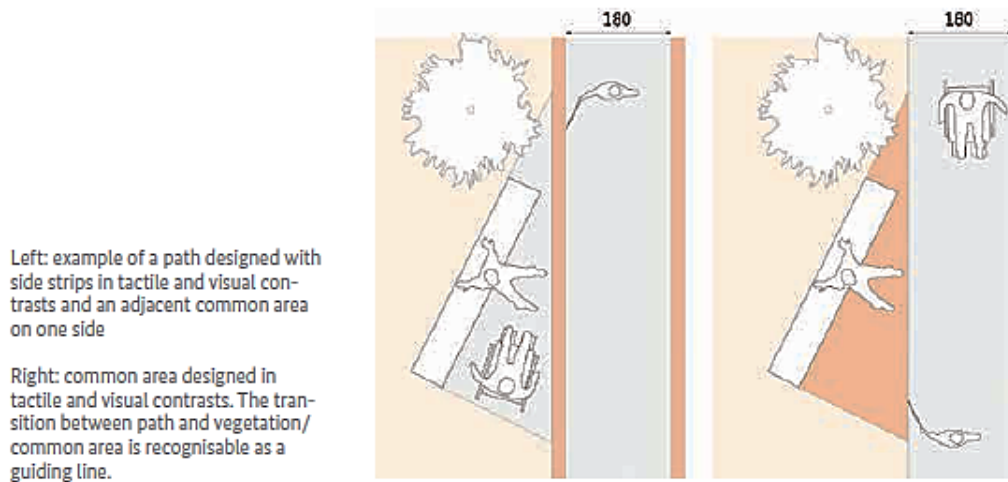
all the necessary elements in a sufficient way without information overload" (Ielegems et al., 2015, p. 262). Time is identified as a constraint factor in the design process, which occasionally limits the possibilities for exploring different sources. McGinley et al. (2015) argue that "optimal tools for designers should be simple, intuitive, highly visual and fast, easy to learn and easy to work with" (McGinley, et al., 2015, p. 190). Similarly, the Framework of the Haptic Design Parameters (Herssens, 2011) aims to achieve flexibility and easy use in order to meet the needs of as many different architects .

Furthermore, designers appreciate when an empathic perspective is included in the information with which they are presented; this assists them in understanding user needs (Goodman et al., 2006). Thus, practical solutions are required to provide fast and easy information transfer together with a sufficient amount of content necessary in understanding user needs. This type of content could be obtained through user images (photographs, drawings and diagrams), which would cater to establishing more empathic comprehension rather than text (Alexander et al. 1977; McGinley et al., 2015). A practical example is the Innovative Solution for Universal Design (IsUD) developed by IDeA Center of Buffalo (IDeA, 2018), which provides a browser of design information associate to the Universal Design goals and case studies that can be accessed easily in an interactive way.

Figure 5. Example of graphics. Source: Berlin Design for All. Accessible public buildings. http://www.stadtentwicklung.berlin.de/bauen/barrierefreies_bauen/en/handbuch.shtml

Left: example of a path designed with side strips in tactile and visual contrasts and an adjacent common area on one side

Right: common area designed in tactile and visual contrasts. The transition between path and vegetation/common area is recognisable as a guiding line.

Detailed drawings can also be used to show technical information as detailed dimensions, while pictures should be used to provide inspirational examples for architects (Fig. 5).

According to Goodman et al. (2006; 2007) user involvement is considered useful in providing information. However, it also includes certain disadvantages from the designers' perspective, requiring extra time to be spent on user participation and involvement which incur extra costs for the design process. This claim further strengthens the need for developing a tool that would be an indirect resource, although users involvement is also highly recommended in many cases, above all at the beginning and at the end of the design process.

To sum up, based on the literature review, a proposed tool for architects should be: fast and easy to find and use, visual and empathic (in order to understand user needs). These characteristics describe the way of providing information to architects concerning the communication methods. This type of communication can be achieved through graphics, as they are appreciated and more effective than words of design information in delivering concepts to a designer (Goodman et al., 2006; McGinley et al., 2015).

WHAT? Descriptive information

The studies selected in the review used a descriptive approach in transferring information to architects (Keates et al., 2003). In order to define the information as descriptive, it should exclude prescriptions regarding 'how things must be made' or 'how things must be', but instead focus on 'what it can do for/with people' (Froyen, 2012). In particular, descriptive information refers to performance indicators which focus on objectives to achieve (Bottero et al. 2015; Mosca et al. 2018). This approach overcomes fixed guidelines to follow, while the specific design solutions proposed to reach the result are decided independently by the architect. Designers need informal, descriptive, and empathically oriented information to comprehend fully the situation and discover the appropriate design solutions (Goodman et al., 2006). This theory is confirmed in the study conducted by Lawson (2005), who views design as a prescriptive enterprise because, this author claims, designers make decisions regarding how things *should* be done, or as he explains: "Unlike scientists who describe how the world is, designers suggest how it might be" (Lawson, 2005 p. 112).

Figure 6.Design Process scheme. Source: Accolla A., Bandini Buti L. (2016)

Similarly, Accolla and Bandini Buti (2016) advise designers and decision makers to think about the abilities, necessities, aspirations, and visions of users in obtaining appropriate performance indicators by asking the right

questions at the beginning of the design process and then looking for the answers by consulting literature and experts (Fig.6).

Thus, a support tool should transfer descriptive knowledge through design indicators, providing information, advice, or suggestions deduced from the relationship between user needs and the built environment. In fully accounting for the nature of design indicators, Alexander (1997) proposed a method regarding the domains of urban development, architecture, and construction, in order to structure the relationship between context, problem, and solution, called Design Patterns. In the context of the present study, the Universal Design (UD) Patterns approach developed by H. Froyen (2012) were based on the Design Patterns (Alexander, 1997) strategy. Indeed, UD Patterns provide "information about conflicts (problems definitions), experienced in handicap situations by users, whether they have specific and permanent situation or not and related to empirically supported resolutions, meaningful combination of design aspects (architectural/technological solutions)" (Froyen et al., 2009a, p. 201).

The WHAT criterion, therefore, emphasize the relevance of gaining a clearer insight into user problems and needs to facilitate more creative and innovative solutions for decision makers and designers, Unlike traditional guidelines, design indicators, based on this assumption, provide rational evidence. Indeed, design indicators assist in providing designers with descriptive knowledge stemming from the findings of case studies, information about user needs, and references to the legal framework of accessibility (Mosca et al. 2019a, 2019b). In this way, a joint consideration of the available information allows for an understanding of the circumstances in which user needs occur and for using design guidelines as support in developing more creative and efficient solutions for design projects.

WHY? Understanding user needs

In the context of 'Design for All' perspective, the "needs" do not only address primary physical needs (e.g. accessibility), but also to cognitive and

sensory needs (e.g. orientation) and social needs as security, comfort, well-being, privacy and inclusion, which refer to the needs of the widest diversity of people, with and without disabilities.

User needs and wishes should be considered and investigated during the entire design process in order to make the knowledge transfer efficient(Goodman et al., 2006 and 2007), since the main body of user-needs is usually tacit by nature (Ielegems et al.2015).

Waller et al. (2015) propose a strategy for developing inclusive projects based on four phases that summarize the process of concept generation, which they dub Explore, Create, Evaluate, and Manage. Theses phases address four questions – What are the needs? How can the needs be met? How well are the needs met? and What should be done next? – essential for the designer to understand and satisfy user and business needs. Similarly, this topic is also addressed in the V-model introduced by Ielegems et al., (2015), who adopt a user-centred design approach, where the user input (needs) are related to the design output (the design process).

The UD Patterns developed by Froyen (2012) are logical design solutions to the conflicts between users and the built environment; more specifically, conflicts are defined as "an analysis of possible conflicts between human activity cycles and environmental elements, potential usage problems and disabling situations, the given socio-spatial setting is investigated in relation to the various user categories." (Froyen, 2012, p. 153) (Fig.7). Regarding a support tool development, from the point of view of the information about user needs, architects can comprehend the situation in an ample way and then they can adapt the information provided in creating their own design solutions.

Figure 7.Graphical representation of the process of detecting and formulating UD Patterns. At the first stage the relation between users and built environment. Source: Froyen 2012 and Froyen et al., 2009b
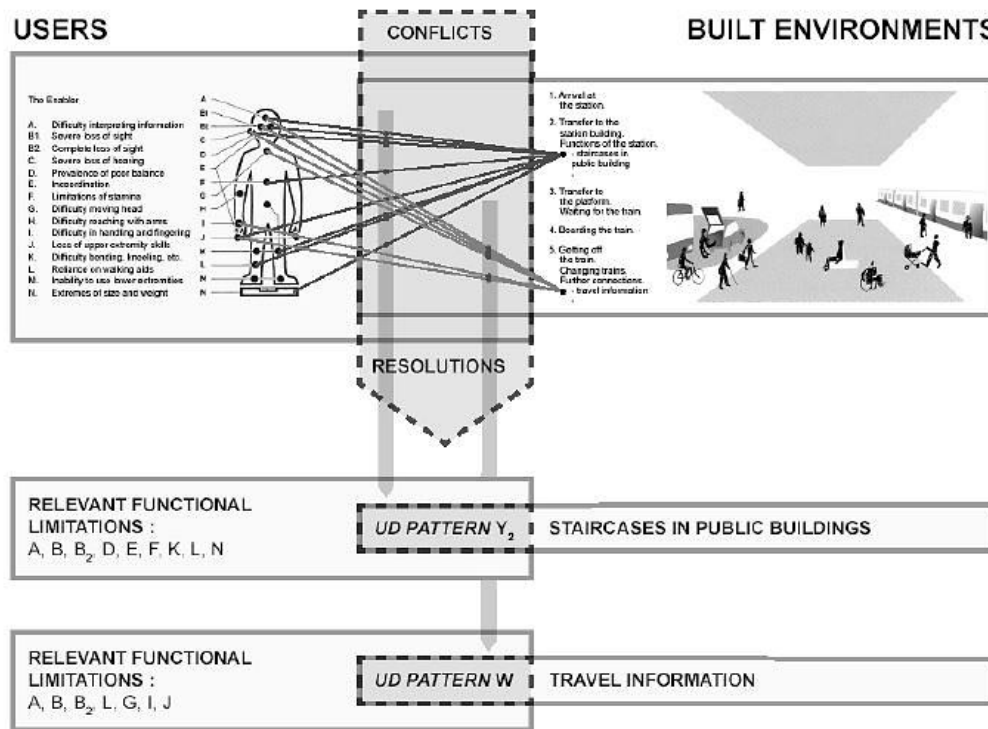
To conclude, for the development of a support tool, user needs, problems, and wishes must be taken into account from the beginning of the design process as they assist architects in understanding why a specific design indicator is provided and what the situational circumstance is (Mosca et al. 2019b).

WHERE? Built environment

It is necessary to simplify information access for designers (Goodman, et al., 2006) by referring to concepts that are familiar and easy to use. The work of architects is interrelated with the built environment, as well as with user problems and needs. The criterion of the *built environment* is used to define a structure that organizes design information to facilitate the choice during the design process. Froyen (2012) organizes UD patterns in a hierarchical structure composed by entities, socio-spatial settings, objects, and elements.

Mosca, E., Herssens, J., Rebecchi, A., & Capolongo, S. (2019). Inspiring architects in the application of design for all: knowledge transfer methods and tools. Journal of Accessibility and Design for All, 9(1), 1-24. doi:http://dx.doi.org/10.17411/jacces.v9i1.147

The actions of people and their needs are constantly placed in relation to the built environment. Froyen (2012) defines settings as circumstances and as the socio-spatial backdrop in which an activity may occur. Similarly, guideline manuals, laws and regulations regarding accessibility should be organized by chapters so that different norms in relation to the elements of the built environment can be identified. This structure allows architects consulting the legislation to inform themselves on their content.

An example to refer can be the website of 'Flemish Agency for Accessibility and Universal Design' called Intern (n.d.), which considers the relation between the users' enabling and/or disabling impairments and the built environment through the so-called 'chain of accessibility' (to reach, enter, use, and understand a site, building, interior, and object). The website provides a database with both legislation and descriptive information in a manual together with case studies, similarly to IsUD (IDeA, 2018).

Consequently, in the process of knowledge transfer, it is fundamental to contextualize information in the built environment to simplify access and create understanding by the architects. It is, therefore, necessary to consider, in the development of a DfA tool, the way of providing design indicators in relation to the activities performed in that specific circumstance by users (Mosca et al. 2019b) . For instance, a support tool should consider the space required to reach, approach, move in, and use, from outside to gradually move inside the building (Fig. 8). In this way, different elements of the built environment are included such as street, parking, path, stair, square, and entrance, hall, corridor, waiting area, toilet, rooms, and so on.

Figure 8. The illustration shows how can be considered the space in relation to a building. From the outdoor space to the indoor space (reach, approach, use). Source: authors
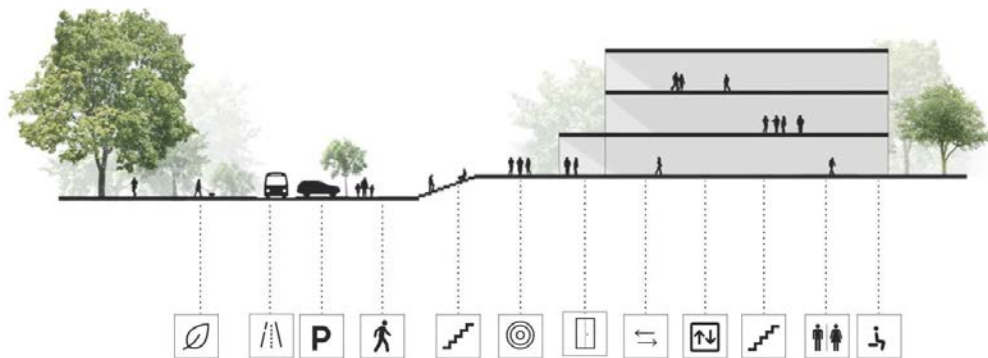
Conclusions

The purpose of the present study was to understand the process of knowledge transfer on DfA in order to allow for a practical use of this strategy during an architectural design project. A literature review was undertaken. Most of the analyzed articles consider a DfA strategy from a theoretical point of view or include studies about the direct participation of users in the design project. Conversely, few studies address the methodologies and practical tools used to inspire and support architects in applying a DfA strategy.

The literature review resulted in identifying nine studies that included recurring items on knowledge transfer of DfA strategies, which were then divided into two categories, *theoretical* and *practical* (RQ1). These studies are used as references in proposing four knowledge transfer criteria in designing inclusive environment (RQ2), more precisely: effective communication; descriptive information; understanding users' needs; built environment.

DfA information needs to be organized and it should result in considering different user needs, necessary in gaining understanding of DfA strategies. Furthermore, DfA information should be transferred by using graphic representation and indirect methods, as well as by referring to case studies,

which will jointly enable its understanding. The criteria described are devised to establish a descriptive transfer of knowledge in order to look beyond the descriptive approach of accessibility legislation and the reductive design adapted for disabled users (RQ3). are envisaged as useful instruments in the development of tools such as manuals, standards, and online databases aimed at the transfer of DfA knowledge. For this reason, they can be useful not only to researchers but also to public administrators and standard developers, in integrating DfA strategies into accessibility norms by means of a descriptive approach. The current study outlines the foundations for the development of an informative tool aimed at inspiring and sensitizing designers to the application of DfA strategies in a practical and reliable way (Mosca et al. 2019a, 2019b).

Acknowledgements

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Appendix 1

Selected articles in the last phase of the literature review divided in categories (Theoretical and Practical).

Authors	Title	Year	Source	Source details	Theoretical Category	Practical Category
Accolla A. Bandini Buti L.	Ask Yourself the Right Question. To know and understand the beauty of Human Diversity it is the first design step: a Design for All structured and autopoietic tool	2016	Conference paper	Conference: AHFE 2016 International Conference on Design for Inclusion	X	
Can G. F., Delice E. K.	A task-based fuzzy integrated MCDM approach for shopping mall selection considering universal design criteria	2018	Journal Article	Soft Computing		X
Froyen H. Verdonck E. De Meester D. Heylighen A.	Mapping and documenting conflicts between users and built environments	2009	Conference paper	Conference:5th International conference on Inclusive Design		X
Goodman J. Langdon P.M. Clarkson P.J.	User Involvement and User Data: A Framework to Help Designers to Select Appropriate Methods	2008	Journal Article	Designing Inclusive Futures		X
Goodman J. Langdon P.M. Clarkson P.J.	Equipping designers for inclusive design	2006	Journal Article	Gerontechnology	X	

Herssens, J. Heylighen, A.	Designing architecture for more, a framework of haptic design parameters with the experience of people born blind	2011	PhD Thesis	University of Hasselt, Leuven, Belgium		X
Ielegems, E. Herssens, J. Vanrie, J.	V – Model for More An inclusive design model supporting interaction between designer and user	2015	Conference paper	Conference: 20th International Conference on Engineering Design		X
Keates S. Clarkson P. J.	Countering design exclusion: bridging the gap between usability and accessibility	2003	Journal Article	Universal Access in the Information Society		X
Waller, S. Bradley, M. Hosking, I. Clarkson P. J.	Making the case for inclusive design	2015	Journal Article	Applied Ergonomics	X	