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DRIVERS AND BARRIERS FOR UNIVERSAL DESIGNING: A SURVEY ON ARCHITECTS' PERCEPTIONS

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Despite a growing awareness of the need to create more usable, comfortable, and sustainable buildings for everyone, in many countries, the adoption of universal design (UD) as a design strategy is still limited. As key stakeholders, architects can contribute greatly to making the built environment more inclusive for all, but many practitioners face difficulties in daily design practice that hold them back from implementing a UD approach. This study investigated architects' perceptions regarding the barriers to and drivers of adopting UD as a design strategy at the start of the design process using a survey of 135 practicing Flemish architects. Results showed that budget constraints and skepticism from other stakeholders were perceived as the main barriers, while time-related issues were experienced as less problematic than the literature suggests. Responses to the open-ended questions revealed how architects carefully evaluate whether to apply UD as a design strategy for each design project according to design-related and client/budget criteria. These results offer insights into practicing architects' motivations regarding UD, which can provide policy makers and researchers with the information needed to more efficiently and effectively address the barriers and drivers that architects face in implementing UD.

INTRODUCTION

Designers play an important role in society in part because of the effect their designs may have in including or excluding people. By designing products, services, and buildings that support all people, designers can contribute to a more inclusive society. However, instead of designing for all, designers often use their own bodies and physical abilities as a main point of reference for their designs (Crilly and Clarkson, 2006; Imrie, 2003; Zeisel, 2006). When they do focus on designing for a diversity of individuals, designers often find it difficult to understand or accommodate the characteristics of people with very different life experiences from their own (Eisma, *et al.*, 2003). This can result in the exclusion of people who fall outside the norm (Gray, *et al.*, 2003; Imrie, 2003). Universal design (UD) (as well as the strongly related paradigms of inclusive design and design for all) can help designers shape their designs to serve a diversity of individuals. UD is "a design strategy resulting in an environment, a product, or a service in which users do not need to adapt but instead are supported in their actions and experiences in a positive and elegant way" (Herssens, 2014; translated from original). UD is more than just an outcome or end result; it is a design strategy that spans the entire design process (Ielegems and Froyen, 2014; Ielegems, *et al.*, 2015). The term *universal designing* (UDing), coined by Steinfeld and Tauke (2002), emphasizes UD as a nonstop process of designing and building (Steinfeld and Maisel, 2012). In UDing, user feedback continuously informs the design process in order to design more inclusive environments (Ielegems, *et al.*, 2015).

UD aims to bring the perspectives of real and diverse people into the design process (Suri, 2007). Yet, despite a growing knowledge base on UD and the availability of a wide range of UD methods and tools in different design disciplines (Goodman-Deane, *et al.*, 2014; Langdon, *et al.*, 2015; Zeeman, *et al.*, 2016), in many countries around the world, UD knowledge does not seem to be generally integrated or applied throughout the design process (Dong, *et al.*, 2003; Fletcher, *et al.*, 2015; Goodman, *et al.*, 2006). Architects' particular ways of working and thinking in daily design practice are likely to affect whether and how they adopt UD tools and methods throughout the design process (Cross, 2006; Lawson, 2005; Symes, *et al.*, 1995). Therefore, this paper aims to gain more insight into the perceived barriers and drivers affecting whether practicing architects start designing for a diversity of individuals. Indeed, developing a thorough understanding of the problems and limitations contributing to the lack of UD implementation in design practice is necessary in order to address these issues (Sandhu, 2011).

LITERATURE ON BARRIERS TO AND DRIVERS OF DESIGNERS ADOPTING UD

The barriers and drivers experienced by designers in implementing UD have been examined within various design disciplines. This study defines UD barriers as all obstacles faced by designers during the design process that prevent them from designing for inclusion. UD drivers are defined as the factors that pull designers, instead of pushing them, toward adopting a UD strategy. After reviewing the literature in different design domains (*e.g.*, architecture, industrial design, information and communications technology [ICT]), the authors identified three main categories of barriers and drivers for designers: attitudinal, practical, and knowledge-based.

Attitudinal Barriers and Drivers

Attitudinal factors that drive designers to adopt UD as a design strategy are mainly related to designers' mindsets toward the values of dignity, equality, equal opportunity (Lid, 2013:47), social responsibility, and sustainability (Ryhl, 2014). Attitudinal barriers pertain to a lack of genuine understanding of the concept of UD on the part of designers and other stakeholders (Bringolf, 2011; Fletcher, *et al.*, 2015; Larkin, *et al.*, 2015; Yusof and Jones, 2014). This lack of understanding hinders designers from adopting a design attitude focused on creating elegant design solutions for

all throughout the design process. Designers often associate UD merely with accessibility (Steinfeld and Maisel, 2012; Yusof and Jones, 2014). Whereas accessibility, from an environmental standpoint, refers to the removal of barriers for the specific purpose of allowing physical access to spaces, UD offers a broader, all-embracing perspective by providing environments that can be fully experienced by all people (Gossett, *et al.*, 2009:440; Iwarsson and Ståhl, 2003). UD is also often associated with designing for special needs, leading to the misconception that it focuses merely on accommodating specific target groups with special needs. In reality, UD aims to address the widest diversity of individuals possible with a bottom-up approach that starts with the mainstream (Bringolf, 2011; Dong, *et al.*, 2003; Vanderheiden and Tobias, 2000) and broadens to include all people. As a result of these misconceptions, UD is often incorrectly perceived to be stigmatizing and compromising when it comes to aesthetics (Bringolf, 2011; Dong, *et al.*, 2004; Goodman, *et al.*, 2006); this may act as an important barrier to adopting UD. However, these incorrect assumptions are actually in direct opposition to the essential ideas behind UD, which strives to create elegant environments and eliminate stigma (Froyen, 2014).

Practical Barriers and Drivers

Time and budget limitations are the practical UD barriers most often cited in the literature. Especially in the field of industrial design, various studies closely link both issues to the lack of UD implementation (Dong, *et al.*, 2003; Goodman, *et al.*, 2006). There is a perception that UD costs more (Bringolf, 2011; Dong, *et al.*, 2004; Gray, *et al.*, 2003; Mazumdar and Geis, 2003), and designers assume that time and money affect many important aspects of UDing, such as the use of specific methods for directly involving users (Bruseberg and McDonagh-Philp, 2000; Goodman-Deane, *et al.*, 2010). Time and budget restrictions are mainly related to the level of flexibility provided by the client for a specific design project (Goodman-Deane, *et al.*, 2010). In the context of companies, Björk (2009) suggested that commercial drivers are often more influential than social drivers. Indeed, practical drivers of adopting UD generally involve economic advantages, such as more lucrative markets, enhanced brand names, and opportunities for innovation (Björk, 2009; Dong, *et al.*, 2004; Vanderheiden and Tobias, 2000). UD has already been promoted as a strategy for innovation from various perspectives, showing the potential of its adoption as a design strategy (*e.g.*, Eikhaug, *et al.*, 2010; Gheerawo and Bichard, 2011; Steinfeld and Maisel, 2012).

Knowledge-Based Barriers and Drivers

According to studies on product design, designers perceive a lack of knowledge as one of the main barriers to UD (Dong, *et al.*, 2004; Goodman, *et al.*, 2006). Moreover, designers have very specific needs and preferences regarding the format and content of user information (Dong, *et al.*, 2015; Suri, 2007; Van der Linden, *et al.*, 2016), and various studies have shown that the available user information is often not adapted to designers' ways of thinking and working (Dong, *et al.*, 2015; Lofthouse, 2006). Often, the available user information does not provide a clear central idea and fails to support designers' cognitive processes (Choi, *et al.*, 2006); furthermore, it is often not presented in a design-relevant manner (Donahue and Gheerawo, 2009; McGinley and Dong, 2011). However, if information is made explicit through research, standards, or guidelines and is presented in an appropriate, design-relevant format, knowledge could become an important driver (Bellerby and Davis, 2003; Dong, *et al.*, 2015).

BARRIERS TO AND DRIVERS OF ADOPTING UD IN CURRENT ARCHITECTURAL PRACTICE: THE CASE OF FLANDERS

The current study, which investigated architects' perceptions of UD barriers and drivers in current architectural practice in Flanders, Belgium, aims to add to the existing body of knowledge of the three main categories of UD barriers and drivers in two distinct ways. First, in contrast to previous research, this study specifically focuses on factors that affect the decision to implement UD at

the beginning of the design process. The main reason for this focus is that the initial motivation or commitment to adopt UD as a design strategy at the very start of the process appears to be important in order to accomplish the goal of inclusion (Bringolf, 2011; Ringaert, 2001). Moreover, in order to create elegant design solutions, it is necessary to integrate rich information on a variety of users from the very beginning of the design process (Ielegems, *et al.*, 2015, 2016). Second, the study focuses specifically on architectural design practice, which currently involves a policy context that contains both push and pull factors regarding more inclusion in the built environment. This provides an interesting context for investigating the factors that stimulate or inhibit architects when it comes to adopting UD. The empirical work focuses on one particular case — the region of Flanders, Belgium — which is illustrative of the situation in many other regions (although there are always contextual factors that are unique to specific countries or regions, especially in the discipline of architecture).

Indeed, there are a number of commonalities between the Flemish context and the overall global context. Social and demographic changes, such as the growth of aging populations, have urged politicians in many places to understand the social relevance of designing buildings that support users instead of excluding them from engagement in society. Accessibility and political action plans have received more attention from various European countries (Bendixen and Benktzon, 2015) since the United Nations adopted the Standard Rules on the Equalization of Opportunities for Persons with Disabilities in December 1993 (UN General Assembly, 1993). Awareness of UD has gradually grown as well. Documents such as the Tomar Resolution, formulated by the Council of Europe (2001, 2007), and the EIDD Stockholm Declaration (European Institute for Design and Disability, 2004) are important signs of this increasing awareness and action in Europe.

With this international framework as a backdrop, new accessibility regulations have been integrated into urban-planning regulations in Flanders since 2010. They aim to make public buildings (at least those with a surface area of 1,615 ft.^{2} [150 m^2] or greater) more accessible and usable (Ruimtelijke Ordening en Gelijke Kansen Vlaanderen, 2010). Private houses are not bound to specific legal standards. In line with regulations in various other countries (*e.g.*, the Americans with Disabilities Act in the United States, Document M in Great Britain), Flemish regulations have focused on setting minimum criteria regarding accessibility, particularly with regard to wheelchair accessibility. Although these accessibility criteria have been integrated into the design process, they are usually not perceived very positively. In fact, in a survey of Flemish architects, the criteria were rated among the top 10 most irritating aspects of their profession (Netwerk Architecten Vlaanderen, 2012). This is also in line with perceptions in other countries, where accessibility regulations are often regarded as costly restrictions on designers' creativity (Gray, *et al.*, 2003; Larkin, *et al.*, 2015; Mazumdar and Geis, 2003). In addition to instituting mandatory regulations pushing architectural design practice toward greater accessibility, the Flemish government has begun to provide additional (optional) information on UD with the aim of encouraging more inclusion in the built environment (*e.g.*, Gelijke Kansen in Vlaanderen, n.d.; Inter, n.d.). This change, which has also taken place in other European countries as well as the United States (Skavlid, *et al.*, 2013), constitutes an important policy shift that moves beyond mere accessibility standards toward policies that place more attention on including a wide diversity of people in the built environment (Haugeto, 2013).

Although there is clearly political interest in some countries in both pulling and pushing design practice toward designing more inclusive solutions (Björk, 2009), some designers are still reluctant to integrate UD as a design strategy. This paper aims to provide insight specifically into practicing architects' perceptions regarding whether to adopt UD in their design process. To this end, the authors conducted a questionnaire survey, which included open- and closed-ended questions, in order to examine the perceptions of practicing architects in Flanders with regard to barriers to and drivers of implementing UD processes. The next section discusses the data-collection procedure, questionnaire design, and participant sampling. This is followed by an analysis of the results in three parts: (1) the quantitative data regarding respondents' past implementation of UD as a design

strategy; (2) the quantitative and qualitative data pertaining to the architects' perceptions of the types of barriers they face to implementing UD; and (3) the results, primarily from qualitative data, from architects without barriers to adopting UD. As such, parts two and three reveal different selection criteria that architects appear to use when evaluating whether to undertake a UD process for a given project. The paper ends with a discussion and conclusion.

METHOD

Procedure

From January through June 2015, the authors conducted a survey among architects who attended various seminars organized by the Flemish architects' association, Netwerk Architecten Vlaanderen (NAV). The questionnaire was distributed at five different sessions that were open to NAV members. Two seminars were directly related to UD (group A), and three seminars had no link to UD (group B). This allowed the authors to collect data from a mix of architects with and without a particular interest in UD (groups A and B respectively). In this paper, architects' perceptions about UD are compared between groups A and B, as well as between respondents with and without barriers to adopting a UD process.

The questionnaires administered to groups A and B contained the same questions. However, for group B, a definition of UD (similar to the one described in the introduction of this paper) was added to the introduction of the questionnaire. In addition, a concise oral introduction explaining the general goals of UD was given to respondents in group B; this introduction stressed the difference between UD and accessibility in order to avoid miscomprehensions about terminology. This approach was not necessary for group A, since they had already attended lectures about UD and aging-in-place. Fisher's exact and chi-squared tests, which were used to examine differences in the sociodemographic characteristics of the two groups, showed no significant differences in age, gender, or design experience among the two groups of respondents.

The authors used SAS 9.3 and Microsoft Excel 14.1.0 software to analyze the data collected from the open- and closed-ended questions.[1] Answers from the open-ended questions were coded and analyzed using principles of constructive grounded theory (Strauss and Corbin, 1990, 1994).

Questionnaire Design

The questionnaire first asked about participants' backgrounds (*i.e.*, age, gender, profession, years of professional architectural experience, and number of employees in the participant's company). Then, in order to get a better idea of practicing architects' involvement in UD processes in daily design practice, the next section asked about participants' specific experiences with UD in their professional practices (*i.e.*, number of inclusive projects, types of inclusive projects, and design stages at which they were actively involved in inclusive projects). Next, the questionnaire explored whether architects had specific attitudinal, practical, or knowledge-based barriers to begin UDing. Based on a literature review of UD barriers in different design domains (*i.e.*, architecture, product design, and ICT), eight barriers were suggested in the questionnaire:

(1) unclear how to start a UD process;
(2) insufficient information available throughout the design process;
(3) no clear, structured information available;
(4) unsure how to transfer UD knowledge into a design;
(5) skeptical attitudes of other stakeholders (*e.g.*, clients, builders, colleagues);
(6) increased complexity of the design process;
(7) time-consuming; and
(8) budget.

Extra space was provided to fill in two additional barriers, if needed. Respondents were invited to rank their three main barriers, with one being the most challenging and three being the least challenging. In addition, in an open-ended question, respondents were asked to further clarify their experiences with each of the indicated barriers in their own words and encouraged to use practical examples from their personal design experiences. The integration of open-ended questions can aid in exploring and interpreting responses to closed-ended questions (Foddy, 1994; Reja, *et al.*, 2003) and identifying more complex frames of reference and motivational influences (Foddy, 1994). Respondents who indicated that they did not have any barriers to begin UDing were asked to elaborate on their drivers in an open-ended question.

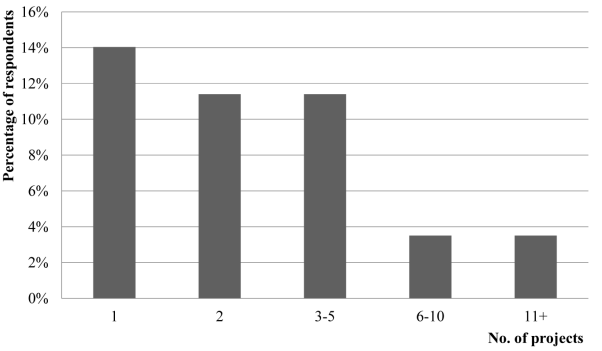

FIGURE 1. Respondent participation in inclusive projects.

Sampling

The authors distributed 396 questionnaires, of which 135 were returned. Eight of these were invalid because they were not completed or contained inconsistent answers, leaving a total of 127 valid questionnaires (a response rate of 32%), 54 from group A and 73 from group B. The response rate differed significantly among the two groups: the rate for group A (47%) was almost twice as high as the rate for group B (26%).

For the complete sample, 59% of respondents were male. Respondents ranged in age from 23-63 years old, with an average age of 39, and had an average of 15 years' experience. In terms of age and gender, the sample of practicing architects (n = 121, omitting six respondents who were not professional architects) did not differ significantly from 2014 statistical data on all architects registered by the Flemish Council of Architects (2014). However, the sample did contain a lower percentage of architects between the ages of 60 and 69 than were registered by the Flemish Council, which may be explained by the inclusion of retired architects on the council's list.

RESULTS AND ANALYSIS

Before analyzing respondents' perceptions regarding barriers to and drivers of adopting UD, this section will take a closer look at their experiences with UD in daily design practice.

Practicing Architects' Experiences with UD Processes

When asked if they had designed one or more inclusive projects (*i.e.*, projects that embraced inclusion beyond adherence to standards set forth in accessibility legislation) in their professional careers, almost half of respondents (48%) said yes. In a follow-up question, these respondents were asked how many inclusive design projects they had been involved in; Figure 1 illustrates the results, which indicated an average of approximately 3.8 projects. Regression analyses revealed no significant differences in participants' involvement with UD based on their age, gender, or years of design experience. Additionally, there were no statistically significant differences between respondents in group A (those who attended a UD seminar) and group B (those who attended an unrelated seminar) regarding their involvement in inclusive projects or the number of projects in which they had been involved.

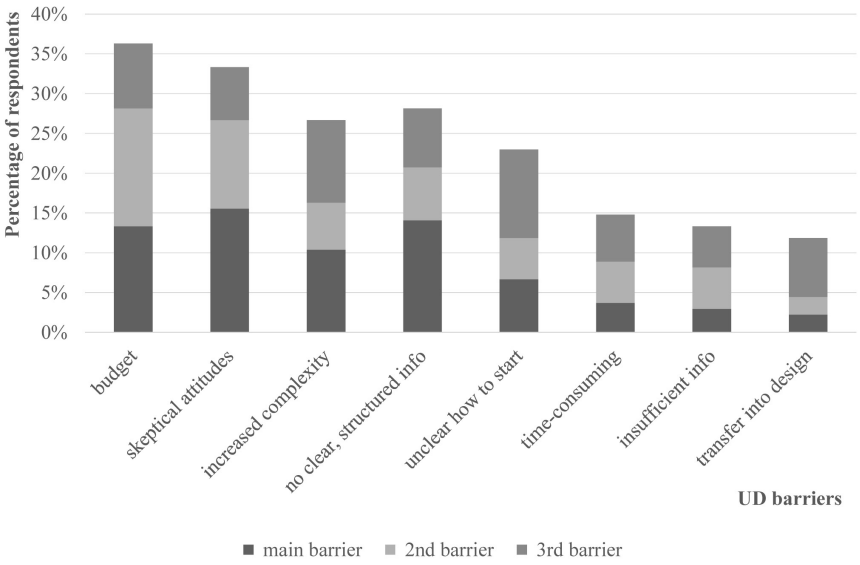

FIGURE 2. Percentage of participants who experienced each barrier to begin UDing (n = 72).

Assuming that the majority of respondents had designed more than five projects (a reasonable assumption given that the average design experience was 15 years), these results suggest that respondent architects do not apply UD as a standard design strategy in every project; rather, they seem to view UD as something to apply in specific circumstances.

Respondents were also asked to indicate in which design stages of the UD projects they had been actively involved (*i.e.*, preparation and brief, concept, developed design, building permit, and/or tender and construction). Interestingly, a large percentage of respondents had participated throughout the design process, with average involvement ranging from 78% (construction) to 92% (concept and developed design). Moreover, approximately two-thirds of respondents had been actively involved in all design stages when designing inclusive buildings. This relatively high rate of involvement throughout the design process may be related to the particular Flemish architectural context, which is characterized by mostly small-scale architecture firms, resulting in architects developing closer relationships with each project and participating in the whole design process instead of splitting tasks among different people.

Architects' Perceptions Regarding Barriers to Begin UDing

Results indicated that 57% of respondents (n = 72) experienced barriers to adopting inclusive design strategies. Figure 2 provides an overview of the UD barriers faced by respondents. The authors found no significant differences between groups A and B regarding whether respondents experienced barriers to implementing UD and the types of barriers they faced[2]; therefore, the results from the two groups have been pooled.

Interestingly, respondents who had designed one or more inclusive projects still reported experiencing barriers, but they reported experiencing significantly fewer of them (Figure 3). Among the eight specified barriers, the difference between the groups of respondents who had and had not participated in an inclusive design project was only significant for two: unclear how to start a UD process and unsure how to transfer UD knowledge into a design.

Skeptical attitudes of other stakeholders was the only barrier that was more commonly faced by respondents with UD experience. This result is not surprising, since this barrier is less dependent

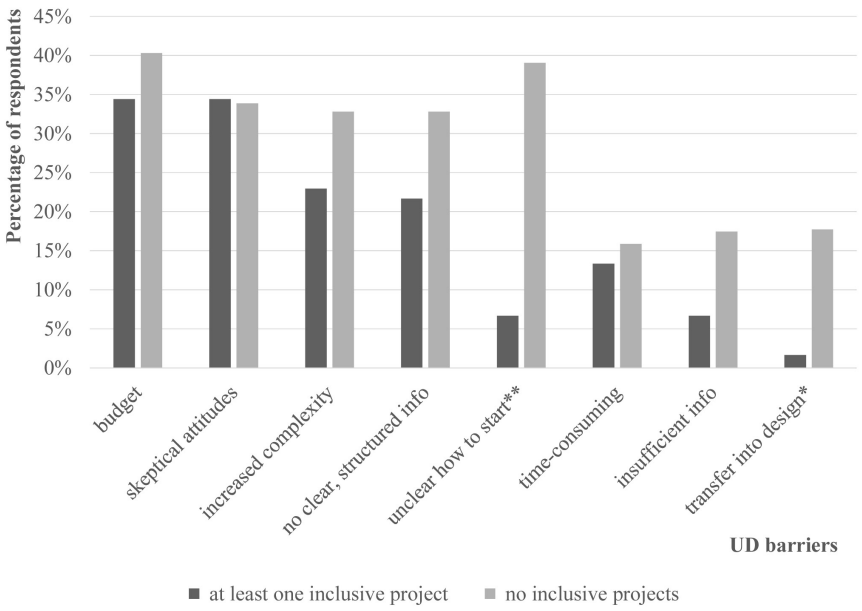

FIGURE 3. Comparison of barriers experienced by respondents who had and had not participated in an inclusive project (* $p < .05$, ** $p < .001$).

on one's own design experience with UD. Similarly, the difference among the two groups was less pronounced for the barriers of time and budget than for other barriers (Figure 3). When taking all barriers into account, it appeared that participants who had designed more inclusive projects (*i.e.*, two or more) experienced fewer UD barriers.

Respondents were invited to elaborate on their personal experiences with UD barriers and provide practical examples from their own design practices. The responses to these open-ended questions are analyzed in the following paragraphs.

Influential role of clients on architects' main UD barriers

Respondents indicated that budget (37%) and skeptical attitudes of other stakeholders (34%) were their two most challenging barriers (Figure 2). Responses to the open-ended questions indicated that architects struggled with stakeholders' poor understanding of UD. The purpose and usefulness of UD is not always clear to clients and other stakeholders, such as colleagues, urban planners, local authorities, and contractors. Some respondents indicated that this made it much more challenging to convince stakeholders to incorporate more inclusive aspects into their designs. Thinking in terms of target groups seemed to inhibit stakeholders from recognizing the potential of UD to improve the overall quality of designs for all people.

Among stakeholders, the skeptical attitudes of clients in particular appeared to be an influential factor contributing to designers' UD barriers. Clients were directly mentioned in 34% of all responses from participants facing barriers. Since clients generally control project budgets, respondents felt that clients could greatly influence the decision-making process and design focus of projects. According to one respondent (no. 92), "The client pays, so they decide how to spend the budget. They do not always understand the need for certain adjustments. This is why no adaptable house is being built despite this being possible."[3] In addition to addressing the significant influence of clients on the decision-making process as providers of the budget, this quote also indicates the important impact of clients' awareness of UD when its implementation requires extra effort. For instance, respondents indicated that the UD philosophy often played a lesser role in the design process than

was initially aimed for when some inclusive design aspects required more complex detailing (nos. 51 and 59) or additional planning (no. 109).

Surface area was another issue that respondents frequently referenced in relation to budget. Respondents specifically mentioned clients who were not end users of the projects: "UD solutions generally require more space, resulting in clients being able to sell fewer square meters" (no. 86). Clients such as property developers who aimed to sell housing projects, for example, often associated UD with the need for extra living area and consequently less profit.

Architects' perceptions regarding UD information

Only 13% of respondents who said they faced UD barriers reported having issues related to the amount of UD information available, but the third most frequently reported barrier (28%) was a lack of clear, structured information (Figure 2). In their responses to the open-ended questions, respondents argued that UD information was too spread out over different sources, making it difficult to gather knowledge efficiently. In addition, some respondents felt that the formatting of UD information was unclear or too abstract, and they could not easily find the specific information they needed at a given time in the design process. Interestingly, respondents mainly referred to acquiring UD information through websites or guidelines; they hardly mentioned alternative indirect information sources (*e.g.*, research papers, books) or direct user contact. Nevertheless, studies have demonstrated that user involvement can generate valuable information to improve the quality of buildings (Eriksson, *et al.*, 2014; Ringaert, 2001).

Perceived complexity of UDing

Another frequently reported barrier was the increased complexity of a UD process (27%) (Figure 2). According to respondents, this complexity appeared primarily in design-context issues and additional design requirements. Limitations related to the design context were sometimes experienced as challenging when adopting a UD strategy, mainly with regard to the existing setting of a given design (*e.g.*, renovations or protected monuments) or a limited surface area (*e.g.*, in an urban context). According to respondents, design elements related to these factors, such as multilevel spaces, narrow corridors, and steep staircases, were more difficult to adjust to more inclusive design solutions.

Making things even more complex, various examples of barriers mentioned by respondents were specifically linked to the combination of UD and other requirements. UD seemed to be perceived as "yet another criteria that must be included from the very first design sketch, in addition to the program requirements, budget, energy efficiency, safety regulations, accessibility, fire prevention, etc." (no. 120), which complicated the process considerably. Respondents also specifically referred to contradictions between Flemish accessibility regulations and other regulations, such as those related to fire safety, protected monuments, or energy efficiency.

Time as a less influential UD barrier for architects

In contrast to various studies showing that issues related to time are some of the main barriers architects face in adopting UD (*e.g.*, Goodman, *et al.*, 2006; Sims, 2003; Vanderheiden and Tobias, 2000), the time-consuming barrier was among the least reported (15%) in the present study (Figure 2). Results indicated that respondents saw budget as the main barrier, while time was less problematic. As a barrier, respondents did not specifically mention time in relation to possible delays in the design or building processes when applying UD as a design strategy. Instead, they mainly mentioned time in relation to their own investments of time to acquire new UD knowledge within a tight deadline. Respondents indicated that the time and financial compensation they receive for a design project generally do not allow for extensive user research: "As an architect, [there is] not enough budget or time to conduct research yourself" (no. 90). As such, respondents focused more on time in relation to their own time investment for specific projects, rather than on the effects of time and budget on the overall design and building process.

Architects Without UD Barriers

Of the respondents who did not report experiencing UD barriers (43% of the total sample), a small subgroup had simply never applied UD (13%), for which respondents gave the following reasons: no attention was given to UD, they had no experience with UD, or there was a lack of demand for UD from their clients. A larger subgroup (35%, or 14% of the whole sample) declared that they consistently adopted UD in all of their design projects, while the remaining respondents (52%) sometimes applied UD. The following paragraphs look at two specific aspects related to the second and third subgroups.

Architects' drivers to begin UDing in general
In their responses to the open-ended questions, respondents primarily mentioned drivers that were linked to their personal values. Some respondents were highly motivated to apply UD as a design strategy in order to increase the overall architectural quality of buildings and improve users' experiences: "I am convinced that a house should be able to adapt to its users and not vice versa" (no. 47). Another main driver concerned architects' social responsibility, which was mainly linked to designing sustainable buildings for current and future generations. Guaranteeing social sustainability appeared to be a decisive motivator for some architects; as one respondent (no. 117) said, "It often is not much extra work and results in a much more sustainable building." Some respondents also mentioned their own age and life experience as a more personal driver to apply UD as a design strategy. Overall, respondents were mainly motivated by personal or social drivers to begin UDing.

Architects' criteria for determining whether to apply UD in a project
As previously mentioned, most respondents indicated that they did not consistently apply UD as a standard design strategy. In the subgroup of architects who said they faced no UD barriers and sometimes applied UD as a design strategy, respondents' answers confirmed this lack of consistency by showing how they consciously evaluate whether to apply a UD strategy in a given design project. It seemed a specific trigger was necessary for these respondents to apply UD; in the words of one respondent (no. 126), "The basic philosophy is always nearby, but if there is no real need or reason for it, it will not be 100% respected." This respondent did not specify if it was the architect or another stakeholder who would not respect the UD philosophy, but the comment touches on the sensitive subject of the importance of architects and other stakeholders understanding the usefulness of UD for a specific project and, consequently, remaining true to the philosophy throughout the design process.

The data revealed two main types of criteria used by architects to determine whether to implement UD: (1) design related and (2) client/budget. Interestingly, these criteria mirror architects' perceived barriers. For example, regarding design-related criteria, the existing design context was mentioned as an important selection criterion by respondents who said they faced no barriers. In addition, architects who said they did not experience barriers considered the design program of the building an important criterion, which was not explicitly mentioned by architects who said they did face barriers. Moreover, respondents clearly viewed public and private buildings differently; they seemed to perceive the usefulness of UD to be more evident for public buildings than for private ones. However, the authors were unable to identify a specific distinguishing typology.

When architects themselves were convinced of the value of UD for a specific project, the willingness of the client (in addition to their budget) was perceived as another main criterion for determining whether to integrate UD at the start of the design process, which was previously noted as a barrier to UD implementation. Respondents explained that some clients did not want to invest in UD because they did not see its potential: "Making the client enthusiastic is the hardest thing to do" (no. 74). However, respondents' answers indicated that when they were convinced of the potential of UD, they clearly made an effort to convince clients. This seemed to be a major difference between respondents who said they did experience barriers versus those who said they did not. A

difference in perception regarding UD was noticeable among respondents who said they did not face barriers, which seemed to be closely related to a more positive design attitude, as illustrated in one respondent's statement (no. 35): "Budget is an obstacle for many clients, but my own house is inclusive and is the best showroom to convince clients." A more positive attitude toward UD and its potential seemed to positively affect architects' perceptions of UD barriers and their interest in beginning a UD process.

DISCUSSION AND CONCLUSION

This study has provided valuable insight into architects' perceptions of the barriers and drivers they experience in relation to implementing UD. Interestingly, respondents did not perceive time as a problematic barrier at the start of the design process. This is in contrast to studies in other design domains that examined UD barriers throughout the design process and found that time and budget were both important barriers (Dong, *et al.*, 2003; Goodman, *et al.*, 2006). In this study, respondents perceived budget and the skeptical attitudes of other stakeholders to be the two main barriers to adopting a UD approach. Although results indicated that respondents who had been involved in at least one inclusive project experienced significantly fewer barriers, this experience seemed to have a limited influence on the two barriers they selected as most challenging. Additionally, findings showed that respondents did not necessarily require more information on UD but instead needed more centralized information that was presented in a design-relevant format and adapted to the design process.

This research compared perceptions surrounding UD among a sample of architects; for analysis, the sample was divided in two ways: (1) comparing architects who reported experiencing barriers to implementing UD with architects who did not and (2) comparing architects who specifically took a UD seminar (group A) with architects who did not (group B). The authors found no significant differences between groups A and B. However, they found a clear difference in perceptions of UD between architects who did and did not report experiencing barriers to its implementation. Similar to respondents who said they faced barriers, respondents who said they did not face barriers mentioned budget, skeptical attitudes of stakeholders (particularly clients), and the existing design context as specific criteria that helped them determine whether to adopt a UD approach. However, architects who said they did not face barriers seemed to view these criteria from a different perspective — not as barriers but as objective criteria for evaluating the usefulness and feasibility of integrating UD at the start of a project. Respondents who believed in the potential of UD said that when they were convinced of its benefits for a specific project, they tried to convince project stakeholders of its applicability at the beginning of the design process. A more positive attitude toward UD and its potential seemed to enable respondents who did not report facing barriers to look at these issues from a different perspective (Ryhl, 2014).

The increased complexity of a UD process was also a frequently reported barrier. Respondents viewed acquiring UD knowledge as another requirement that needs to be embedded in the design process from the start, along with other requirements. This barrier may also reflect the nature of the architect's profession. Various studies have shown that the growth of specialization in architectural design teams has contributed to the field's growing complexity (Sang, *et al.*, 2009; Symes, *et al.*, 1995; Tijerino, 2009). In this regard, UD can be thought of as a kind of specialized knowledge that needs to be integrated into the design process from the very beginning.

More awareness and knowledge of UD among architects and key stakeholders such as clients is crucial to changing general perceptions about UD (Van der Linden, *et al.*, 2016; Yusof and Jones, 2014) and, consequently, perceptions about barriers to and drivers of implementing UD in the design process. These authors agree with Steinfeld and Maisel (2012) that current accessibility regulations may significantly influence the creation of "tunnel vision" among architects regarding UD. Respondents' perceptions at the start of the design process seemed to be mainly dominated by

an accessibility perspective instead of a broader perspective on inclusion. For instance, more than three-quarters of the examples participants gave in their responses to the open-ended questions were related to mere accessibility (*i.e.*, removing environmental barriers) and not to other important inclusive design elements that may affect the psychological, physical, and social wellness of individuals (Wright, *et al.*, 2017), such as improving the sensory qualities of a building. Ryhl (2014) described this as the difference between perceiving UD merely in terms of regulatory requirements and viewing it as a more holistic approach to designing for users' bodies and diverse multisensory experiences in every architecture design project. As such, these results demonstrate how this tendency toward tunnel vision influences architects' perceptions and attitudes surrounding UD and their decisions regarding its adoption and implementation at the beginning of the design process.

Further research is needed to better understand the reasons behind architects' perceptions of UD and the factors that affect them. In addition to addressing the barriers architects face to begin UDing more effectively and efficiently, this study also showed how shining more attention on architects' perceptions of UD barriers could be a decisive factor in improving the uptake of UD in architectural design practice.

NOTES

1. For the quantitative part of this study, the authors have included statistical details to verify results and prove their reliability and transparency. However, not all statistical details are included because it would have compromised the readability and clarity of the text.

2. Four variables were tested between respondents from groups A and B: (1) participation in an inclusive project (yes/no), (2) number of inclusive projects in which they had participated, (3) experience of UD barriers (yes/no), and (4) types of UD barriers faced.

3. The authors have translated respondents' comments from Dutch to English.

REFERENCES

Bellerby F, Davis G (2003) Defining the limits of inclusive design. Paper presented at the International Conference on Inclusive Design and Communications 2003 (INCLUDE 2003). London (18-25 March).

Bendixen K, Benktzon M (2015) Design for all in Scandinavia — a strong concept. *Applied Ergonomics* 46(B):248-257.

Björk E (2009) Many become losers when universal design perspective is neglected: Exploring the true cost of ignoring universal design principles. *Technology and Disability* 21(4): 117-125.

Bringolf J (2011) Barriers to universal design in Australian housing. Paper presented at the International Conference on Best Practices in Universal Design at FICCDAT. Toronto (5-8 June).

Bruseberg A, McDonagh-Philp D (2000) User-centred design research methods: The designer's perspective. In PRN Childs and EK Brodhurst (Eds.), *Integrating design education beyond 2000*. Hoboken, NJ: Wiley-Blackwell, pp. 179-184.

Choi YS, Yi JS, Law CM, Jacko JA (2006) Are universal design resources designed for designers? In S Keates and S Harper (Eds.), *Assets '06: Proceedings of the 8th international ACM SIGACCESS conference on computers and accessibility*. New York: Association for Computing Machinery, pp. 87-94.

Council of Europe (2001) Resolution ResAP(2001)1 on the introduction of the principles of universal design into the curricula of all occupations working on the built environment. https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016804c2eee. Site accessed 26 March 2020.

Council of Europe (2007) Resolution ResAP(2007)3 "Achieving full participation through universal design." https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805d46ae. Site accessed 26 March 2020.

Crilly N, Clarkson PJ (2006) The influence of consumer research on product aesthetics. In D Marjanovic (Ed.), *DS 36: Proceedings of DESIGN 2006, the 9th international design conference*. Dubrovnik, Croatia: The Design Society, pp. 689-696.

Cross N (2006) *Designerly ways of knowing*. London: Springer.

Donahue S, Gheerawo R (2009) Inclusive design 2.0 — evolving the approach and meeting new challenges. Paper presented at the 5th International Conference on Inclusive Design (INCLUDE 2009). London (5-8 April).

Dong H, Clarkson PJ, Ahmed S, Keates S (2004) Investigating perceptions of manufacturers and retailers to inclusive design. *The Design Journal* 7(3):3-15.

Dong H, Keates S, Clarkson PJ, Cassim J (2003) Implementing inclusive design: The discrepancy between theory and practice. In N Carbonell and C Stephanidis (Eds.), *Universal access: Theoretical perspectives, practice, and experience: 7th ERCIM international workshop on user interfaces for all, Paris, France, October 24-25, 2002, revised papers*. Berlin: Springer, pp. 106-117.

Dong H, McGinley C, Nickpour F, Cifter AS (2015) Designing for designers: Insights into the knowledge users of inclusive design. *Applied Ergonomics* 46(B):284-291.

Eikhaug O, Gheerawo R, Plumbe C, Berg MS, Kunur M (2010) *Innovating with people: The business of inclusive design*. Oslo: Norsk Designråd.

Eisma R, Dickinson A, Goodman J, Mival O, Syme A, Tiwari L (2003) Mutual inspiration in the development of new technology for older people. Paper presented at the International Conference on Inclusive Design and Communications 2003 (INCLUDE 2003). London (18-25 March).

Eriksson J, Glad W, Johansson M (2014) User involvement in Swedish residential building projects: A stakeholder perspective. *Journal of Housing and the Built Environment* 30(2): 313-329.

European Institute for Design and Disability (2004) The EIDD Stockholm declaration 2004. http://dfaeurope.eu/what-is-dfa/dfa-documents/the-eidd-stockholm-declaration-2004/. Site accessed 24 March 2020.

Flemish Council of Architects (Orde van Architecten Vlaamse Raad) (2014) Statistieken van het ledenbestand van de orde (data files) (Dutch). Retrieved from http://www.ordevanarchitecten.be/orde/statistieken.php.

Fletcher V, Bonome-Sims G, Knecht B, Ostroff E, Otitigbe J, Parente M, Safdie J (2015) The challenge of inclusive design in the U.S. context. *Applied Ergonomics* 46(B):267-273.

Foddy W (1994) *Constructing questions for interviews and questionnaires: Theory and practice in social research*. Cambridge, UK: Cambridge University Press.

Froyen H (2014) Universal design: A methodological approach. In H Caltenco, PO Hedvall, A Larsson, K Rassmus-Gröhn, and B Rydeman (Eds.), *Universal design 2014: Three days of creativity and diversity*. Amsterdam: IOS Press, pp. 7-8.

Gelijke Kansen in Vlaanderen (n.d.) Handboek toegankelijkheid publieke gebouwen (Dutch). www.toegankelijkgebouw.be. Site accessed 24 March 2020.

Gheerawo R, Bichard JA (2011) Support strategy. *New Design* 87:32-37.

Goodman J, Dong H, Langdon PM, Clarkson PJ (2006) Increasing the uptake of inclusive design in industry. *Gerontechnology* 5(3):140-149.

Goodman-Deane J, Langdon P, Clarkson J (2010) Key influences on the user-centered design process. *Journal of Engineering Design* 21(2-3):345-373.

Goodman-Deane J, Ward J, Hosking I, Clarkson PJ (2014) A comparison of methods currently used in inclusive design. *Applied Ergonomics* 45(4):886-894.

Gossett A, Mirza M, Barnds AK, Feidt D (2009) Beyond access: A case study on the intersection between accessibility, sustainability, and universal design. *Disability and Rehabilitation: Assistive Technology* 4(6):439-450.

Gray DB, Gould M, Bickenbach JE (2003) Environmental barriers and disability. *Journal of Architectural and Planning Research* 20(1):29-37.

Haugeto AK (2013) Introduction: Trendspotting at UD 2012 Oslo. In TD Centre (Ed.), *Trends in universal design: An anthology with global perspectives, theoretical aspects and real world examples*. Oslo: Norwegian Directorate for Children, Youth and Family Affairs, pp. 6-9.

Herssens J (2014) Universal design, ontwerpen met zorg voor iedereen (Dutch). Paper presented at the "Design for Health, Design with Care" interregional meeting. Hasselt, Belgium (4 December).

Ielegems E, Froyen H (2014) Universal design: A methodological approach. *Design for All* 9(10): 31-42.

Ielegems E, Herssens J, Vanrie J (2015) AV-model for more: An inclusive design model supporting interaction between designer and user. In C Weber, S Husung, G Cascini, M Cantamessa, D Marjanovic, and M Bordegoni (Eds.), *DS 80-9: Proceedings of the 20th International Conference on Engineering Design (ICED 15), Vol. 9: User-centred design, design of socio-technical systems*. Milan, Italy: ICED, pp. 259-268.

Ielegems E, Herssens J, Vanrie J (2016) User knowledge creation in universal design processes. In G di Bucchianico and P Kercher (Eds.), *Advances in design for inclusion: Proceedings of the AHFE 2016 International Conference on Design for Inclusion*. Basel, Switzerland: Springer, pp. 141-154.

Imrie R (2003) Architects' conceptions of the human body. *Environment and Planning D* 21(1): 47-66.

Inter (n.d.) Toegankelijkheid en universal design (Dutch). www.inter.vlaanderen/toegankelijkheid-en-universal-design. Site accessed 24 March 2020.

Iwarsson S, Ståhl A (2003) Accessibility, usability and universal design — positioning and definition of concepts describing person-environment relationships. *Disability and Rehabilitation* 25(2):57-66.

Langdon P, Johnson D, Huppert F, Clarkson PJ (2015) A framework for collecting inclusive design data for the UK population. *Applied Ergonomics* 46(B):318-324.

Larkin H, Hitch D, Watchorn V, Ang S (2015) Working with policy and regulatory factors to implement universal design in the built environment: The Australian experience. *International Journal of Environmental Research and Public Health* 12(7):8157-8171.

Lawson B (2005) *How designers think: The design process demystified*, 4th edition. London: Architectural Press.

Lid IM (2013) An ethical perspective. In S Skavlid, HP Olsen, and AK Haugeto (Eds.), *Trends in universal design: An anthology with global perspectives, theoretical aspects and real world examples*. Oslo: Norwegian Directorate for Children, Youth and Family Affairs, The Delta Centre, pp. 46-51.

Lofthouse V (2006) Ecodesign tools for designers: Defining the requirements. *Journal of Cleaner Production* 14(15):1386-1395.

Mazumdar S, Geis G (2003) Architects, the law, and accessibility: Architects' approaches to the ADA in arenas. *Journal of Architectural and Planning Research* 20(3):199-220.

McGinley C, Dong H (2011) Designing with information and empathy: Delivering human information to designers. *The Design Journal* 14(2):187-206.

Netwerk Architecten Vlaanderen (2012) *Ons vak in vorm* (Dutch). Gent, Belgium: Flemish Architects' Association.

Reja U, Manfreda KL, Hlebec V, Vehovar V (2003) Open-ended vs. close-ended questions in web questionnaires. *Developments in Applied Statistics* 19(1):159-177.

Ringaert L (2001) User/expert involvement in universal design. In WFE Preiser and E Ostroff (Eds.), *Universal design handbook*. New York: McGraw-Hill, pp. 6.1-6.14.

Ruimtelijke Ordening en Gelijke Kansen Vlaanderen (2010) Stedenbouwkundige verordening betreffende toegankelijkheid (Dutch). https://www.toegankelijkgebouw.be/Regelgeving/Downloads/tabid/328/Default.aspx. Site accessed 26 March 2020.

Ryhl C (2014) The missing link in implementation of universal design: The barrier between legislative framework and architectural practice. In H Caltenco, PO Hedvall, A Larsson, K Rassmus-Gröhn, and B Rydeman (Eds.), *Universal design 2014: Three days of creativity and diversity*. Amsterdam: IOS Press, pp. 433-434.

Sandhu JS (2011) The rhinoceros syndrome: A contrarian view of universal design. In WFE Preiser and KH Smith (Eds.), *Universal design handbook*, 2nd edition. New York: McGraw-Hill, pp. 44.3-44.12.

Sang KJ, Ison SG, Dainty AR (2009) The job satisfaction of UK architects and relationships with work-life balance and turnover intentions. *Engineering, Construction and Architectural Management* 16(3):288-300.

Sims R (2003) 'Design for all': Methods and data to support designers. PhD dissertation, Loughborough University, Loughborough, UK. https://repository.lboro.ac.uk/articles/_Design_for_all_methods_and_data_to_support_designers/9355466. Site accessed 26 March 2020.

Skavlid S, Olsen HP, Haugeto AK (Eds.) (2013) *Trends in universal design: An anthology with global perspectives, theoretical aspects and real world examples*. Oslo: Norwegian Directorate for Children, Youth and Family Affairs, The Delta Centre.

Steinfeld E, Maisel J (2012) *Universal design: Creating inclusive environments*. Hoboken, NJ: John Wiley & Sons.

Steinfeld E, Tauke B (2002) Universal designing. In J Christophersen (Ed.), *Universal design: 17 ways of thinking and teaching*. Drammen, Norway: Husbanken, pp. 165-189.

Strauss A, Corbin J (1990) *Basics of qualitative research, Vol. 15*. Newbury Park, CA: Sage.

Strauss A, Corbin J (1994) Grounded theory methodology: An overview. In KD Norman and SLY Vannaeds (Eds.), *Handbook of qualitative research*. Thousand Oaks, CA: Sage, pp. 273-285.

Suri JF (2007) Involving people in the process. Paper presented at the 4th International Conference on Inclusive Design (INCLUDE 2007). London (2-4 April).

Symes M, Eley J, Seidel AD (1995) *Architects and their practices: A changing profession*. Oxford, UK: Butterworth Architecture.

Tijerino R (2009) The architecture profession: Can it be strengthened? *Journal of Architectural and Planning Research* 26(3):258-268.

UN General Assembly (1993) The standard rules on the equalization of opportunities for persons with disabilities. http://www.un.org/esa/socdev/enable/dissre00.htm. Site accessed 26 March 2020.

Van der Linden V, Dong H, Heylighen A (2016) From accessibility to experience: Opportunities for inclusive design in architectural practice. *Nordic Journal of Architectural Research* 28(2):33-58.

Vanderheiden G, Tobias J (2000) Universal design of consumer products: Current industry practice and perceptions. *Human Factors and Ergonomics Society Annual Meeting Proceedings* 44(32):6-19–6-21.

Wright CJ, Zeeman H, Whitty JA (2017) Design principles in housing for people with complex physical and cognitive disability: Towards an integrated framework for practice. *Journal of Housing and the Built Environment* 32(2):339-360.

Yusof M, Jones D (2014) Universal design practice in Malaysia: Architect's perceptions of its terminology. In H Caltenco, PO Hedvall, A Larsson, K Rassmus-Gröhn, and B Rydeman (Eds.), *Universal design 2014: Three days of creativity and diversity*. Amsterdam: IOS Press, pp. 347-355.

Zeeman H, Wright CJ, Hellyer T (2016) Developing design guidelines for inclusive housing: A multistakeholder approach using a Delphi method. *Journal of Housing and the Built Environment* 31(4):761-772.

Zeisel J (2006) *Inquiry by design: Environment/behavior/neuroscience in architecture, interiors, landscape, and planning*. New York: W. W. Norton & Company.

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