Human–Computer Interaction Series

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Architecture and Interaction

Human Computer Interaction in Space and Place

Springer

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ISSN 1571-5035
Human–Computer Interaction Series
ISBN 978-3-319-30026-9   ISBN 978-3-319-30028-3 (eBook)
DOI 10.1007/978-3-319-30028-3

Library of Congress Control Number: 2016943077

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Chapter 2
Applying HCI Methods and Concepts to Architectural Design (Or Why Architects Could Use HCI Even If They Don't Know It)

Jakub Krukar, Ruth Conroy Dalton, and Christoph Hölscher

Abstract The act of designing a building is indirectly, but conceptually very closely, linked to the user experience of its final outcome. It is this experience which often constitutes a major criterion for assessing the quality of the architect's work. And yet, it would be a gross overstatement to suggest that architectural design is a user-centered process.

On a more generic level, designing any physical object acting as a catalyst for the final experience can be viewed as an act of designing a human-artifact interaction where the 'artifact' (be it a building or a computer device) serves as an interface for the ultimate behavior or emotional reaction. This chapter argues, that the field of Human-Computer Interaction (HCI) can be viewed as a source of inspiration for architects wishing to incorporate, or enhance, user-centric planning routines in their creative workflows.

Drawing from the methodological toolbox of HCI, we demonstrate how user-centric planning can be placed in a structured framework, with tested and easy-to-apply methods serving as the vehicle for holistic user-centered planning processes.

The chapter proposes a formal model for understanding usability and user experience in the architectural context, demonstrates a number of methods suitable for its application, and concludes with a case study of an attempted use of one of such methods in an award-winning (yet, not necessarily user-friendly) public library project.

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N.S. Dalton et al. (eds.), *Architecture and Interaction*,
Human–Computer Interaction Series, DOI 10.1007/978-3-319-30028-3_2

Introduction

It should be self-evident that architects design buildings for the people who will ultimately come to inhabit them and therefore it could be assumed that the architectural design process might exemplify a user-centred design approach. The reality unfortunately falls short of this ideal. Frequently, the needs of a building's end-user/s fade into the background due to the fact of being subsumed by numerous other, and often conflicting, design constraints: these include the needs of the client (where the client and end users are not one and the same) or functional, programmatic, structural, material and legal requirements. Conversely, the needs of the user may receive less consideration, as experienced architects may believe that they can intuitively (and hence implicitly) design for building's inhabitants without any need to make this an explicit part of the design consideration. Sometimes this is true; sometimes it is not. It is the position of this chapter that by explicitly placing the needs of users at the centre of the architectural design process, the overall quality of public architecture and cities can be increased. If so, how might this be achieved? One suggestion is to look to another field where the needs of the users are integral to their methodologies, namely human-computer interaction (HCI; see e.g. Dix et al. 1997; Preece et al. 2011).

Ultimately, human-computer interaction is a type of human-artifact interaction, and HCI research is characterized by analyzing human behavior, cognitive processes and task structures faced by the user. Buildings can also be understood as artifacts, and humans interact with these artifacts in numerous ways. In the behavioral sciences, this has been investigated under the label *environmental psychology* since the 1970s and, more recently, also within the *spatial cognition* domain. While a large number of studies in these two fields have tried to identify how people react to environmental settings (e.g. Kopec 2006) and how they mentally represent spatial relations (e.g. McNamara 1986), such research has had little impact on architectural design practice in comparison to the established role of HCI professionals and their methodology in contemporary software and IT systems design.

In the last 10 years there has been an important revitalization of the interaction between cognition and architecture. One example is the *evidence-based design* movement in architecture, which calls for better understanding of human behavior inside buildings. The main thrust is to obtain performance measures of implemented designs (existing buildings) and/or derive predictions of such measures for design options under consideration. The *evidence-based architectural design* movement has emphasized the need for adopting a human-centered, empirically grounded perspective and for developing scientifically appropriate evaluation methods (Hamilton and Watkins 2009). This approach is most prominent in health care and office architecture (e.g. Suttell 2007; Ulrich et al. 2004; Sailer et al. 2008). Evidence-based design has been significantly inspired by the success of evidence-based medicine with its core demand for decision-making based on unbiased, reliable data-sets that often question expert intuitions and long-held preferences (Sackett et al. 1996). Besides issues such as energy-efficiency, human factors are now seen as a component of building performance, involving perception, emotion and aesthetic appraisal, psychological well being, as well as behavioral and cognitive factors of movement in a building or through cities.

In HCI, the usability of a digital system typically can be described by a triangle of user characteristics, task properties and system features (including the user interface and underlying functionality). In architectural design we find a similar triangle, here of the building user, building-specific tasks, and the features of the building. Consequently, methods for capturing the usability of buildings must be able to take these factors into account. In order to do this, we must first, however, unpick what exactly is meant by the term *usability* when applied to architecture rather than to a digital system. And since in HCI the importance of usability is most often seen through the wider lens of the holistic *user experience* we must define the relation between these two concepts in the architectural context; this will be addressed in the first section of this chapter.

Building Usability and User Experience

Reviewing the Existing Usability Models in HCI

Understanding what is a *usable building* varies significantly between publications (Hölscher et al. 2006; Leaman and Bordass 2000; Norman 2002) and a universal acceptance of quantifiable measures defining it is still a distant goal. Such an understanding is necessary on an interdisciplinary level, since many design-related fields could benefit from such knowledge transfer (Ingram 2009) – particularly with respect to architecture, where emerging, reliable means of measuring usability require a clear framework of reference. One of the aims of this chapter, therefore, is to contribute to the debate on building usability by appropriating existing knowledge from the field of human-computer interaction.

In software engineering usability has been investigated thoroughly and has been clearly defined in ISO standards; defining the concept from different perspectives. Abran et al. (2003) provide a review of some existing definitions, identifying the two most widely accepted ones:

1. [Usability is] "the capability of the software product to be understood, learned and liked by the user, when used under specific conditions" (ISO/IEC 9126-1, 2000).
2. "Software is usable when it allows the user to execute his task effectively, efficiently and with satisfaction in the specified context of use" (ISO 9241, 1992/2001).

It should already be noted that both of these definitions encompass similar ideas, describing the ability to be "*understood*, *learned and liked*" by the user in the former example and used "*effectively*, *efficiently and with satisfaction*" in the latter one.

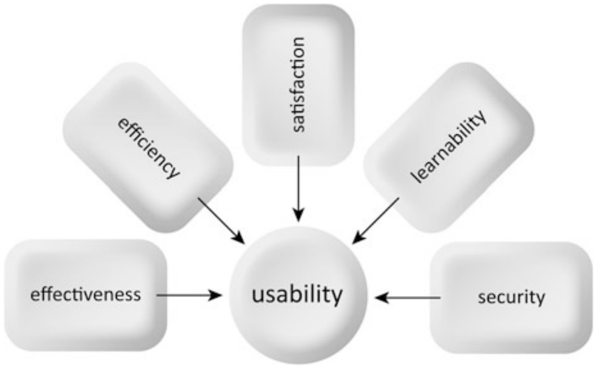

Fig. 2.1 Enhanced usability model (After Abran et al. 2003)

All of these concepts relate to how well a user is able to perform a given task whilst using a given interface (or whilst 'using' a given building in the new context to follow), as well as what resources or features he or she must make use of in order to perform their undertakings (whatever they may be) successfully. The reference to "*specific conditions*" and "*specified context of use*" are also important parts of both definitions, emphasizing the need to take into account various meanings of usability if and when a different context of use is being considered. Using these ISO standards as a starting point, Abran et al. (ibid.) combined a number of existing definitions with their own interpretations and presented an *enhanced usability model*. This is shown in Fig. 2.1.

This model can be explained as follows:

- *Effectiveness* relates to how many mistakes people make while performing a task;
- *Efficiency* is described by how much time and resources it costs to perform a task;
- *Satisfaction* could be measured as the ratio of favorable to unfavorable opinions about or comments on the process as elicited from the users;
- *Learnability* describes the time required to learn how to perform a task;
- *Security* is important in terms of access controllability.

In architecture, each of these factors has been considered for decades, if not centuries, but almost only in isolation from each other. *Effectiveness* has been studied, for example, by counting the number of wayfinding errors at decision points (Golledge 1992; Williamson and Barrow 1994). *Efficiency* might be indicated by the time needed to find a specific room in a wayfinding task. *Satisfaction*, from the building experience perspective, has been measured as part of standard Post-Occupancy Evaluation research (Leaman and Bordass 2001). *Learnability* in the building context indicates how long it may take a user to become familiar with a building (Peponis et al. 1990). *Security* in an architectural context relates to the way in which buildings have to accommodate the needs of different user groups with differing levels of control, access, and hierarchy (medical staff vs. patients vs. visitors in a hospital or the myriad complex levels of non-intersecting access, occupation and egress required by the different groups such as judge, lawyers, jury, prisoners, police and the public in a courtroom; Pati et al. 2007).

Abran's model, combining numerous, existing definitions of usability in the field of human-computer interaction indicates that usability is a quality of a product (or of a building, in this case) that makes it safe, easy, pleasant and stress-free to operate. At a very fundamental level, usability is about nothing more than avoiding frustrating the user. While, currently, this is certainly implemented in any major software development project, in contrast, this *bottom-line goal* has rarely been explicitly formulated (and planned for) in architectural practice. The result of this omission is that our built environment, despite being composed of numerous multi-million pound/dollar/euro projects, does not lack frustrating, annoying, confusing, stressful, or mentally tiring spaces. Is it any surprise, therefore, that the concept of usability remains somewhat under defined, and certainly underused, in an architectural context? The following section will aim to reinterpret what has already been written about usability, and convert it into a format that has the potential to be beneficial to architectural researchers and practitioners.

Introducing a Usability Model for Architecture

We have just suggested that usability is fundamentally about avoiding frustrating your user and there is clearly no reason why such an aim should be any different for an architect than for a software engineer: it is about intentionally placing your future users at the very center of the design process. In reality, however, things are never quite this simple and, of course, all design processes include limitations: financial, spatial and procedural, to name but a few. But such constraints are no different, whether the designer is a software engineer or an architect; the essence of their task remains the same, namely, to satisfy the final user with the delivered product. To demonstrate the similarity of the concepts and of the design processes, we can start by replacing the software-related words in the ISO usability definitions presented above with alternative terms relating to architectural design. This action produces the following initial re-interpretations:

1. [Usability is] the capability of the **BUILDING** to be understood, learned and liked by the user, when used under specific conditions.
2. A **BUILDING** is usable when it allows the user to execute his/her tasks effectively, efficiently and with satisfaction in the specified context of use.

Buildings essentially exist for the structuring or organization of different functional spaces: this is the purpose of their existence (Hillier et al. 1984). They can be considered a physical *interface* (an environment) that facilitates the undertaking of a range of everyday actions – from a guard supervising inmates in a prison to a child reading a book in a library. Likewise, computer software offers an *interface* (an environment) through which to conduct many everyday actions – from computing mathematical equations to communicating with a distant relative. Both artifacts (buildings and software) stand between us, the action-performers, and the action's outcome. This is irrespective of whether the action is mental or physical and notwithstanding of the scale of the action. Both, buildings and software, therefore serve as an *interface* and this principal fact requires them to be usable. These artifacts-as-interfaces determine how well we, the end user, can perform our actions. This aspect of building usability is both captured and emphasized by the re-definitions provided above: buildings should be "*understood*, *learned and liked*" by their users, so they are able to do what they want, or need, to do "*effectively*, *efficiently and with satisfaction*".

In terms of satisfaction, it is worth mentioning that how users 'like' a product or are 'satisfied' with it frequently relates more to a *lack of negative feelings* about the interaction than to an abundance of positive ones. This is a widely accepted understanding of usability in HCI (Hassenzahl 2010) since users, in general, do not expect to have positive experiences of their everyday equipment. For example, an alarm clock would rarely be a source of positive feelings, but users will get frustrated if their interaction with it is not flawless (i.e. if they could not reprogram easily the time of the alarm). This is not equivalent to saying that designers should limit themselves to providing only 'tried and tested' solutions. Even alarm clocks can remain a source of innovation.[1] But each such innovative departure is treated with the highest caution and consequently is preceded by extensive user testing. The same is not true in an architectural context, even though the financial and social consequences are usually much larger (e.g. a potential user might not be able to choose to ignore and avoid a confusing train station building).

In terms of the kinds of tasks that building users might wish to perform, there is a striking departure from the analogy with digital systems as described above. This is because an architectural setting demands a sub-categorization of the types of tasks that can be performed. These can be broadly held as: (a) the task of moving from one place to another in the building and (b) conducting a subsequent action once that place or context has been reached. Therefore, another distinction can be made, between 'dynamic' and 'static' activities, i.e. those involving wayfinding through the, often complex, spatial structure of a building and those actions which take place within a single space. This distinction is important, since a change of spatial location in a building often produces a change of context (e.g. moving from a cafeteria in a hospital to the emergency room) and also because wayfinding can be an extremely challenging task in its own right, demanding careful user-centric planning (e.g. Wiener et al. 2009). As a result, the model of building usability illustrated above can be further modified (Fig. 2.2).

This model of building usability now permits us to present both wayfinding and the full range of other actions facilitated by a building within a single framework allowing for considerations of successful and comfortable task performance. As mentioned previously, both of these aspects of building use are extensively studied, although the second category (the static actions) is dispersed across a range of research and literature. Many examples can be found, for instance, in the

[1]Consider, for instance, the case of integrating alarm clocks into touch-screen-based devices, e.g. by means of a 'wheel' metaphor as used in an iPhone.

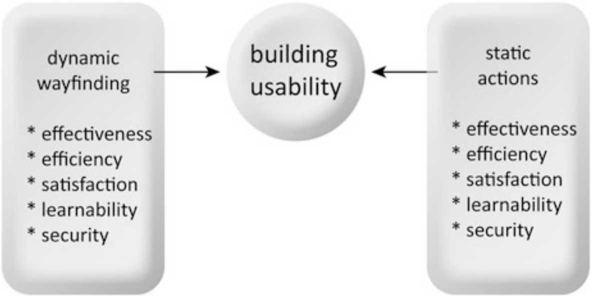

Fig. 2.2 Enhanced usability model after Abran et al. (2003), applied to architecture

post-occupancy evaluation studies (e.g. Leaman 2000; Leaman and Bordass 2000, 2001). For instance, Leaman and Bordass (2000) name perceived control, speed of building's response, lighting, noise and health-comfort-productivity interaction as the crucial aspects influencing human comfort, and hence productivity, in places of work.

From Usability to User Experience

However, to subordinate everything to mere usability would imply total and rigid coherence to functionality within the building. To give an example from HCI, Hassenzahl (2010) cites a Microsoft Games employee who once said that "*if a usability engineer designs a game*, *it would be most likely a single button announcing* >*To win press here*<" (Hassenzahl 2010, p. 43). Considering building usability, it must be remembered that building design cannot pursue an ever-increasing spatial simplification with the aim to efficiently support users' needs/actions (The building's equivalent of "*To win press here*"). What excites and stimulates us, what we love about architecture is its diversity. To promote usability above all other criteria in the design process would be to destroy the very identity and uniqueness of our buildings.

For this reason, usability's "*lack of frustration*" is merely a starting point for creating a pleasant and satisfying experience of being in a place. It is a prerequisite, if such a satisfying experience is to emerge, but it is not the only factor required for it. Therefore, in human-computer interaction, another distinction is proposed which takes user-centered design a step further through the concept of User Experience (often abbreviated as UX). Hassenzahl (ibid) describes Experience Design as a process of designing for users' goals, where all of these goals are equally taken into account.[2]

[2]We will base further discussion on this particular work, although the reader should bear in mind that there are many approaches to UX design in HCI, some of which are less formalised than the one here cited.

Discovering what these goals are is the aim of user-centered design. But the users' explicit goal is rarely, *not to experience frustration*. Rather they expect, and even seek, positive and memorable experiences while interacting with designed products (Hassenzahl 2010). The same seems to be true within an architectural context, since the buildings that win architectural awards and those that gain public recognition often stand out, either visually or conceptually, from the everyday and commonplace buildings. This appears to be true even when some of these acclaimed buildings are, at the same time, relatively 'unusable' (Carlson et al. 2010).

As Hassenzahl (2010) writes, "*Even the best usability may never be able to put a smile on users' faces, because it only makes the difference between bad and acceptable*." (Hassenzahl 2010, p. 28). In contrast, Experience Design addresses the issue of achieving a positive experience, rather than merely an acceptable one. He therefore reformulates existing psychological theories (see Hassenzahl 2010 for details) and introduces a three-level hierarchy of goals:

- *Motor goals* answer to the question of '*how*' something is achieved, e.g. how does one get from A to B (in a building) or find a particular menu item (in software);
- *Do goals* answer the '*what*' question and relate to the action itself, i.e. what is it that a user is trying to do (e.g. read a book in a library or send an email from a given software);
- *Be goals*, however, answer the most important '*why*' question and reveal the motivation behind every action.

A book can be read in many different places other than a library and paintings can be viewed from the computer screen at home instead of on a museum wall. Answering *why* people do things they do (i.e. go to libraries or museums) is the most crucial element of a user-centric design. Making a library usable by allowing its users to find books easily is a fundamental necessity but it is not, and should never be, the only aim of the buildings' design. Figure 2.3 presents so-defined relations between the introduced hierarchy of goals and the Usability-UX distinction. Yet, since every user is different, and therefore every single experience of any space must vary from individual to individual (Thompson 1990), how can this final user experience be planned and designed?

Fig. 2.3 Three-level hierarchy of goals based on Hassenzahl (2010)

If we accept that all mindful user-activities are goal-driven,[3] the key of successful user-centric design lies in revealing these goals and correctly evaluating their importance. Turning this theory into design practice requires the use of methods that have to be reliable, reproducible and easy to apply in a fast-paced design studio environment often run by a team of people responsible for different parts or aspects of the same end product. Understanding the users' motivations is one aspect of this process, but effective communication within the team and applying this understanding to all stages of the design process might prove to be a more difficult challenge. As this is an issue equally present in HCI, one of the intentions of this paper is to present an example method, usage of which might be beneficial to architects just as it is to software and product designers. First we will take some time to briefly outline some of the range of methods taken from HCI, which we believe could be usefully appropriated by architects, in order to later take a closer look at one particular method.

A Brief Overview of Human-Computer Interaction Methods Available

HCI Methods in HCI Practice

We believe that the methodological toolbox of HCI researchers and practitioners can be valuable for understanding the challenges of designing buildings that meet user needs. It is important to note that the number of theoretical approaches, methods and specific tools used within HCI is diverse and our focus here lies on those that emphasise the cognitive, goal-oriented perspective (as opposed to e.g. the ethnographic perspective).

One family of methods broadly used within Human-Computer Interaction is *task analysis*. It aims at understanding the nature of potential interactions with a system being designed by decomposing the cognitive processes and behavioural actions required from the user in order to accomplish the desired task. *Behavioural scenarios* (Sutcliffe 2003) as well as *cognitive and computational models such as GOMS* (Olson and Olson 1995) *and ACT-R* (Anderson et al. 2004) were, among other methods, used to describe, structure, and analyse such tasks. *Personas* (which we will review in more detail below) are yet another tool often used for this purpose. In principal, *task analysis* is applied at the earliest stages of the design process, but remains relevant until its end (Diaper and Stanton 2003).

Collection of empirical user data in HCI occurs at all stages of the design process. Early ideas are tested through *interviews* and *focus group* meetings with potential users (see e.g. Lazar et al. 2010). These are often facilitated by simple *prototypes*

[3]Even if the goals are implicit.

such as paper prototypes (Snyder 2003), or prototypes believed to be functional while in reality they are operated by a human (so-called *Wizard of Oz studies*; Dahlbäck et al. 1993). Their goal is to make the discussion more focused, and to identify potentially critical areas of the user-system interaction. Under the lack of prototypes, other tools are available to extract the user's understanding of the structure of the potential task. *Card sorting* (e.g. Hudson 2005), for instance, is often used for guiding the design of menu items in a more complex software/websites, as it makes it easy for the participant to communicate which items in his or her mind 'belong' to similar categories.

More advanced versions of the device or software under development are often tested with a battery of usability studies, where participants are asked to perform specific tasks within the system. Behaviour of the user is then monitored, so that potential errors (but also emotions demonstrated during these errors) can be analysed. Some examples include *video recording* the interactions and *monitoring physiological processes* (Park 2009) or *eye-movement* (Poole and Ball 2005; Holmqvist et al. 2011). Additionally, HCI studies often involve *Think-Aloud-Protocols*, where the participant is asked to say what he or she thinks while performing the task (van Someren et al. 1994). Such behavioural studies take place both inside psychological laboratories and in-the field (Wynekoop and Conger 1992).

After public release of the new system, evaluation can continue as the usage data is gathered from the users of the system and new improvements can be studied with the so-called *A/B tests* (e.g. when a subset of users of an exisiting mobile application is presented with an alternative version of the main screen layout on their phone; see e.g. Nielsen 2005).

HCI-Like Methods in Architecture

A reader well familiar with the methods described in the previous section might be surprised that there are design-related fields which *do not* follow a similar work plan. A reader familiar with the architectural studies, on the other hand, might find many linkages to some of the methods used in the (still, almost exclusively academic) world of architectural usability studies. Those assumptions are only partially correct.

Early stages of the architectural design are very often proceeded by interviews with the client (note: who is not always the final user). Some versions of *task analysis* are employed throughout the analysis of functional spaces required for the particular structure (note: although they tend to be very generic and space-, instead of user-oriented). Prototypes (both virtual and physical) are constructed in order to explore multiple design alternatives (note: and not to test them with the potential users). Finally, Post-Occupancy Evaluation studies are employed to test the actual building performance (note: which is done extremely rarely; Cooper 2001; Roberts 2001).

In the academic sphere, multiple other methods were employed for testing building usability: *Virtual Reality A/B tests* (Kuliga et al. 2015), *physical mock-up A/B tests* (Krukar 2015), *Think-Aloud-Protocols* (Hölscher et al. 2006), or *Eye-Tracking* (Krukar 2015) to name but a few. What differs the academic world from the architectural practice, however, is that academics typically do not conduct their studies as a means to designing a specific product, but rather to generate generalisable insight or evaluate the current state-of-the-art solutions (namely: completed buildings). Perhaps for this reason, there is a number of methods available to test an existing (or a virtual) building (the slow adoption of which by practitioners is an issue deserving its own book chapter), but relatively little tools for facilitating the user-centric thinking at the earliest stages of the design process.

In the next section we are going to take one of the above methods, namely that of *personas* (a subset of task analysis) and demonstrate how they may be directly used in the architectural design field to address this gap. We will give one example of where something akin to a persona has already been used to great effect in architectural design, but where the architect was possibly unaware of its precedent usage.

Personas

If we summarize the chapter so far, and we concur that a usable building is one that can "*be understood*, *learned and liked by the user*" and that to move beyond mere usability is to be able to design an enriching and enjoyable "*user experience*" of a building, one needs to understand something about the goals and motivations of the user (Hassenzahl 2010). How might an architect or team of architects go about doing that? And more importantly what kinds of processes might be involved? The vast majority of architectural practices are small and 'micro' firms of two to ten staff with, in the UK for example, only 3–4 % of chartered architectural practices having more than 50 staff (RIBA 2012). For the most part, the majority of their work is of a domestic scale and their clients will also be their end-users and therefore the challenge of understanding the end user is simply one of getting to know, and developing a good relationship with, the client. This is, in fact, the familiar *modus operandi* for most architects and the way in which the majority of architects are trained in schools of architecture. However, what happens in larger practices, when architects are commissioned to build large-scale, public buildings (such as airports, hospitals or libraries)? The client may then be an amorphous institution and the end-users a separate group distinct from the client. In this situation the client's needs frequently do not map onto the end-users' needs. It is not a coincidence that these are frequently the building types that are beset with usability issues such as wayfinding difficulties.

If you cannot design for the client (since the client is not the end user any more) and you cannot design for every single user (since they are too many) the option that is left is to design for a sub-set of the future user-group. After all, designing for some of the users might still be better than designing for none of them. For that reason, even the simplest, evidence-based representations of a potential, future building user can help guide the design process and result in the building being significantly more usable. HCI designers faced the very same problem and noticed that every product (or, correspondingly – a building) belongs to a different 'product category' and serves many different people trying to perform different actions (described in the form of behavior scenarios). As a result, an HCI tool called *personas* (Cooper 2004; Cooper and Reimann 2003) has been developed and successfully used to provide customer/market research for websites or handheld interface designs. A persona, as Cooper writes, is a characterization of a user or groups/types of users that exhibits the most prominent attributes of the whole group: in other words, it is an archetype presented in the guise of a fictional character (Cooper 2004). In the architectural context, there is no reason why such behavior scenarios and the inspired personas could not be evidence-based, as architectural user studies are increasing and, at the same time, automated methods of behavioral data generation are more readily available.

There can be as many descriptions of archetypal users, or personas, as it makes sense (to the designer) to differentiate, but in general they should remain concrete and distinct from each other. They are a point of reference for a designer to help him or her keep the project consistent and suitable throughout the design process. At the same time, if confronting the goals of different possible users, through the use of different personas, the designer can ensure that the building will be flexible enough to be used by many dissimilar people once it has been completed. The most powerful personas are frequently based on focus groups and user interviews and, as such, they can also protect the researcher from forming false assumptions. So methodologically being very simple, they remain a tool, or, better to say, a way of thinking about interaction design, which can help architects just as much as they helped HCI designers.

The following bullet points identify some of the key features of using personas:

- A persona is a portrayal of an archetypical user intended for use in the design process;
- A persona's character may be constructed from surveys/interviews and observations of real would-be users: this data is then analyzed and distilled into the characteristics of the persona;
- In situations where it is impossible or impractical to consult with real end-users the persona/s serve as ersatz versions for the designer's guidance;
- The use of personas may provide inspiration without the need to engage directly with end-users;
- Personas may also be termed 'user archetypes', 'target customer characterizations', and 'user profiles'.

The use of personas is not without controversy or criticism. These include the criticisms of the method as being non-scientific (not based on real data but meta-data), as being insufficiently rigorous, methodologically under-developed and un-verifiable (Chapman and Milham 2006). Additional criticism points out that their use results in less, rather than more, user-centered design by lulling the designer into a sense of false security that they are being user-focused when in reality they are not, since the persona is only ever a substitute user (Portigal 2008; see also: Matthews et al. 2012). However, despite these reasonable criticisms, the authors of this chapter argue that the architectural profession could benefit from their use, particularly when designing large-scale public buildings with a varied user-group. Friess (2012) argues that it is the sole involvement in the process of creating personas that facilitates more user-centric thinking by individual members of the design team. Thus, even though their value might not be obvious throughout the process, it 'forces' the planners to consider the potential user within a relatively structured framework. Due to the growing number of technologies and sensors for monitoring human behavior in the built environment, the process of constructing personas can easily become much more evidence-based. This evidence can potentially be available, inputted and modified in real-time, as users interact with increasingly 'smart' buildings and cities. Simultaneously, the newly established design workflows and the benefits of truly user-centric thinking will remain unchanged. In the following section we will present a single case study illustrating the tentative steps into using persona-like methods in architectural design. This case study is given not as a best-practice example, since, as it will be demonstrated, its outcome can be considered far from ideal for any usability engineer. It is rather here in order to emphasise the key aspects of persona-building process (namely, its grounding in real data) which has been already mentioned above and remains equally relevant in the architectural design context.

Case Study: Seattle Public Library

The Seattle Public Library in Seattle was designed in 2004 by the Office for Metropolitan Architecture (Rem Koolhaas and Joshua Ramus) in partnership with LMN Architects. It is an enigmatic building having both won a significant number of awards whilst simultaneously dividing the opinion of its users, some of whom find it practically dysfunctional (Conroy Dalton et al. 2013). In our quest to unearth the source of its dysfunctionality we examined OMA's design process and discovered a strong focus on the user: in particular, a series of diagrams or 'scenarios' that OMA produced in order to develop the design (Ferré et al. 2004).

Each diagram represents a different type of 'user' of the library, indicated by a black question mark (?) and their questions or queries are expressed as speech bubbles. Each archetypal user has a need that can only be met by successfully navigating through the library and a dotted red line indicates their resultant trajectory or path. In one of such diagrams (Ferré et al. 2004), the user is characterized as a research student in conversation with a roving librarian. They ask the question, "*My professor claims that OMA is a postmodern practice, and I'd like to prove her wrong*." Further up the library (and further into their search indicated by a dotted line traversing across the simplified layout of the library) they encounter a second librarian, of whom they ask, "*Maybe I should refer to Mies van der Rohe ... do you have any publication of his works*?" This is an example of the type of user that OMA characterizes as a 'knowledge acquirer' (those seeking a holistic understanding – a deeper and wider body of knowledge) in contrast to an 'information gatherer' (who requires ease of access, efficiency and speed; Kubo and Prat 2005). This alternative 'user type' – the 'information gatherer' is shown in a different diagram, with the accompanying speech bubble query, "*Which way to the latest Tom Wolfe Book*?". Other Reference Strategy Scenarios show yet another a user wanting to buy tickets to a concert in the auditorium and another, asking in Spanish, "*¿Dónde están los libros de ingles como segundo idioma*?" (Where are the books of English as a Second Language?). Although these are not fully developed personas in the way that is typically used in software and product design, this does represent an innovation in terms of architectural practice.

Through firsthand accounts of OMA's design practices (Yaneva 2009), we are relatively confident that OMA architects were not consciously employing personas in order to create these Reference Strategy Scenarios. Rather, we suspect, it was the architects own intuitive response to how to 'get inside the head' of what otherwise would have been an amorphous and intractable multiple-user group. The personas represented above can be characterized as the 'Research Student', the 'New Fiction Reader', the 'Concert Lover' and the 'English-Language Learner'. In these scenarios, depicted visually rather than in text or data, each persona has a specific task, which necessitates them travelling to a different part, and hence to a different floor, of the library. The resultant journey through the building is calculated and visualized (and hence part of the '*usability*' of the building would be dependent upon them being able to effectively navigate from one part of the library to their destination, without getting lost, confused or disorientated). However, despite the superficial similarities between OMA's Reference Strategy Scenarios to HCI personas, these attempts fall short of the real thing. First, they are probably not based upon survey data about library user or derived from interviews or focus groups. If, for example, they had survey data from the library indicating the 14 % of library user were enrolled in college and were using the library for college work, then the 'Research Student' persona could have been based upon this statistic. As mentioned above, the most effective personas emerge from a rich dataset that is then analyzed and distilled into the characteristics of the persona. Second, if they were true personas, they may well have been presented in the guise of a fictional character. The 'Research Student' would have been called Sally, aged 24, who would have been a grad student enrolled on the Master of Architecture Program in the Department of Architecture at University of Washington. She lives only a few blocks from the library, has a liking for espresso coffee, yoga and a phobia of enclosed spaces. Of course, all of this is fiction, but that is the joy of personas: when real users are not available to you, personas act as substitutes, willing and able to be as 'fleshed out' as necessary to whatever level of detail the architect needs for design inspiration. In this way the 'Research Student', the 'New Fiction Reader', the 'Concert Lover' and the 'English-Language Learner' (or Sally Meacham, Mrs A. Johnson, Chuck B. Headley and Rodrigo Lopez as they might have become under their new persona transformations) could have, collectively, represented the much larger community of would-be library users.

The benefit of using personas lies not only in structuring the individual architects' thinking about the complexity of the designed building in user-centric terms. Most importantly, it forms a 'common ground' for understanding this complexity by multiple members of larger design teams. Personas provide an inspiration for discussing critical user-centric design issues and focus individual efforts of many team members in the direction of well-defined design challenges.

The example presented above has been included in order to demonstrate what we believe to be the receptiveness for this approach by the architectural profession, despite the fact that their use of personas is rare. It is our conviction, that could the methodology be further adapted for architectural design, there would be considerable interest and uptake within the profession. Furthermore, we suggest that the use of personas may be a highly efficient method of designing with a building user in mind. It is our theory that by focusing on the user, architects can design better buildings and that any technique that helps this shift in focus is beneficial. From the example above, it should be noted that personas can be used both in the design-phase and in the post-occupancy evaluation stage in order to understand the building once it is in use. The use of both together, may form a 'virtuous circle' in which knowledge of previous schemes helps in the design of subsequent ones.

Additionally, we suggest that the use of personas could serve as a valuable tool in architectural education, where the students are frequently disadvantaged through lack of access to a real client; there is evidence that the use of personas in education produces higher quality student work (Long 2009). Finally, in terms of the criticisms of the use of personas, we do not disagree with them, rather suggest that this is a greater incentive to research this area and provide evidence for the methodology.

Conclusion

The use of personas is but one of the many sets of methods developed in HCI that might be adapted for use in architectural design. We chose just one of these methods, in order to illustrate how easy it is to transfer the methods from one arena to the other and to suggest the potential receptiveness for this approach. The field of human-computer interaction has the potential to provide a methodological framework for investigating how people understand buildings and cities and how the cognitive processes of their orientation and navigation behaviors are structured. Analytic methods such as cognitive task analysis and cognitive walkthroughs have already been adapted to the task performance of building users (e.g. Hölscher et al. 2006). Similarly, observational techniques such as video analysis (e.g. Tomé et al. 2015), movement tracking (e.g. Tröndle et al. 2014; Dalton et al. 2012) and virtual reality simulations (Conroy Dalton 2001) have been employed, increasingly relying on usability metrics (e.g. error classification).

Currently, however, the majority of architectural research (such as the previously mentioned Post-Occupancy Evaluation), happens *after* the building is in use with the assumption that the insights generalised from such studies might potentially be disseminated and applied as a guideline for future cases. The field of HCI demonstrated that shifting the user-centric efforts into early stages of the design process can result in an overally higher quality of an average end-product. It is important to note, that the methods which make this possible in architectural design are already in place, and need not be expensive or sophisticated. Personas, as presented earlier in this chapter, only facilitate a particular way of thinking, rather than enhance it with any novel, previously unavailable data. This early focus on the user is also visible in other methods used within *usability* and *user experience* design, such as preparing (and testing) prototypes (e.g. paper prototypes) even of very early versions of the device or software. Similar 'prototypes' are available to architects both in the form of 3D virtual models, as well as physical, miniaturised maquettes. What perhaps differs these two fields is therefore not the technological, financial, or procedural availability of such prototypes, but the aim they serve. In HCI, those methods revolve around the user's needs and goals. The aim of a simple paper prototype is to make the vague assumptions about the particular behavioural scenarios (and the mediating interactions between the artifact and the user) more concrete. This leads to earlier detection of potentially critical elements of the design. In architecture, it seems, prototypes make the vision about the shape and structure of a designed building more concrete, but the concept of the user is present there barely as a meaningless placeholder in images, maquettes and visualisations. Those, primarily aim to encapsulate the atmosphere of the designed spatial experience (as it is envisioned by the planner) or to explore multiple design alternatives but rarely, if ever, serve as a platform where any data-driven (or at least data-inspired) representation of a user would play the central role. As a result, the focus of the work heavily lands on what is visible, while neglects the more subtle characteristics of a building – those, which have been shown to influence its usability. These include the configurational functionality of its sub-spaces (e.g. Peponis et al. 1990), the visibility of key building elements (such as staircases) from the viewpoint of a potential user (e.g. Hölscher et al. 2006), or the building's suitability for diverse preferences and limitations (both mental and physical) of its potential occupants (e.g. Heitor et al. 2013). The commonly accepted assumption that architects prioritise the visible, outer shell of a building over its functionality might in this case not be true at all as the priorities are rarely explicitly set as such; they simply happen to influence the final outcome more, given the currently existing design workflows.

Taking HCI methods to architecture therefore requires a rigorous framework for capturing environmental properties not clearly conveyed with traditional maquettes or 3D models, which refer to the aspects other than the visible outer shell of a building, like saliency of landmarks or complexity of layout geometry. Space Syntax techniques, for example, are just one tool with the potential to make building features accessible to quantification and capture features relevant for understanding cognitive deficits of buildings (Franz and Wiener 2008; Conroy Dalton et al. 2005).

In addition to this, 'big data' increasingly captured via sensor-enabled buildings and cities, contribute to the corpus of user data allowing the researchers and practitioners to verify their theoretical assumptions, often in real-time. With this chapter, we are not only calling for more user studies in architecture (although that would naturally be welcome) but rather for a uniformed approach to measuring building usability and integrating it into the design process. Important questions to be addressed for the future include how to establish a user-centered perspective in the architectural design process, and how to refine analytic techniques suitable for use in design practice. Here, the field of HCI can serve as a model of best practice for evidence-based approaches in architectural design.

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