

RESEARCH PAPER

Measuring the design of empathetic buildings: a review of universal design evaluation methods

Eoghan Conor O Shea¹, Sara Pavia¹, Mark Dyer¹, Gerald Craddock², and Neil Murphy²

¹Department of Civil Structural & Environmental Engineering, Trinity College Dublin, Dublin, Ireland and ²Centre for Excellence in Universal Design, National Disability Authority, Dublin, Ireland

Abstract

Purpose: Universal design (UD) provides an explanation of good design based on the user perspective, which are outlined through its principles, goals, and related frameworks. The aim of this paper is to provide an overview of the frameworks and methods for UD building evaluations and to describe how close they have come to describing what a *universally designed* building is. **Methods:** Evaluation approaches are reviewed from the existing literature across a number of spatial disciplines, including UD, human geography and urban studies. **Results:** Four categories of UD evaluation methods are outlined, including (1) checklist evaluations, (2) value-driven evaluations, (3) holistic evaluations, and (4) invisible evaluations. **Conclusions:** A number of suggestions are made to aid research aimed at developing UD evaluation in buildings. (1) Design standards and guidelines should be contested or validated where possible; (2) evaluation criteria should be contextual; (3) it may be more practical to have separate methodologies for contextualising UD to allow for the creation of an evaluating tool that is practical in use. Additionally, there is a difficulty in establishing a clear basis for evaluating how empathetic buildings are without expanding the methodological horizons of UD evaluation.

Keywords

Architecture, building evaluation, inclusive design, literature review, post occupancy evaluation, universal design

History

Received 28 January 2014

Accepted 3 May 2014

Published online 26 May 2014

► Implications for Rehabilitation

- For universal design (UD) evaluation to address human need requires methods that are culturally, temporally, and typologically specific.
- Practical instruments for measuring UD need to be divorced from but *contingent* upon methods than can address local specificities.
- The process of evaluation can provide knowledge that can contest or validate the literature based sources such as design guidelines, or standards.
- UD evaluation requires constant renewal by searching for new, flexible strategies that can respond to socio-cultural change.

Introduction: the aims of universal design evaluation

Evaluating a building is a messy activity, particularly as human behaviour obstinately refuses to conform in an homogenous manner to the rational behaviour patterns traditionally assumed by many economists, modernist thinkers, and modernist designers. Building evaluation involves identifying important *values* by which a building should be judged and these differ according to where evaluators place this value. For example, building energy rating systems judge low energy consumption as the most appropriate value criterion, while BREEAM, LEED, and other sustainable building evaluators assume low impact on global and local resources as representative of good design [1].

These evaluations are based on the type of easily understood and measurable criteria that are not necessarily associated with universal design (UD), and overlapping evaluative paradigms such as inclusive design and design-for-all. The UD paradigm places value in the assessment of many of the less tangible human needs associated with buildings. The commonly observed aims of UD include the production of a built environment that allows “participation and empowerment for all” [2]; and producing an environment that enables “human performance, health, and wellness” [3] through buildings that “can be accessed, understood and used” by all people, regardless of their age, shape, size, or ability [4]. The political arguments for the importance of UD are well rehearsed including the demographic incentive which points to the ageing of western societies and the consequent higher levels of physical and mental impairment [5,6]. Moreover a moral argument exists in the recognition within the UD literature of the equal rights of all people to embodied participation in society, and a parallel recognition of disability as a universal human condition [7, see also 8]. A key value for Lawton [9] which

Address for correspondence: Eoghan Conor O Shea, PhD Candidate, TrinityHaus, Department of Civil Structural & Environmental Engineering, Trinity College Dublin, Dublin, Ireland. Tel: + 353 76 0631705; Work tel: + 353 1 896 3676. E-mail: osheacc@tcd.ie

Table 1. Comparison of conceptual frameworks of UD.

Nussbaum's Central Human Capabilities [21]	CUD principles of UD [13]	Lawton's need satisfaction behavior [19]	Steinfeld goals of UD [12]	Preiser habitability framework [25]	
Life	Equitable use	Security/safety	Body fit	Health	1st order of need
Bodily health	Flexibility in use	Function	Comfort	Safety	
Bodily integrity	Simple and intuitive use	Cognition	Awareness	Security	
Senses, imagination and thought	Perceptible information	Comfort	Understanding		
Emotions	Tolerance for error	Order	Wellness	Functional	2nd order of need
Practical reason	Low physical effort	Autonomy	Social integration	Efficiency	
Affiliation	Size and space for approach and use	Privacy	Personalization	Workflow	
Other species		Stimulation	Cultural appropriateness	Psychological	3rd order of need
Play (laugh, play, recreational activities)		Affiliation		Social	
Control over one's environment (material and political)		Individuality (self-actualization)		Cultural	
		Spirituality		Aesthetic	

embodies many of these aims is the value of satisfying human need.

While satisfying wide perspectives of human need can appear a sound evaluative foundation, many architects will have a different prism through which to judge good design based on their architectural training and disciplinary bias [10], although the two positions are not necessarily irreconcilable [11]. In order to induce UD into mainstream architectural practice, two things are important. The first is to produce examples of “good” architecture, both from the perspective of architects and from people who use buildings. The second is to design UD evaluation methods that exhibit easily digestible indicators of UD to an audience lacking in-depth knowledge of the paradigm. Unfortunately, the criteria establishing buildings as “universally designed” [12] are unclear, creating a difficulty for evaluation development. Despite the wide dissemination and the use of the seven principles of UD (Table 1) developed by the Center for Universal Design [13], criticism has been aimed at their structure and content [12], where an important convergence of design ideas based on human activity occurs, but no clear path to universally designed solutions is mapped. This lack of definition is consistent with the widely held perception of UD as process [6,14,15], rather than destination – “universal designing” as opposed to “universal design” [3].

A UD process approach suggests an absence of fixed benchmarks, which in itself is understandable considering the vast range of factors that affect people – both as individuals and as social beings – within buildings. The continually changing nature of human practice, lifestyles, and demographics renders a predictable and stable societal condition impossible, and only in such a closed condition could a *universalised* statement of “UD” in practice be made. This uncertainty is exaggerated by the complicated interactions within the disparate range of local contexts which Davies and Lifchez [16] characterise as the “social psychology” of design. No attempt to evaluate UD has persuasively demonstrated the ability to gather all the tacit, difficult to describe qualities of building experience that are of fundamental importance to analyzing performance.

The embrace of UD as a policy direction by a number of national and supranational entities [17] has been accompanied by an inevitable political enthusiasm to make it measurable [18]. In Norway, the UD approach is fully integrated across all government ministries, and it is, not coincidentally, the only country to have developed a workable UD rating system, presently only applicable to transport facilities [19].

This article examines the current state of building evaluation from the perspective of UD, outlining present evaluative methods and parallel approaches from other disciplines. UD criteria section will analyze the principal frameworks that attempt to capture UD. This is followed in Barriers to UD evaluation section by an outline of the barriers and complexities that have affected the development of UD evaluation instruments. UD evaluation methods section will introduce systematic analysis of existing evaluative methods, highlighting the strengths and weaknesses of present approaches. Discussion section will integrate observations from the earlier sections of the paper to outline future research and practical opportunities for UD evaluation.

2 UD criteria

UD building evaluation looks at the needs of the wide body of people who use and experience a specific building in a specific place at a specific time. Human need is a difficult variable to closely define: two centuries ago Adam Smith had already identified need as relative, contextual, and always changing [20]. A number of authors in different fields have proposed universal principles that underpin human need [9,21,22]. Sen [22] introduced the idea of human capabilities – levels of functioning which everyone in society should be allowed to reach if they wish or require, which include performing key activities in the public realm. This is an idea which Nussbaum [21] codified into 10 basic capabilities (Table 1), framed as the minimum set of human needs that each citizen should have the capability to satisfy. The need for affiliation and to maintain a dignified existence underpins these capabilities.

In the UD domain, Lawton [9] maps aspects of human need onto the specific affordances required of an environment to address that need. The Center for Universal Design's seven principles [13] codify need as the intersection of ergonomic, performance qualities (reflected in principles 2, 5 and 6); spatial affordances for navigation and manoeuvring (in principle 7); and orientation and communication affordances (codified principles 3 and 4). The first CUD principle has been tagged as the “value” principle of UD in that it underpins all other principles [23,24]. The CUD principles do not address psychological and social elements, which Lawton's need satisfaction scheme focuses upon (Table 1). This is a deficiency Steinfeld's [12] eight “goals” of UD (Table 1) actively sought to address by explicitly locating satisfaction at the intersection of human performance and social

participation. Steinfeld identifies *health and wellness*, derived from the sociological understanding sense of “psychological health, social engagement and spirituality”, as the vital bridge between human performance and social participation [3].

Preiser’s more streamlined “habitability framework” of need [25] evokes Steinfeld’s goals, in that it deals with social and psychological factors absent in the CUD principles and borrows its hierarchical ordering from Maslow’s pyramid of human motivation [26]. Preiser’s first order of need is addressed by basic building regulations; the second order by technological “state-of-the-art” knowledge and the third order needs encompassing less codify-able social experiential factors. This approach tries to illustrate clearly the layered interrelationships between orders of need in a manner that summons a comparison with Brand’s shearing levels of change concept [27] which differentiates between the durability of the different layers in a building, including between the “stuff” that people populate a space with and the internal walls and barriers that contain spaces in plan.

Barriers to UD evaluation

A number of difficulties undermine the usefulness of these frameworks for evaluation. One is the noticeable conflict between different meanings attributed to broadly similar terms employed, for instance, by Steinfeld and Presier. A second is a less than sharp distinction between the individual criteria used in these frameworks, and occasional gaps that make the criteria impractical to employ in evaluation systems. Apart from the absence of social participation among the seven CUD principles, one of their authors notes “... they may be too broad, too generic, and too difficult to apply...” [24]. Steinfeld’s goals are in part an attempt to address this deficiency.

Understanding what an inclusive building experience is requires input from a range of disciplines and investigations. This leads to conflict in how terms are employed in the UD literature, and even disagreement as to how knowledge emerges and should be utilized. For instance, the term “health” when traced between Preiser’s framework and Steinfeld’s goals in Table 1 reveals different concepts at work. Steinfeld and Maisel’s concept of *health and wellness* is framed as a high order indicator of UD concatenating social and psychosocial aspects alongside physical indicators [3] whereas Preiser [25] designates health a “first order” basic need that can be addressed pragmatically through the application of basic normative standards. This contrast in use mirrors the shift toward a more social model of health by the World Health Organisation, as can be seen in conceptual leap between its classifications of health and functioning. An earlier incarnation, the International Classification of Impairment, Disability and Health (or ICIDH) relied heavily on a medical model of health which located disability as a factor of the individual, while the updated International Classification of Functioning Disability and Health (or ICF) builds upon the significant impact of social and physical environmental factors in creating disabling situations [14].

This linguistic barrier to a coherent basis for evaluation leads to methodological confusion, where contrasting attitudes to understanding the built environment, or *epistemologies*, are carried through disciplinary-specific methods. For instance, the epistemology of engineering, characterized by the binary logic of the machine [28], is discernible in UD research through the significance placed on a scientific and controlled approach to gathering user data, centred particularly around ergonomic and anthropometric data [29]. This objectivist world-view pushes the cultural or social context to one side. In contrast, the epistemology that forms a common strand through disability studies, and through some strands of social theory, is based around the social

constructivist position. This epistemology locates the source of knowledge, as something “constructed” by society. According to this view, verifiable and *universal* truths that scientific methods discover are always open to question [30], and the time, place, and circumstances under consideration in any study have a significant impact on the knowledge acquired. For social constructivists, UD is not ascribable in a definable and an eternally applicable way but is a paradigm that responds to the vagaries of people’s attitudes and experiences, while for objectivists UD can be defined and evaluated by enlisting and relying on an already agreed body of knowledge, such as standards and guidelines.

This conflict is discernible in the dichotomy between the use of *professional experts* [31] and *user-experts* as evaluators [32], two distinct groups shown to disagree on what legitimates “good” design [11]. The *user-expert* position recognises people with different abilities or disabilities as experts in evaluating designs that impact on their lifestyle [32]. *Professional experts* are building professionals whose knowledge of the processes of building procurement is verified by years of practice. Due to the complicated nature of human and non-human actors in buildings, there is a shift toward mixing both scientific and person-focused approaches [30,33]. The mix of ergonomic and socio-cultural concerns throughout Steinfeld’s UD goals, listed in Table 1, reflect this shift in the UD domain, and the goals offer a realistic overview of the factors involved in (re)producing non-stigmatising environments. This follows emerging consensus that the ICF classification can marry terminological differences visible between scientific and sociological epistemologies [3,14,34–36].

Addressing the wicked problems of producing socially inclusive buildings requires an assemblage of techniques that can juggle such epistemological oppositions, where – applying a crude simplification – a person is either an engineered entity or a subjective being. A person can be assessed as a laboratory-based engineered object [37] along the narrow dimensions of *accessibility* and *usability* in a building, which restricts evaluation to spatial affordances required for users and the appropriateness of building interfaces and threshold conditions. This exclusive focus can unfortunately sustain a culture of design exhibiting “... limited empathy with the sensuous nature of the body...” [38].

Assessing subjective human experience requires an understanding of a person’s perceptual and mental activities that direct a building’s ability to communicate and reassure [39]. Within design standards and guidelines, some perceptual and cognitive aspects are addressed, such as outline guidance on wayfinding [4]. These are useful to evaluators but cannot prove a building is responsive to the needs of the people who *actually* use it. While a scientific experiment can be assumed to be replicable in similar provisioned laboratories anywhere [40], individual buildings provide a unique set of circumstances dictated by local conditions at the time it is experienced [41]. Observation or testimony of people carried out in everyday practices in different settings can effectively capture subjective experience [30]. In order to capture how a building performs for the whole constituency of people who use it and who will potentially use it in the future, the methodological net should to be cast wide. It is at this intersection of different methods, including both scientific and qualitative approaches, that a clearer evaluation of a building’s empathy can be assessed and where indicators of UD can begin to surface.

UD evaluation methods

Sanford [34] separates UD evaluation approaches into those that assess the *potential demands* and *actual demands* placed on people by buildings. Evaluations based on *potential demands* enlist existing standards and guidelines as the objective basis from which to measure the success of a building. Evaluations based on

Table 2. Summary of UD building evaluation methods.

Type of assessment	Focus of approach	Type of methods	Data sources used	Outcomes
Checklist evaluations	Potential user needs	Building survey; document analysis	Documents; normative standards, guidelines and regulations; physical building layout; professional experts	Evaluation of building based on existing knowledge
Value evaluations	Actual user needs	Questionnaires, interviews, workshops	User feedback and testimony (user-experts)	Evaluation of buildings based on existing knowledge, generation of new knowledge
Holistic evaluations	Actual/potential user needs	Document analysis, buildings survey, questionnaires interviews, observational studies, workshops	A cross section of normative sources and user feedback, (user experts and professional experts)	Evaluation of buildings based on existing knowledge, generation of new knowledge
Invisible designer evaluations	Generally potential user needs, some degree of actual user needs	Informal ad-hoc techniques	Professional experience, normative guidelines, input from clients (potential user-expert involvement)	Evaluation of building based on professional experience

actual demand analyze how people perform in a given building verified by direct observation or testimony.

Using this focus of approach, and drawing on systems of classification garnered from other spatial disciplines [42], this research has established four distinct classes of evaluation and summaries of these classes are shown in Table 2. The remainder of this section contains summaries and analysis of selective examples of evaluation approaches that fit into these categories.

Checklist-driven evaluations

Checklists are at the heart of most formal evaluations and are the basis for many published studies. Checklist-driven UD evaluations rely on a set of simplified criteria, usually based on either the seven CUD principles (see Table 1) informed by local regulatory-based accessible or usable design strategies [43–46]. There is scope for more sophisticated instruments based on checklists. For instance, when more graduated responses are allowed rather than the simple binary choice of yes/no, rating mechanisms can be developed [19,47–50]. Guimaraes [47], Ramot et al. [49], and Steinfeld et al. [50] describe rating systems based on local accessibility guidelines augmented by international best practice. Guimaraes identifies 420 environmental criteria rated on a 0–5 scale. Steinfeld's *Enabler* [50] is based on a narrower checklist of 188 environmental features, but stretches to include a checklist of 15 structural and functional impairments of the body in order to judge the degree of “fit” between body and building. The *Enabler* (see Figure 1) has been adapted [48] for use by occupational therapists in testing the suitability of homes in Nordic countries. One constraint in using the *Enabler* is that it is a response to the requirements of a single individual on individuated home or office needs, rather than a larger cohort of people.

Øvsteda and Meland [19] describe a Norwegian transport checklist approach for evaluating UD which similarly employs graduated responses to produce an A–F rating. By separately rating a number of indicators including physical barriers, and orientation and information barriers, this approach is more focused on locating where the particular strengths or deficiencies of a design are situated, implying *who* might be affected – for instance, physical barriers are more likely to affect people whose mobility and dexterity is affected. Afacan and Erbug [31] choose a different tactic to adding depth to the checklist by employing a usability evaluation technique borrowed from the product design. The method involves evaluation along a set of criteria based on the seven principles of UD by a multi-disciplinary team of

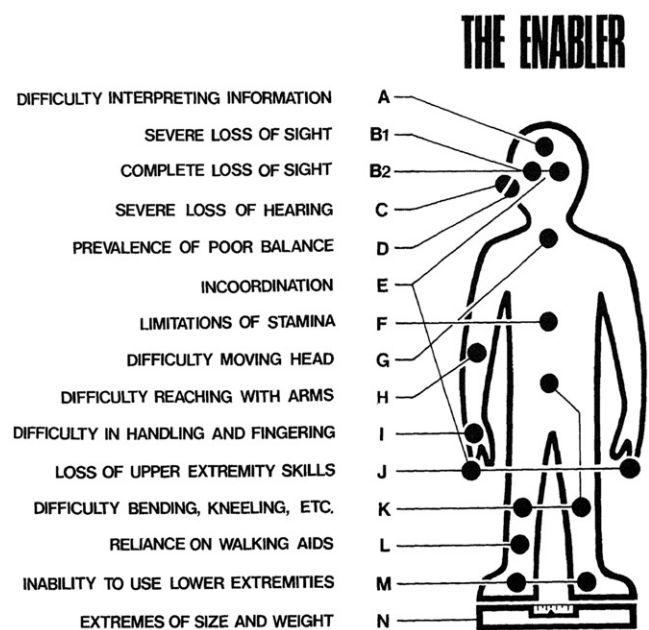


Figure 1. The Enabler from Steinfeld et al. [50].

building professionals. While each expert picked up on different elements depending on their discipline, the outcomes of such an evaluation were reported in a less structured way.

The main drawback of checklist-based evaluations is their basis on potentially un-validated data [34] that concentrate on the *potential demands* placed on building users. The *Enabler*, by placing an equal weight on evaluating the person, might appear to come closest to a nuanced understanding. However, it shies away from evaluating the point of interaction between person and environment, instead analyzing both parties separately. The evaluation is then made of a modeled interaction between the two, rather than an empirical observation of person–environment fit.

Holistic evaluations

Holistic evaluations can measure physical indicators and *potential demands*, but also the *actual demands* placed by a building on the mental and even emotional life of the people that use it. Most significantly, they can analyze the point of interaction

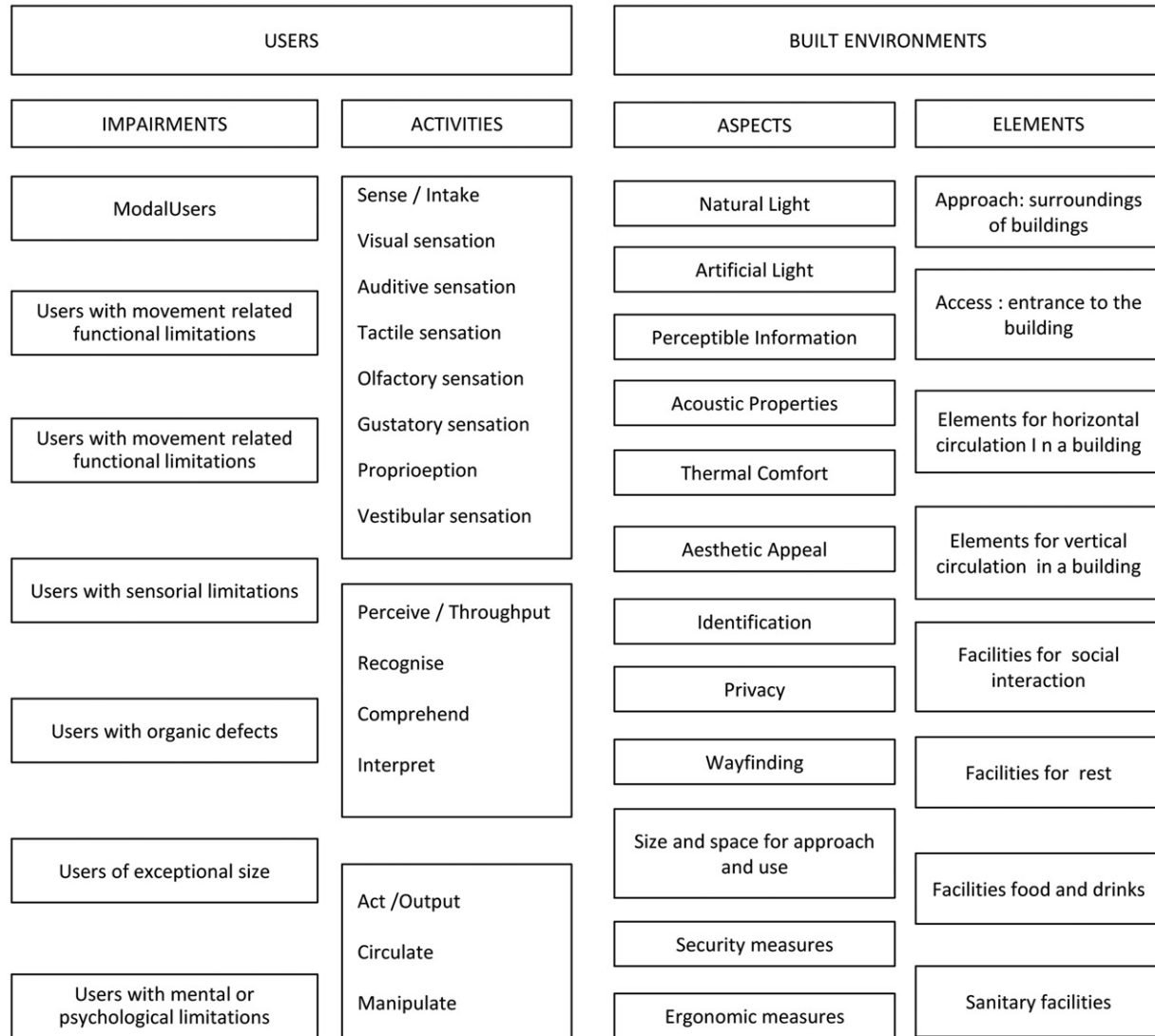


Figure 2. Hubert Froyen's UD users – built environment model [14].

between people and buildings. Sanford's comprehensive UD Assessment Protocol (UDAP) [24] assesses 18 embodied abilities assessed on a rating of 1–4. However, by trying to establish *actual demands* in a systematic way the system becomes complicated in use: for instance, 612 criteria are involved in analyzing a door handle [34]. Sanford employs the seven principles of UD in his tool, but critically must add two extra to overcome the failure to address key absences such as social participation in the CUD principles. Froyen's UD pattern approach [14] is a less structured method, focusing instead on calculating the key circumstances that affects a person's interaction with very specific activity settings, and on providing a taxonomy for storing and re-engaging with UD studies based on activities or "patterns" of interaction within described socio-spatial environments. He uses the ISO Guide 71 [51] as a stepping-off point for defining human abilities and allocating user groups in the model, as shown in Figure 2. Froyen does not suggest a prescriptive approach to carrying out these studies, instead pointing toward the use of a loose, multi-spectrum approach [14].

Post-occupancy evaluation (POE)

The specific approach advocated by Froyen and others [3,25] is POE, which on first glance appears the most promising framework for a UD evaluation that can combine the range of

epistemologically distinct methodologies [52] noted in Barriers to UD evaluation section. Preiser [25] sketches a possible roadmap by placing the seven CUD principles within POE's suite of intersecting techniques to assess both a building's quantitative (lighting, humidity, temperature, humidity, durability, amount of space, and distribution of space) and its qualitative aspects (ambiance of space, sensory modes, aesthetic considerations, and visual compatibility with surrounding buildings). This over-arching framework facilitates an analysis of *actual* user demand described through participant-based studies [53–55]. Cohen et al. [56] demonstrate a POE approach that intersects actual and potential demand, assessing *actual* physical and perceptual responses through interviews and questionnaires, and *potential demand* through building assessments underpinned by design standards and guidelines.

The use of participant studies as a strategy for evaluating actual demand owes much to a developing position in anthropology that "everyone is an expert" on their own life and activities [57], to which geographers have responded by developing methods that place participants as proxy-researchers, who themselves will gather information on their own experience through devices such as diaries [58]. This position feeds into UD evaluation through Ringaert's [32] recognition of people with disabilities as "user-experts" as discussed in Barriers to UD evaluation section. POE can be seen to regard the "user-expert"

in both Danford [54] and Grimble et al. [59] which make use of visitors recruited from three main “impairment” groups (mobility, sight, and hearing) recoding responses along three dimensions – (1) general attitude to buildings; (2) reaction to a case study building; and (3) functional performance in that setting during 14 prescribed tasks. While these methods record the impression a building makes, they cannot document how the building functions for those who experience it every day, although Cohen et al. [56] demonstrate the ability of the POE approach to produce this level of analysis. Yet despite its obvious analytical strength, POE and holistic-driven evaluation approaches to UD demand an investment of time which may be impractical to suggest as a stand-alone evaluation approach.

Value-driven evaluations

Value-driven evaluations focus on actual demands imposed on people by concentrating on a single parameter that indicates a wider set of issues [42]. Several issues or values are considered in value-driven UD evaluations including equality [60,61], social participation [62], and *imageability* [39,63]. Nasar [60] uses a photo-centric questionnaire to investigate whether retrofitted and separate accessible routes to buildings are less equal than “shared” routes, showing how difference in functional ability can effect a person’s perceptions of what equality is. Similarly, a study of Spanish universities [61] examines the effect of the social and physical environment on perceptions of equality for people with disability through interviews with students and stakeholders. Kitchen and Law [62] utilise interviews to focus on the effect that the availability of usable public toilets has on people with disability. These evaluations pick out aspects of the built environment, such as toilet provision, which act as indicators for wider problems that affect social participation for particular groups in society. The Danish Accessibility Labelling [64], shown in Figure 3, presents a quantitative alternative by expressing the value of a building through its ability to facilitate a range of prescribed disability groups.

Lynch [63] identified a separate indicator that of the *imageable* quality of places, or how reproducible they are in memory. Participants are prompted to recall city environments through mapping exercises. Lynch’s approach has proved flexible enough to move from urban scale analysis to investigations of building orientation through the emergent discipline of wayfinding [39]. In a similar vein, social interaction is examined by space syntax evaluation which is represented diagrammatically as the inter-connectivity between spaces in built environments [65]. This is useful for sketching the social complexity, and the burden on decision making placed on individuals. In general, the role of

value-driven approaches lies within larger evaluation strategies, in order to direct research toward the source of problems.

Invisible evaluations

The invisible evaluation method is seen in the instinct of the designer, based on training, skill, and moral values, which take place during the design process [42]. This is the designer who succeeds in “muddling through” [66]; who by constantly making evaluations in an informal, invisible way, happens upon processes of universal designing. There are guides available that can direct a self-evaluative approach for architects [67] which outline how to involve multiple perspectives from potential users throughout the design process, in line with co-design and participatory design approaches which direct designers to act as facilitators of a design process involving multiple stakeholders [68]. The end-goal of UD advocates could be described as influencing a global environment where invisible UD evaluations become intuitive for all building designers, as the end result of widespread dissemination and absorption of the UD paradigm.

Discussion

UD evaluation assesses how successfully particular building designs serve their users, and can facilitate comparative studies with similar buildings [6]. The choice in the design of an evaluation is between assessing the potential demands or the actual demands of users, which roughly equates to either reliance upon guidelines and building surveys, or upon knowledge gleaned from direct user engagement [34]. Simple checklist-driven approaches are insufficient for evaluating holistically what makes a building *universally designed* but are practical in use. Value-driven evaluations play a significant role in establishing indicators of a building’s empathy toward its users, such as in the Danish Accessibility Labelling scheme [64], but will not on their own evaluate UD. The more holistic-driven participant approaches and POE methodologies are better equipped to observe and analyse the actual demands placed by a building upon people, but are time consuming and demanding of resources. A conclusion can be drawn that combination of some of these methods of evaluations might achieve better success.

Current trends in building research are toward overarching methodologies containing a plurality of sometimes contradictory approaches for gathering knowledge in buildings. Within UD, no clear roadmap exists on how these different approaches might intersect to create a practical system of evaluation that can be accessible and usable by people without extensive training. To date, Froyen’s UD pattern approach is potentially the most promising step in this direction. However, Froyen’s emphasis remains on the system of storing knowledge rather than the methods for capturing it. In doing so, Froyen might be seen as suggesting two paired methods – a methodology for producing both actual and criteria, and a simple instrument for carrying out evaluation.

The advantage of pairing scoping methodologies with the production of instruments that are calibrated to specific locations, and possibly to specific building types, is that contextualized evaluation criteria can be produced for each site of evaluation. This is likely to be at a national or state level as this is the level at which building regulations are set. These can involve collating the “engineering” data based on standards and regulations, alongside harvesting knowledge from participation studies within case study buildings. Knowledge tied to local conditions can be accessed through visitor studies, but also from regular users of particular buildings. Collecting this knowledge can require interviews and touring interviews, but also more common holistic techniques such as questionnaires, or diarists to probe the everyday

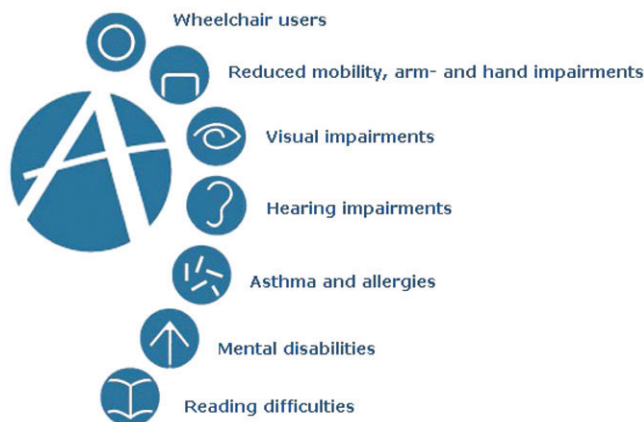


Figure 3. Danish Accessibility Labelling scheme which describes building value through its accessibility for a range of disability groups.

experience of buildings. Taxonomical frameworks such as UD patterns can function as a sorting house for all these data types. While such scoping methodologies are often seen as a once off method for generating the knowledge base for an instrument, this ignores UD as a reactive paradigm, influenced by the demographic and sociological character which fluctuates both in time and by place. The Froyen approach of being decidedly not once off, and creating a structure that demands constant, unending exploration is timely in this regard.

Froyen similarly hints that useful indicators can emerge by focusing on activity settings and personal attributes, which are necessary components of his structured *patterns*. Replacing UD principles, criteria and goals that explicate conceptually organized but difficult to measure frameworks with unambiguous indicators can result in rating schema that are easy to understand and use. Ultimately, this can mean simple and practical evaluation instruments. The separation of human and environmental factors introduced by the *Enabler* can be seen to foreshadow the use of narrower and more focused indicators that probe both the building environment, as seen for instance in the Norwegian transport indicator tool [19], and users' circumstances, which are the focus of the Accessibility Labelling scheme in Denmark. The building indicators described by Øvsteda and Meland [19] are a distilled version of Preiser's habitability framework (see UD criteria section) and highlight the utility of tightly compartmentalised indicators. By distilling this framework further, a tripartite separation could be posited with an accessing indicator pertaining to spatial and infrastructural criteria of a building such as floor gradients or space to approach and manoeuvre; a using or interfacing indicator pertaining to the interactive elements of the building such as handles, or the grip/smoothness of floors; and an orientating indicator pertaining to the ability of the building to communicate routes, hazards, and general location information, such as color contrasts between floor and wall element. This system of building indicators illustrates a layered conceptual model of a building, recalling Brand's conceptual layered described in UD criteria section [27]. This adapted model is illustrated in Figure 4. This is not to say that existing UD principles, goals, or frameworks should be jettisoned, but that they are best suited to use during the design process and in establishing criteria for evaluation.

The strategy for selecting and sifting criteria – the scoping methodology – is where these more substantive UD frameworks are essential, rather than as a structuring mechanism for carrying out evaluation and directing the evaluator. There are similar

opportunities for merging these frameworks with trans-disciplinary categorisations such as the ICF [69] which has been embraced to a meaningful extent by practitioners in the medical, sociological, and design domains for its comprehensive categorisation of functional and structural states pertaining to the body, activities, and social participation. These systems can help to generate *universalized* methodologies which can be applied in any place, at any time, to produce simple, effective, and *particularised* instruments for local evaluators to use.

Conclusion

UD evaluations are a central part of UD knowledge and theory development, so they must be enabled to query guidelines, and to engage in a dialectical relationship between existing knowledge and actual experience in order to continuously and conspicuously evolve. Although evaluation can only ever be partial and indicative – even design standards analysis combined with meaningful users engagement cannot capture all supports and barriers – it must strive toward embracing knowledge and reacting to social and cultural changes, while at the same time remaining usable.

Checklist evaluations layered with answer ranges rather than prompting simple yes/no answers can be made increasingly effective and responsive to local conditions by partnering them with on-going investigations that take input from users, user-experts, and professional-experts. With this level of input, simple and practical evaluation instruments can provide meaningful ratings for whole buildings and even elements of buildings, and produce clear indicators that are meaningful to a wide variety of people, even those unfamiliar with the definition and aims of UD. These instruments can similarly absorb local cultural and contextual factors intrinsic to how we “value” a place. From this building designers and procurers can continually question how best to create buildings that empathize with their users, and be held accountable for buildings that fail to support people's efforts to maintain their dignity as human beings.

Declaration of interest

This research project was funded through the National Disability Authority (NDA), Dublin, in partnership with the Irish Research Council (IRC). The research was carried out with input and guidance from the Centre for Excellence in Universal Design, which is a part of the NDA. This research is part of a PhD programme funded by the Centre for Excellence in Universal Design (CEUD), a part of the Irish National Disability Authority (NDA), in partnership with the Irish Research Council (IRC).

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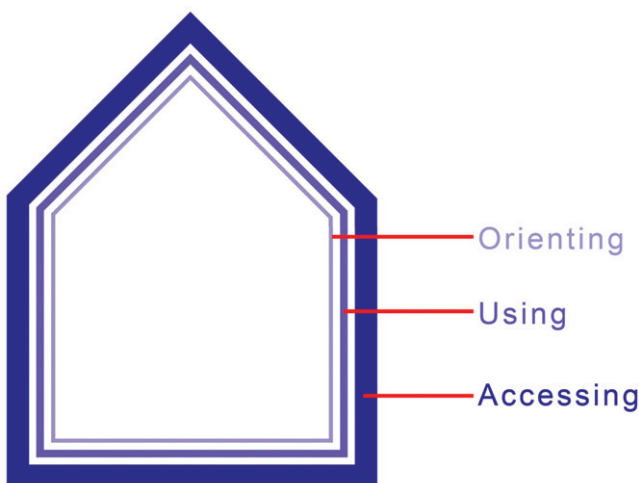


Figure 4. Overview of building indicators that can be applied to a UD evaluation instrument.

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