

COMPARATIVE STUDY OF USER-CENTRED DESIGN APPROACHES

Min Hi Chun¹, Chris Harty and Libby Schweber

School of Construction Management and Engineering, University of Reading, Reading, UK

This paper sets out to investigate user-centred design approaches utilised in design and construction of the built environment. “*User-centred design*” refers to design which focuses on users’ needs and wants. The term is widely used in software design, graphical design and in healthcare products used in the hospital and in design and construction of the built environment, for example in urban development, place-making, workplace design and refurbishment. The phrase covers a number of different approaches including Participatory Design, Co-Design, Space Syntax and Usability of Buildings. This paper compares these supposedly distinct approaches to better understand the different ways in which users’ needs can and are being incorporated. More specifically, it focuses on the deployment of these terms in construction research. A comparison of the definition of users, proposed role of users in the design process reveals significant differences in the definition and proposed role of users across the four approaches, with direct implications for the type of space envisioned and produced.

Keywords: co-design, participatory design, space syntax, usability, user-centred design.

INTRODUCTION

This paper investigates User-Centred Design approaches in design and construction of the built environment. It is motivated by two related interests - first, how users are incorporated into processes of designing and redesigning space, and second, how users’ experiences and existing practices can be used to inform design activity. Although there is a long tradition in the built environment professions in engaging with users, whether positioned as part of design, planning, the briefing process, stakeholder management etc, there is variation in the extent to which users’ needs and experiences are used to inform design (Ågerfalk, 2001).

User-Centred Design is defined as a design approach focuses on users’ needs and wants (Norman, 1988). It is widely used in software design, graphical design and in healthcare products used in the hospital and is also used in design and construction of the built environment, for example in urban development, place-making, workplace design and refurbishment (Sanders and Stappers, 2008; Sanoff, 2007). Variants include: Participatory design Co-Design, Space Syntax and Usability of Buildings. While all four approaches call for the more active engagement of users in the design process, they also often present themselves as distinct alternatives, either as research tools or more practical recipes or prescriptions for 'doing' user engagement.

This paper explores these differences with an aim to clarifying the different design options available and their implications for the type of space produced. It does this by

¹ m.h.chun@pgr.reading.ac.uk

selecting a range of papers from these traditions and evaluating them with respect to three dimensions; 1. The way the studies define 'the user'; 2. The methods of user engagement mobilised in practices and 3. The specificity and nature of the 'space' under negotiation during the (re)design process. The paper begins by briefly defining four distinct labels used with User Centred Design more broadly. It then describes the analytical approach used, and the analytical categories or dimensions that are developed. The analysis presents an evaluation of the distinctiveness (or otherwise) and features of these approaches.

DEFINITIONS

User-Centred Design tries to optimize the fit of product and services with how users can, want and need to use them, rather than forcing the users to change their behaviour to accommodate the product and services. This approach was first defined by Norman (1988) as *“a philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable”*.

According to Eason (1995), there are two possible meanings of user-centredness, 'Design for users' and 'Design by users'. The first calls on the designer to gather information about human behaviour and design the product and services for users, the second incorporates the user more substantively within the design process. Four, supposedly distinct, approaches currently dominate UCD. These include: Participatory Design, Co-Design, Space Syntax and Usability of Buildings.

Participatory Design originated in the Scandinavian Cooperative design tradition, where researchers engaged with workers and unions to explore how technology might be designed for skilled workers. The approach is characterized by its emphasis on cooperation between the researcher and users. Its strength lies in being a movement that cuts across traditional professional boundaries. This is based on the principle that the environment works better if citizens are active and involved in its creation and management instead of being treated as passive consumers (Sanoff, 2000).

Co-Design, a more recent version of UCD, goes even further by engaging users more actively in all stages of the design process as co-designers. Whereas Participatory Design calls on designers to interpret users' needs, behaviours, desires and contexts to learn about their needs, Co-Design calls on them to facilitate user participation, asking them to express their experience and knowledge directly in the design process (Rizzo, 2010). It would therefore claim to incorporate the user more closely in the process, and to not privilege the expertise of the designer over that of the user.

In contrast to both of these approaches, Space Syntax offers a view from outside of the designer-user relation. More specifically, it tries to understand the *“natural”* relations between users and built environment. The aim is to find out why certain spatial forms work for users and others do not (e.g. 1970's social housing estate and traditional houses in the city). A central assumption of Space Syntax is that space plays a distinct role in our existence in the world. *“Culturally and socially, space is never simply the background of our material existence. It is a key aspect of how societies and cultures are constituted in the real world, and, through this constitution, structured for us as 'objective' realities”* (Hillier 1996).

According to Hillier (1996), the relations between space and social existences do not lie at the level of the individual space, or of individual activity. It lies in the relations between configurations of people and the configuration of space. Thus Space Syntax focuses on spatial configuration and developed mathematical descriptions of spatial

configuration and shows how empirically testable outcomes can be predicted for aspects of collective human behaviour in building and urban settings. Designers use this to simulate the likely effects of the designs on the people who occupy and use the buildings rather than the democratic approach of taken in participatory design.

As described by Sanders and Stappers (2008), the Space Syntax design approach is more like a classical user-centred design process in that the user is a passive subject of study. The researcher produces knowledge, brings it to the designer who then uses it in the creative development of their design. This is in sharp contrast to the more democratic focus of participatory design and co-design.

Similarly, 'Usability of Buildings' focuses on the relationship between buildings and people or organizations. Usability is defined as the “*effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment*” (ISO 9241-11, 1998). According to this definition, three key factors determine usability - efficiency, effectiveness and satisfaction - and bring the user perspective into focus.

In 2001, International Council for Research and Innovation in Building and Construction (CIB) set up the Usability of Workplaces as a task group to investigate the application of an international standard on usability and techniques – often applied in the evaluation of consumer products – to the built environment. The aim was to identify methods and tools that could provide a better understanding of the user experience of buildings and enable a more positive user experience in organisational settings (Jenso, M. Hansen, G K. Haugen, T, 2004).

While these four approaches present themselves as distinct alternatives, the terms are often used far more loosely. This paper uses a review of articles claiming to adhere to each approach to explore variations in the approaches proposed. The aim is both to introduce a bit more rigour into the use of the terms and, more importantly, to clarify the alternative approaches currently being mobilized and their implications for the type of space produced.

METHOD

Selection of papers

Three papers which explicitly describe themselves as aligned with each specific design approach are selected for comparison. The criteria of selection are;

- Whether the title includes the design approach that is being used
- Whether the abstract or the keywords include the design approach being used
- Whether the main text includes the design approach that is being used
- Whether the paper offers an empirical example, which allows for an evaluation of the difference between the label and the approach deployed in the analysis.

Table 1 lists the selected papers. It is not the intention of this paper to suggest that these are fully representative of either each specific approach or UCD more broadly, but they do enable a comparison to be made, and align with our starting interest in assessing the distinctiveness and characteristics of these different UCD concepts.

Table 1: The full list of three papers from the different User-Centred Design approaches

Design approach	Ref	Author	Year	Paper
PD	Paper 1	Rachael Luck	2003	Dialogue in participatory design
	Paper 2	Julia A Garde, Mascha C. van der Voort	2008	The design of a new NICU patient area_ combining design for usability and design for emotion
	Paper 3	Ole Sejer Iversen, Christian Dindler	2014	Sustaining participatory design initiatives
Co-Design	Paper 4	Yanki Lee	2008	Design participation tactics_ the challenges and new roles for designers in the co-design process
	Paper 5	K Vaajakallio, J J Lee, T Mattelmäki	2009	It has to be a group work-Co-design with children
	Paper 6	Jiri Lallimo	2014	From pedagogical ideas to a school building: Analysis of user involvement in building design
Space Syntax	Paper 7	Kerstin Sailer, Andrew Budgen, Nathan Lonsdale, Alasdair Turner, Alan Penn	2010	Pre and post occupancy evaluations in workplace environments-theoretical reflections and practical implications
	Paper 8	Daniel Koch, Jesper Steen	2012	Analysis of Strongly Programmed Workplace Environments. Architectural Configuration and Time-Space Properties of Hospital Work
	Paper 9	Hui Cai, Craig Zimring	2012	Out of sight, out of reach. Correlating spatial metrics of nurse station typology with nurses' communication and co-awareness in an intensive care unit.
Usability of Buildings	Paper 10	Monica Jenso, Geir K Hansen, Tore I Haugen	2004	Usability of Buildings_ Theoretical framework for understanding and exploring usability of buildings
	Paper 11	Siri H Blakstad, Geir K Hansen, Wibeke Knudsen	2008	Methods and tools for evaluation of usability in buildings
	Paper 12	Siti Norsazlina Haron Md Yusof Hamid	2011	Patient perspective_ the usability evaluation approaches as assessment for quality of outpatient spatial design

Development of dimensions

The study examines the different design approaches against three dimensions: how 'user' is defined, the method of user engagement employed in the design process and the conceptualisation of the 'space' being designed.

First, it will explore how the 'user' is defined in each design approach, what user unit they are engaging with and what their overall objectives as User-Centred Design are. For example, Granath (2001) defines 'user' as those who actually use the building in their everyday activities. Thus users are all people working in a building, staff, management and service personnel, but not patients, visitors, owners, union representatives and public officials. Other authors include a broader array of stakeholders within their definition of users - those individuals and groups who can affect an organization. For example, Kernohan *et al* (1992) classified stakeholders at the demand side or the supply side and defines three different kinds of users - occupants, visitors and owners/ tenants organizations. Olsson *et al* (2008) developed further user categories and proposes to include owners, facilities management personnel, indirect and direct service receivers as well as service providers. As we can see, there are several possible definitions of "user" that are used in different studies. But as well as who counts as a user, there can also be variation in how concrete the definition is, with some studies being concerned with a more abstract and generic

notion of the user. Therefore this paper will investigate whether the same definitions are used *within* each design approach as well as *between* different design approaches. It will examine who the user is and how specific the user is defined in the paper.

For instance, according to Vischer (2008), there are three user units that exist within an office building - the individual, the team and the organization. This is not only limited to the office building: there will be different user unit within any organizational environment. Then what user units are in each approach engaging with? Are there any common features within each design approach in terms of the user units that they engage with? User-centred design approaches set out clear objectives in order to design products and services that meet users' needs and wants. This study will compare what the objectives of different design approaches are and explore whether there are any difference between them, if there is, what it is and how this would impact on its development and outcome of the design process.

Secondly it will investigate whether there are any differences between the methods applied in each of the different design approaches. Eason (1995) distinction between 'Design for users' and 'Design by users' suggests that there is different way to engage users in the design process. 'Design for users' involves gathering information about human behaviour from the users and using this to design better products and services for users. In this paper, this will be called 'passive user engagement'. 'Design by users' is about helping the user to actively engage in design process. This will be referred to as 'active user engagement'. The analysis will examine whether there are clear distinctions in how users are engaged in the different design approaches or not and, if there is, what their characteristics are.

As the level of user engagement differs, their role in the design process changes. In the 'Design for users' approaches, users are research subjects who provide the information and designers/architects are experts who design the building. In contrast, in 'Design by users' approaches, users are actively engaged in the design activities and act as co-designers. This transforms the role of the designer into one of facilitator.

Thirdly, the analysis will look at how these design approaches and techniques impact on the outcomes of the design process, shaping the building that is created. In the traditional design process, architects and designers use their own knowledge and experience to create spaces, beginning with abstract ideas and transforming them to concrete spatial formations through their cognitive design activities (Dursun, 2007). User-Centred Design approaches aim to incorporate users' needs, experiences and practices into the design process. These approaches engage users to develop the abstract ideas of the building project, such as the perfect future hospital and most efficient or collaborative workplace design, and to create its concrete space.

However the level of user engagement differs, the space envisioned changes. In the 'Design for users' approaches, architects and designers use a range of techniques to understand the needs of users and use this information to design better products and buildings on behalf of users. In doing this they focus on 'objective components of space', by emphasizing spatial patterns of behaviour, by incorporating the spatial components of social space through social area analysis, and by studying a more micro level of social space using concepts such as action spaces, activity spaces, behavioural fields (Buttimer and Seamon, 1980).

In contrast, in the ‘Design by users’ approaches, users are acting as co-designers to express their experience and knowledge of the space and building throughout the entire design process. The aim of these approaches is to incorporate users’ perceptual and cognitive evaluations of space and building, in other words the subjective spatial experience. These approaches focusing on ‘subjective components of space’ are explored using concepts such as life space, cognitive maps and urban images (Buttimer and Seamon, 1980).

ANALYSIS

Definition

Table 2: Key definitions used in different approaches

Design approach	User	User unit	Their objectives
Participatory Design	Targeted user group/ stakeholders	Individual, groups	Emotional satisfaction and needs
Co-Design	Targeted user group/ stakeholders	Individual, groups	Emotional satisfaction and needs
Space Syntax	Mixed definition	Organization	Organizational goals and efficiency
Usability of Buildings	Mixed definition	Individual, groups and the organization	Efficiency, effectiveness and satisfaction

1 Who is the user?

As we can see from table 2, all the papers from different approaches use inconsistent definitions of the user. For example, in PD, paper 1 looks at a specific and targeted user group, such as people with different disabilities, while paper 2 and 3 defined the user more broadly as all relevant stakeholders. The papers from Co-Design tend to define users as stakeholders and engage with the representatives of each of the user groups, but paper 5 looks at a specific group (children aged 7 to 9). It is also noted that in paper 6 the school employed a full time 'head user' as their representative in the design process who was responsible for organizing the design activity and the communication between the users and the architects and designers. This approach was taken due to the time requirements of co-design processes and helped enable very busy users' to be involved in the design process while they were carrying out their everyday job. Similarly, in Space Syntax approach, paper 8 defined users as people who use the building in their everyday activities but select the representatives of three main roles of the hospital's healthcare work - doctors, nurses and auxiliary nurses. While paper 7 define it as people who use the building in their everyday activities, but in a flattened hierarchy of the organisation.

2 What user unit are they engaging with?

Participatory Design and Co-Design approaches engage the user through interviews, focus groups and workshops, thus these design approaches engage the individual user unit. For example, paper 1 uses semi-structured interviews to allow the user to express their individual experience. Similarly paper 3 uses a series of collaborative workshops to allow users to express their experiences and is used in the paper to create new learning environment that supports current and future school activities. The studies

using Space Syntax approaches studies the collective human behaviour (organizational behaviour) in the institution using observation, user surveys and interviews and so engages the organizational user unit. However paper 8 engages the individual user unit as the study selects representatives of the three main roles in the hospital's healthcare work. Interestingly Usability Studies seem to engage different user units, from the individual to the organization.

3 What are their objectives (users' need)?

As shown in table 2, the objectives of the Participatory Design and Co-design are more likely to be maximising individual's satisfaction and meeting their needs through giving users power to be involved in a decision-making process in the building project, while Space Syntax and Usability study are trying to achieve organizational goals and efficiency by providing an appropriate and efficient physical space.

Method

Table 3: Method-the level of user engagement and the role of actors in the design process

Design approach	The level of user engagement	The role of actors in the design process
Participatory Design	Semi-active engagement	Blurrily
Co-Design	Active engagement	Blurrily
Space Syntax	Passive engagement	Clear
Usability of Buildings	Semi-active engagement	Clear

4 The level of user engagement

Co-Design approaches engage users most actively in the design process, while Participatory Design and Usability of Buildings approaches engage less active in the design process. For example, paper 4 use the workshop to discuss users' experience and design the building blocks with them, while paper 2 ask users about their experience by interviews, survey and observation then workshops and a virtual reality setting to understand users' wants. However it seems that there are some confusion of the conception of PD and Co-Design. Paper 3 uses the workshop to actively engage with users as design partners, but it classifies itself as PD.

Meanwhile the Space Syntax approach was engaging user more passive as users are more likely research subjects to provide information about their needs. Paper 8 undertakes interviews and seminars with the representatives of the users to understand workflows and practices, and a series of experiments with the plan of the unit to test the impact of changes of the spatial configuration on workflow and staff' work conditions.

5 The role of the actors in the design process

Participatory design and Co-Design have very blurrily professional boundaries. As users engaged in the design process actively and become co-designer, designers and architects' role change and become a facilitator rather than the expert who design and construction of the building. It was difficult to distinguish between Participatory design and Co-Design in terms of the role of actors. This differs from the Space

Syntax approach as the role of actors clear. Designers and architects receive the information about users' needs and wants from researcher, and design buildings based on this information.

Space

Table 4: Space in the design process

Design approach	Envisioned Space
Participatory Design	Subjective components of space
Co-Design	Subjective components of space
Space Syntax	Objective components of space
Usability of Buildings	Subjective and Objective components of space

Co-Design approaches engage users actively in the design process allowing them to express their subjective spatial experience and desires. For example, in paper 5 two Co-Design techniques are used to enable users to think aloud about design ideas that are connected to their everyday life, and negotiate with others in the user group to justify different solutions that meet not their only individual user' needs and desires, but those of other users too. Thus this approach looks at 'subjective components of space' (see above table 4).

This contrasts with the other approaches, such as Space Syntax approaches, in which researchers study spatial pattern of human behaviour and spatial analysis to understand users' needs, with the designers using this information to shape their abstract ideas to create concrete space. Therefore it focuses on 'objective components of space'.

Usability of Buildings approaches try to accommodate both 'objective' and 'subjective components of space' as their aims are to increase the effectiveness and efficiency of buildings, and users' satisfaction. In paper 10, different methods are combined to measure and evaluate the building (objective components of space) and also to organize a workshop with different users to explore the user experience (subjective components of space).

DISCUSSION

This study explores different UCD approaches in design and construction of the built environment. It focuses on different ways of user engagement and compares the definition of users, roles of the users and the type of space envisioned and produced. The study reveals significant differences in the definitions and proposed role of users across the four approaches, with direct implications for the type of space envisioned.

The term user is used inconsistently across the different approaches. Some papers define it as people who use the building in their everyday activities while others use it to mean all relevant stakeholders. The papers using the first definition give each of the different users equal weight regardless of their position in the organisation – there is a, flattened user hierarchy. Space Syntax approaches use this definition to study the spatial pattern of human behaviour for a random selection of users, so it could represent any potential users in the buildings and cities. The papers using the latter definition select representative users from each stakeholder group reflecting the organizational structure. A number of approaches, including Co-Design, use this definition of the user, aiming to intensively engage users in the design process to

allow them to express their experience and knowledge. One challenge for these approaches is ensuring that the experience and opinions of the representative users who are engaged with is truly representative of those of the whole of the user group. Innovative techniques can help bridge this potential gap.

Co-Design approaches are engaged with more subjective components of space through incorporating users' cognitive and perceptual experience of the building. One potential risk of this approach is that the focus on what users think they *want* leads to some aspects being neglected and the outcome not providing what users actually *need* in everyday spatial practice and the building not functioning as it should do.

Conversely, Space Syntax approaches study 'objective components of space' by looking at spatial patterns of human behaviour in the building and using spatial analysis to understand users' needs and create space and buildings that support users' activities and organisational goal in the building. A potential risk of this approach is that people who are directly and indirectly affected by the building dislike it even though the focus in the design process has been on making the building function effectively and providing the space the user needs in everyday spatial practice.

The contribution of this paper is in raising a number of questions around the role and status of users in design, and the models and concepts of user-engagement that have been mobilised. These include tensions between individual and emotional needs versus organisation and efficiency oriented goals, the specific status and privileging of types of users in the process and consideration of the subjective / multiple or more unitary and objective conceptions of the design space. These questions are currently being assessed through a case study of user-engagement in a new hospital design in Denmark.

REFERENCES

- Ågerfalk, P. J. (2001). "Who 's the User in User-centred Design? ", 102–104.
- Blakstad, S,H. Hansen, G,K. Knudsen,W (2008) Methods and tools for evaluation of usability in buildings, "Usability of Workplaces", Phase.
- Buttimer, A. Seamon, D (1980) "The Human Experience of Space and Place", Croom Helm London
- Eason K, D. (1995) User-centred design: for users or by users?, "Ergonomics", **38**(8), 1667-1673.
- Koch, D. Steen, J. (2012) Analysis of strongly programmed workplace environments – Architectural configuration and time-space properties of hospital work, "Proceedings of the 8th International Space Syntax Symposium"
- Dursun, P. (2007) "Space Syntax in architectural design", Space Syntax Symposium
- Garde,J.Van Der Voort (2008) The design of a new NICU patient area: combining design for usability and design for emotion, Undisciplined! "Proceedings of the Design Research Society Conference".
- Granath, J. (2001) Architecture - Participation of users in design activities, "Encyclopedia of Ergonomics and Human Factors".
- Haron, S, N. Hamid, M,U. (2011) Patient perspective: The usability evaluation approaches as assessment for quality of outpatient spatial design, "International Conference on Environment Science and Engineering", **8**, 4-8.
- Hernes T. (2004) "The Spatial Construction of Organizations", Amsterdam: John Benjamins.

- Hillier, B (1996) *"Space is a machine. A configurational theory of architecture"*, Cambridge University Press.
- International Standards Organization. (1998), ISO 9241-11, *"Ergonomics of human system interaction"*.
- Iversen, O,S. Dindler, C. (2014) Sustaining participatory design initiatives, *"CoDesign"*, **10**(3-4), 153-170.
- Jensø, M and Haugen, T. (2005) Usability of Hospital Buildings: Is patient focus leading to usability in hospital buildings?, *"11th Joint CIB International Symposium"*.
- Jenso,M. Hansen, G,K. Haugen, T,I. (2004) *"Usability of Buildings: Theoretical framework for understanding and exploring usability of buildings"*.
- Kernohan, D. Grey, J. Daish, J. Joiner, D. (1992) *"User participation in building design and management"*, Butterworth-Heinemann, UK.
- Lallimo, J (2014) From pedagogical ideas to a school building: Analysis of user involvement in building design, *"Proceedings 30th Annual ARCOM Conference"*, 195–204.
- Lee, Y. (2008) Design participation tactics: the challenges and new roles for designers in the co-design process, *"CoDesign"*, **4**(1), 31-50.
- Luck, R. (2003) Dialogue in participatory design, *"Design Studies"*, **24**(6), 523–535.
- Norman, D. (1988) *"The design of everyday things"*, New York, Basic books.
- Olsson, N,O,E. Blakstad, S, H. Hansen, G, K. (2008) Who is the user?, *"CIB W070 International Conference in Facilities Management"*.
- Rizzo, F (2010) Co-design versus User Centred Design: Framing the differences. In: Guerrini, L. ed. *"Notes on doctoral research in design"*. Contributions from the Politecnico di Milano: Franco Angeli, pp.125-132.
- Sailer, K. Budgen, A. Lonsdale, N. Turner, A. Penn, A. (2010) Pre and post occupancy evaluations in workplace environments-theoretical reflections and practical implications, *"Journal of Space Syntax"*, **1**(1), 199-213.
- Sanders, E, B, N and Stappers, P, J. (2008) Co-creation and the new landscapes of design, *"CoDesign"*, **4**(1), 5-18.
- Sanoff, H. (2006) Multiple views of participatory design, *"METU Journal of the Faculty of Architecture"*, 1965, 131-143.
- Sanoff, H (2007) Special issue on participatory design. *Design Studies*, 28(3)
- Vischer, J,C. (2008) Towards a user-centred theory of the built environment, *"Building Research and Information"*, **36**(3), 231-240.
- Vaajakaliio, K. Lee, J, J. Mattelmaki, T. (2009) *"It has to be a group work-Co-design with children"*, IDC.