

The Inclusive Design Canvas. A Strategic Design Template for Architectural Design Professionals

M. Zallio  and P. J. Clarkson

University of Cambridge, United Kingdom

 mz461@cam.ac.uk

Abstract

Designing accessible and inclusive buildings is essential if they are to provide enjoyable and inspiring experiences for all their occupants. Research revealed that many architectural design professionals perceive a lack of awareness of the aspects to consider when designing to be a limiting factor in the uptake of Inclusive Design. By involving expert stakeholders this study provides evidence for the demand to create an Inclusive Design Canvas, a strategic design template offering an educational springboard for building industry professionals to embed Inclusive Design in the design process.

Keywords: inclusive design, design tools, architectural design, accessibility, collaborative design

1. Introduction

Designing buildings that are sustainable whilst supporting the comfort and well-being of occupants has been a prominent factor in recent years which has led to the development of principles and practices to improve the design process of buildings (Altomonte et al., 2020).

In recent years contextual factors including accessibility and inclusion were considered as enablers to guarantee an engaging and positive experience for occupants within the built environment (Zallio and Clarkson, 2021a).

The importance of designing buildings that are accessible and inclusive is well known among the professional community (Zallio et al., 2016) and therefore going beyond accessibility and designing spaces to prevent exclusion and discomfort for neurodivergent individuals is rapidly becoming a key priority (BSI, 2021).

However, in observing and analysing buildings in different urban and rural areas there are often not extensive opportunities to engage with buildings that are fully embracing accessibility and inclusion criteria (Heylighen et al., 2017). It appears that certain buildings, initially designed according to essential accessibility criteria, once built can still generate exclusion to some of their occupants.

This challenge appears to often be correlated with a lack of awareness among the architectural design community about the practice of designing inclusively, as well as a lack of tools and frameworks to foster Inclusive Design (ID) among professionals (Zallio and Clarkson, 2021a).

A question emerges. How is it possible to educate architectural design professionals to reduce the points of exclusion for building occupants and address the challenging mismatch between the design of a building and its construction and delivery, according to principles of Inclusion, Diversity, Equity and Accessibility (IDEA)?

With this paper we address the challenge of reducing the mismatch between the prediction of how a building should be constructed and how the building will be built by providing educational and training resources to architectural design professionals to embed ID in the design process.

The paper presents the results from a validation study with architectural design professionals that participated in two co-design workshop sessions. Participants brainstormed and evaluated ideas based on previous findings from a Delphi study conducted in 2020 and 2021 (Zallio and Clarkson, 2021a).

2. State of the art on Inclusive Design tools

In the business and engineering fields a large number of methods and tools to facilitate the design process were created in recent decades (Chasanidou et al., 2015; Franke and Piller, 2004).

From Design Thinking (Gallanis, 2020), to Inclusive Design toolkits (Clarkson et al., 2007) a number of fields of application can be identified for each tool. They are commonly used in product and user interface design, engineering design and business and management.

These cross-disciplinary fields are not mutually exclusive and constitute complementary domains that assist engineers, designers and managers in creating positive user experiences.

The standard ISO 9241-210 defines the user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" (ISO, 2019).

From an analysis of these data, it emerges that the design of the user experience initially focused on developing products and services, however in recent years the discussion embraced the importance as well to improve the overall experience of building occupants.

This appears to be a challenging goal to achieve as there is a lack of design tools and frameworks for architectural design professionals focusing on different aspects of the experience of building occupants, such as inclusion, diversity, equity, and accessibility (Fernandez et al., 2021).

Previous research by the authors highlighted that architectural design professionals have a particularly limited knowledge of tools or frameworks to support an ID process when designing buildings for all (Zallio and Clarkson, 2021a).

Tools such as Soft Landings from BSRIA, a process to ensure all decisions are based on improving the performance of a building by meeting the expectations of clients (BSRIA, 2015) and the BUS methodology, a process to capture the complexity of the features of a building and highlight building performance indicators (Usable Buildings Trust, 2017) are examples of the few tools currently available to architectural design professionals. One of the challenges when analysing these tools is that they emphasise building performance and sustainability, rather than inclusion and accessibility.

At a point in time where the principles of inclusion, diversity, and equity are becoming fundamental (Tan, 2019) it is important to foster IDEA among architectural design professionals through education, awareness, and ultimately practice.

With this research we aim to define educational and training resources to facilitate professionals in embedding ID in their design process by embracing the diversity of user needs, their capabilities and the principles of inclusion.

3. Rationale and research approach

To answer the research question and to achieve an understanding of what solutions might best support architectural design professionals during the design process, two co-design workshops were organised.

Researchers and designers can create more user-centred and innovative concepts when working and co-designing with others than they would if creating ideas on their own (Mitchell et al., 2016).

To generate more diverse and insightful outputs, a number of stakeholders from the building and construction industry were identified and recruited according to the ethical protocols from the University of Cambridge.

Architectural design professionals with expertise and interest in ID, Diversity, Equity and Inclusion (DEI) practices and knowledge of accessibility and inclusion standards were contacted via email. Ten prospective participants expressed their interest in taking part in the workshops.

Stakeholders from the United Kingdom and Europe, including access consultants, architects or design managers who have been active practitioners in the field of ID, identified themselves as females (six) and males (four), and belonged to an age range between 40 and 75 years of age.

After testing the activities in a pilot, the workshops were organised with two separate sessions where participants were divided into two groups of four and six experts and run through remote meeting platforms.

The recorded sessions lasted one and a half hours and began by introducing the research team and the project, then background information on design tools and challenges architectural design professionals experienced from previous research were provided and goals and expectations of the workshops were finally explained.

The goals and expectations were to identify features a design tool should embrace to support architectural design professionals with an ID process and brainstorm and organise use and applications of new design tools to facilitate the architectural design process.

Through note taking and journey mapping feedback was collected by using online collaboration platforms. With the support of sketches, icons and statements, questions about the challenges and opportunities in using newly developed design tools, the characteristics and themes of such tools and possible future applications were asked by using the HMW (How Might We) questions to spark creative thinking and discover new solutions (Gallanis, 2020).

Through an initial divergent process, followed by more convergent discussion, comments were elicited and successively consolidated into clusters that allowed for a thematic analysis of the data.

4. Results

The two workshops were organised to first share new knowledge generated from previous research and then to explore ideas and collect feedback on solutions to reduce the mismatch between how a building should be designed according to the real needs of users, and how a building will be constructed.

During the sessions participants were involved in brainstorming and journey mapping activities, emphasised by means of the laddering technique which allowed for taking suggestions and investigating in greater depth the reasons behind them (Reynolds and Olson, 2001).

The table below summarises the results of the workshops analysed through a thematic method of analysis which identified and interpreted the emergent themes. The analysis focused on information redundancy and was performed by considering the background of participants and their feedback by using the established six-step process of thematic analysis (Braun and Clarke, 2016). Inputs from participants were coded and clustered within five overarching themes. Under each theme a series of subthemes were identified to maintain the granularity of collected information. An additional column with a 'take-home' message was identified to highlight strengths and weaknesses of the solutions.

Table 1. Thematic analysis: participants' feedback

Overarching theme	Subtheme	Take-home message
The user persona	<ol style="list-style-type: none"> 1. Personas reduce barriers by focusing on people's needs. 2. Use demographics instead of personas: it helps to ask about and identify the differences between people. 3. Users vary widely: using just one semi-fictional person may reduce design requirements to only a few individuals. 4. Consider RIBA work stages: it is about understanding who the users are at the early stage of the process. 5. Architects rarely know the user persona and applications. 	To train people about the importance of empathy and the need for emphasising people diversity.
The user journey and the building's characteristics	<ol style="list-style-type: none"> 1. Allowing users to self-identify with their capabilities and during their journey can help to frame personas. 2. The user journey and building characteristics should facilitate a dialogue about the building regulations. 3. Create a clear number and level of details for the user journey. 4. Do we have to first consider building regulations before describing the user journey? 	A tool for an educational experience about journeys to consider when designing inclusively according to regulations.

User capabilities	<ol style="list-style-type: none"> 1. Architects rarely know about user capabilities: how can we make sure we identify the barriers of the building? 2. Develop the demands of the users in a positive way so they can provide more design inputs. 3. Focus more on the environment, less on capabilities. 4. Develop a social awareness model on the impact of impairments to eliminate the environmental barriers for people. 	To positively consider user capabilities as enablers of the interactions between the body, the mind and the environment.
User needs	<ol style="list-style-type: none"> 1. Identify the limitations that the environment brings to people, with a people-first approach. 2. Needs are the interactions between people and environment. 3. Complexity of the number of user needs and building regulations: high chances of not meeting expectations. 4. Risk of just ticking the box by only checking for certain user needs. 	Help professionals to see things differently, identify challenges and opportunities without just ticking the box.
Purpose and applications of the tool	<ol style="list-style-type: none"> 1. Educational tool: exercise to train people on ethnographic research, understand user needs and ID. 2. Visualise the barriers that some people experience and what are the changes if designed inclusively. 3. Avoid a mismatch between standards and tool purpose. 4. A springboard to establish diversity and demographics inclusion. 5. A design framework to achieve tangible outputs and integrate accessibility and inclusion into the design process. 	An educational springboard to bring ID into the design process.

During the sessions participants identified challenges and opportunities to be included within a tool to support greater ID in the architectural design process.

User persona can assist designers to better understand and consider the range of expertise and capabilities across the population (Goodman-Deane et al., 2021). It appears that architectural design professionals find it challenging to adopt the use of user persona, mostly due to a lack of clarity regarding their purpose. Notwithstanding the valuable contribution of user persona in breaking the routine of often considering the same users when designing, there is an acute need to educate architectural design professionals on the added value user personas can bring when involving and identifying the diversity of demographics, capabilities, needs and, as an output, a better framing of the design requirements.

Significant factors that help to reduce bias are the importance of empathy while discovering the user journey (Heylighen and Dong, 2019), and an understanding of the journey that people experience by allowing users to self-identify with their capabilities in the user persona. By empathically describing the user journey and including different real users in the process through the user persona it should be possible to consider more inclusive characteristics for buildings that rely on people's needs in conjunction with building regulations.

The consideration of physical, sensory and cognitive capabilities is perceived as dichotomous amongst architectural design professionals; however, it should not be seen as a strict and siloed classification but rather should be perceived as a unified framework for the description of health and health-related states (Stokes, 2009). According to the World Health Organization this model offers a scientific tool for a paradigm shift from the purely medical model to an integrated biopsychosocial model of understanding human functioning, diversity and disability (WHO, 2002). Therefore, it is important to create a social awareness model about the impact of user capabilities to help reduce exclusion and eliminate environmental barriers. Physical, sensory and cognitive capabilities should be considered positively and not as limitations, but as the enablers of interactions between the body, the mind and the environment.

User needs are distinguished from wants (Green, 1990) and are statements based on challenges and pain points that define values, aspirations, demands and goals to achieve. As the complexity of user needs is correlated to the user capabilities and contextualised in the user journey, it is important that this design

tool inspires architectural design professionals with the right activities to think out of the box, see things differently and design by going beyond accessibility requirements and target inclusion, diversity, and equity.

The complexity of information that arises by considering a variety of personas, their capabilities in different journeys and match their needs but also comply with building regulations, offers a challenging exercise for architectural design professionals when defining design requirements. A common vision in relation to this design tool appeared amongst participants and emphasised the need to raise awareness and educate professionals at different stages of the design process. Particular attention should be paid to the first stages of design when often ID encounters friction if it is to be embedded within the discussions, design, plan and development of the built environment. The current disparate availability of tools to support an ID process and the inadequate spread of knowledge about the value of ID across many architectural design professionals accentuates the importance of providing training and educational exercises to allow for a positive change in the architectural community by incorporating ID into the traditional design process.

An educational tool can deliver training on the value and applications of ethnographic research, on visualising the barriers that people experience and on understanding people's needs with a mindset oriented towards inclusion, diversity, equity and accessibility.

5. The Inclusive Design Canvas

Architectural design professionals are often overloaded with excessive amounts of guidance, regulations and constraints (Zallio and Clarkson, 2021b). Feedback revealed that the use of yet another design tool is often seen as useless and an overwhelming activity to pursue during the design process. However, it is important to underline that continuing professional development (CPD) plays a fundamental role in advancing working practices, inspiring professionals and providing an improved service to customers (Zallio and Clarkson, 2021a).

Thus, educating experienced professionals but also newly qualified professionals and students on the importance of inclusion, diversity, equity and accessibility when designing the built environment is essential for the foreseeable future. The findings from this study further confirm the urgency of developing an Inclusive Design Canvas to foster educational experiences by training different stakeholders on the values of inclusion, the importance of diversity and the need to design buildings that provide access and equity, rather than barriers and inequalities.

The Inclusive Design Canvas is a strategic design template that offers an educational springboard for architectural design professionals to embed ID in the design process.

The Inclusive Design Canvas is collaboratively developed upon established practices in Inclusive Design (Persad et al., 2007; Clarkson et al., 2007), takes inspiration from the business and management fields (Osterwalder and Pigneur, 2010) and is presented as a catalyst to provide training and to drive the consideration of the variety of user journeys, the diversity of human capabilities, the equitable importance of diverse user needs and to promote the conditions for change by identifying and organising bespoke design requirements.

The power of the Inclusive Design Canvas lies in ethnographic research and in the user persona, a popular tool employed in user experience design, where a semi-fictional character represents a type of user that may use a software or product (Cooper, 1999). User personas are constructed to be representative of specific segments and emphasise how a specific rather than generalised user would make use of a particular software or product.

The value of bringing the user persona into architectural design practice is to break with routine, think above and beyond and foster the ability to navigate ambiguity by exploring the experience of different users with a variety of skills, capabilities, culture and needs. This process helps the designer to develop an empathic experience and to navigate the process of designing a building through journeys that are shaped according to users with different experiences, aspirations and needs.

To avoid a mismatch between current design practices which hierarchically follow building regulations (e.g., the BS 8300, the Americans with Disabilities Act, etc.) and the application of the Inclusive Design Canvas, a logical journey sequence was adopted. As most guidelines, standards and building regulations for accessibility and inclusion were developed with a user journey sequence model (Fernandez et al.,

2021), this becomes a fundamental component of the Inclusive Design Canvas to help architectural design professionals familiarise themselves with the tool.

Besides using semi-fictional characters to populate the different personas, which should not be limited in number, there is further added value in allowing future building occupants to self-identify with their journeys, capabilities and needs in the user persona. Both the use of semi-fictional or real personas can empathically bring about gamification in the process of designing inclusively and help to reduce bias by considering a broader range of information to elucidate design requirements during the design process.

The Inclusive Design Canvas is composed of five main segments that support professionals in identifying building users, their journeys, capabilities, needs and to navigate the design process adopting a more inclusive approach.

The user persona helps team members to share a specific and consistent understanding of various users with cultural considerations, physical, sensory and cognitive capabilities, and to contextualise their journey by providing a human face empathically for the persons represented by the demographics.

The persona's journey helps to contextualise a persona and through a brainstorming exercise highlights challenges and opportunities in a given time and place.

The persona's capabilities, including physical, sensory and cognitive, can offer several descriptors when considering how the interactions between the body, the mind and the built environment work.

The persona's needs describe the demands of the building occupants and are correlated to the capabilities and the interaction with the built environment. User needs are context dependent and strongly correlated to the design of a built environment and its characteristics.

The design requirements represent the summary of the key inputs that the future design should consist of. By interpreting the user needs, as an expression of people's challenges, design requirements provide actionable insights for the design of built environments that engage and inspire people by being accessible, inclusive and guaranteeing diversity and equity is respected.

The Inclusive Design Canvas

User Persona <small>Describe the user persona</small>	Persona's journey <small>Describe the persona's journey, considering key tasks and associated demands</small>	Notes
Persona's capabilities <small>Are descriptors that influence the ability for a persona to perform tasks within a built environment</small>	Persona's needs <small>Are descriptors, given persona's capabilities, to perform tasks within a built environment</small>	Design requirements <small>Are descriptors of design actions required to ensure the built environment meets the persona's needs</small>
Physical capabilities <small>Describe the persona's physical capabilities E.g., mobility, stamina, agility, balance, etc.</small>	Physical needs <small>Describe the persona's physical needs by focusing on the descriptors from the persona's journey and physical capabilities E.g., "User needs to to achieve"</small>	Physical requirements <small>Describe the key inputs for the design of the built environment by referring to the persona's journey, capabilities and needs E.g., "Ensure the entrance is to include"</small>
Sensory capabilities <small>Describe the persona's sensory capabilities E.g., vision, touch, smell, taste, hearing, vestibular, etc.</small>	Sensory needs <small>Describe the persona's sensory needs by focusing on the descriptors from the persona's journey and sensory capabilities E.g., "User needs to to achieve"</small>	Sensory requirements <small>Describe the key inputs for the design of the built environment by referring to the persona's journey, capabilities and needs E.g., "Ensure the room colors are to include"</small>
Cognitive capabilities <small>Describe the persona's cognitive capabilities E.g., think, learn, understand, question, etc.</small>	Cognitive needs <small>Describe the persona's cognitive needs by focusing on the descriptors from the persona's journey and cognitive capabilities E.g., "User needs to to achieve"</small>	Cognitive requirements <small>Describe the key inputs for the design of the built environment by referring to the persona's journey, capabilities and needs E.g., "Ensure the space is to include"</small>

The Inclusive Design Canvas is a strategic design template that offers an educational springboard for architectural design professionals to embed inclusive design in the design process.

CC BY-NC-SA
 This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/4.0/> or write to Creative Commons, PO Box 1888, Mountain View, CA 94042, USA.

V1.6 • Designed by: Matteo Zallo - www.matteozallo.com
 University of Cambridge • Engineering Design Centre

Figure 1. The Inclusive Design Canvas. A strategic design template that offers an educational springboard for architectural design professionals to embed inclusive design in the design process

Within these key features lies the value of the Inclusive Design Canvas - a strategic design template that does not aim to disruptively revolutionise established practices in the architectural design world but proposes to be used as a coaching exercise to help people exercise muscles of empathy, understand the power of ethnographic research, allow an ID mindset to flourish and to better identify and understand the variety of user needs.

The Inclusive Design Canvas assists people in eliciting out of the box information and collecting and visualising thoughts by bringing an added value to the design process.

6. Conclusions and future implications

With the emergent need for ensuring that ID is embedded throughout the whole process of designing, developing, constructing and maintaining buildings, methods and tools to increase awareness of theories and practices are an essential requirement within the building industry.

Within the overall research project, funded by the European Union's Horizon 2020 research and innovation programme, the challenges architectural design professionals face were highlighted and through multiple qualitative and quantitative stakeholder engagement and consultation sessions strategies to foster ID were developed.

The Inclusive Design Canvas represents a unique approach that takes lessons learned from engineering design and user experience design fields and applies them to the building sector.

The Inclusive Design Canvas has the potential to support architectural design professionals both through education and in practice to design buildings for people that empower rather than disable and exclude.

Although the Inclusive Design Canvas is a tool primarily aimed at architectural design professionals for use both in their education and practice, it could also serve to have a complementary use in processes with other stakeholders and cross-functional teams.

One of the challenges to overcome which is related to the infancy of the Inclusive Design Canvas is to populate it with multiple examples from different building and construction industry groups, including residential/non-residential, infrastructures and industrial facilities and different strategic design templates so that they can be used as case studies for a wide number of professionals. Some examples are currently available at <https://www.matteozallio.com/idea>.

A second challenge relates to the generalised approach that the Inclusive Design Canvas seeks to pursue by inspiring professionals and engendering an ID mindset, rather than being just a 'box ticking' problem solving tool that operates almost as a panacea. In the near future it hopes to become a bespoke tool that assists in bridging the gaps arising within different building industry groups, including but not limited to residential/non-residential, infrastructures and industrial facilities. The Inclusive Design Canvas is currently under testing and evaluation phase to understand effectiveness and implementation among architectural design professionals.

Future potential for the Inclusive Design Canvas lies in it being embedded within design software and the digital twin space, where a proactive system of prompts and indicators, questions and suggestions will provide architectural design professionals with a virtual journey that demonstrates to them how a building currently is and teaches them what they can do to design it more inclusively.

The extension of the application of the Inclusive Design Canvas in the Metaverse and the digital twin space allows designers to identify and better manage a higher granularity of detail when designing inclusive physical or virtual spaces, setting the scene for parallel worlds that are inclusive, equitable and where both people and avatars are empowered to fulfil their self-efficacy.

This evolution which starts initially with the application of the Inclusive Design Canvas for educational and exploratory purposes in physical spaces, will rapidly lead to further developments of a digitalised canvas and other tools that will feed the design of both physical and virtual spaces to guarantee inclusion, diversity, equity and accessibility.

Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement N°846284. Authors equally contributed to the research and article writing. The authors would like to express a heartfelt appreciation to all the participants of the workshops,

in particular to: D. Bonnet, L. Deane, R. Marshall, D. Jimenez Martín, T. Rumble, Centre for Accessible Environments, J. Simpson, J. Slocombe, I.T. Steffan, E. Warner, J. Watkinson.

References

- Altomonte, S., Allen, J., Bluysen, P.M., Brager, G., Hescong, L. et al. (2020). "Ten questions concerning well-being in the built environment", *Building and Environment*, Vol. 180 No. 106949. <https://doi.org/10.1016/j.buildenv.2020.106949>
- Braun, V. and Clarke, V. (2016). "(Mis)conceptualising themes, thematic analysis, and other problems with Fugard and Potts' (2015) sample-size tool for thematic analysis", *International Journal of Social Research Methodology*, Vol. 19 No. 6, pp. 739-743. <https://doi.org/10.1080/13645579.2016.1195588>
- BSI (2021), PAS 6463: Design for the mind - Neurodiversity and the built environment - Guide. Available at: <https://standardsdevelopment.bsigroup.com/projects/2020-00234#/> (accessed 11.11.2021).
- BSRIA (2015), Soft Landings Set of 5 Guides (SL5). Available at: https://www.bsria.com/uk/product/Krq5er/soft_landings_set_of_5_guides_sl5_a15d25e1/ (accessed 11.11.2021).
- Chasanidou, D., Gasparini, A. A. and Lee, E. (2015). "Design Thinking Methods and Tools for Innovation", In: Marcus, A. (Ed.), *Design, User Experience, and Usability: Design Discourse. Lecture Notes in Computer Science*, Springer, Cham, Vol. 9186, pp. 12-23. https://doi.org/10.1007/978-3-319-20886-2_2
- Clarkson, J., Coleman, R., Hosking, I. and Waller, S. (2007). *Inclusive Design Toolkit*. Engineering Design Centre, University Of Cambridge. <https://www-edc.eng.cam.ac.uk/downloads/idtoolkit.pdf>
- Cooper, A. (1999). *The Inmates are Running the Asylum*. Sams Publishing, Indianapolis, Indiana.
- Fernandez, C., Zallio, M., Berry, D. and McGrory, J. (2021). "Towards a people-first engineering design approach. A comprehensive ontology for designing inclusive environments", *Proceedings of the International Conference on Engineering Design (ICED21)*, Gothenburg, Sweden. <https://doi.org/10.1017/pds.2021.579>
- Franke, N. and Piller, F. (2004). "Value creation by toolkits for user innovation and design: The case of the watch market", *Journal of Product Innovation Management*, Vol. 21 No. 6, pp. 401-415. <https://doi.org/10.1111/j.0737-6782.2004.00094.x>
- Gallanis, T. (2020). "An Introduction to Design Thinking and an Application to the Challenges of Frail, Older Adults", In: Celi L., Majumder M., Ordóñez P., Osorio J., Paik K. et al. (Eds.) *Leveraging Data Science for Global Health*. Springer, Cham, pp. 17-33. https://doi.org/10.1007/978-3-030-47994-7_2
- Goodman-Deane, J. A.-L., Bradley, M., Waller, S. and Clarkson, P.J. (2021). Developing personas to help designers to understand digital exclusion. *Proceedings of the Design Society*. Cambridge University Press, pp. 1203-1212. <https://doi.org/10.1017/pds.2021.120>
- Green, A. (1990). "What do we mean by user needs", *British Journal of Academic Librarianship*, Vol. 5 No. 2, pp. 65-78.
- Heylighen, A. and Dong, A. (2019). "To empathise or not to empathise? Empathy and its limits in design", *Design Studies*, Vol. 65, pp. 107-124. <https://doi.org/10.1016/j.destud.2019.10.007>
- Heylighen, A., Van der Linden, V. and Van Steenwinkel, I. (2017). "Ten questions concerning inclusive design of the built environment", *Building and Environment*, Vol. 114, pp. 507-517. <https://doi.org/10.1016/j.buildenv.2016.12.008>
- ISO (2019), ISO 9241-210: Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems. Available at: <https://www.iso.org/standard/77520.html> (accessed 11.11.2021).
- Mitchell, V., Ross, T., May, A., Sims, R. and Parker, C. (2016). "Empirical investigation of the impact of using co-design methods when generating proposals for sustainable travel solutions", *CoDesign*, Vol. 12 No. 4, pp. 205-220. <https://doi.org/10.1080/15710882.2015.1091894>
- Osterwalder, A. and Pigneur, Y. (2010), *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons, Inc., Hoboken, New Jersey.
- Persad, U., Langdon, P.M. and Clarkson, P.J. (2007). "A framework for analytical inclusive design evaluation", *Proceedings of the 16th International Conference on Engineering Design (ICED07)*, Paris, France, August 28-31, 2007, pp. 817-818.
- Reynolds, T.J. and Olson, J.C. (2001). *Understanding Consumer Decision Making: The Means-end Approach to Marketing and Advertising Strategy (1st ed.)*. Psychology Press, New York. <https://doi.org/10.4324/9781410600844>
- Stokes, E.K. (2009). "Chapter 11 - Outcome measurement", In: Lennon, S. and Stokes, M. (Eds.), *Pocketbook of Neurological Physiotherapy*, Churchill Livingstone, Edinburgh, pp. 191-201. <https://doi.org/10.1016/B978-044306854-6.50016-4>
- Tan, T.Q. (2019). "Principles of Inclusion, Diversity, Access, and Equity", *The Journal of Infectious Diseases*, Vol. 220 Issue Supplement_2, pp. S30-S32. <https://doi.org/10.1093/infdis/jiz198>

- Usable Buildings Trust. (2017). *BUS Methodology*. Available at: <https://busmethodology.org.uk/> (accessed 15.06.2021).
- WHO (2002). Towards a Common Language for Functioning, Disability and Health: ICF The International Classification of Functioning, Disability and Health, World Health Organization, Geneva, Switzerland. Available at: <https://www.who.int/classifications/icf/icfbeginnersguide.pdf>
- Zallio, M., Berry, D. and Casiddu, N. (2016). "Adaptive homes for enabling senior citizens: A holistic assessment tool for housing design and IoT-based technologies", *Proceedings of the IEEE 3rd World Forum of Internet of Things (Wf- IoT), Reston, Vancouver, December 12-14, 2016*, pp. 419-424, <https://doi.org/10.1109/WF-IoT.2016.7845463>
- Zallio, M. and Clarkson, P.J. (2021a). "Inclusion, diversity, equity and accessibility in the built environment: A study of architectural design practice", *Building and Environment*, Vol. 206 No. 108352. <https://doi.org/10.1016/j.buildenv.2021.108352>
- Zallio, M. and Clarkson, P. J. (2021b). "On Inclusion, Diversity, Equity, and Accessibility in civil engineering and architectural design. A review of assessment tools", *Proceedings of the International Conference on Engineering Design (ICED21), Gothenburg, Sweden*. <https://doi.org/10.1017/pds.2021.491>

