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ADVANCING INCLUSIVE SERVICE DESIGN THINKING IN TRANSPORT BUILDINGS: RESEARCH AND PRACTICE REFLECTIONS

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ABSTRACT

Addressing the slow progress in developing socially equitable solutions, this research explicates the benefit of 'inclusive service' thinking by integrating Service Design (SD) from financial services with inclusivity in the built environment (BE). The study applied the five-stage SD methodology—observe, synthesise, new idea, refine, and implement—to underground station design. Four empirical studies analysed how vertical and horizontal circulation systems in crowded stations impacted inclusivity and service experiences. Study A used a questionnaire to gather passenger experiences in existing Tube stations, informing the design of studies C and D. Study B captured insights from a participant-observer's experience in a crowded underground station. Study C refined circulation arrangements for new inclusivity proxies, including Level of Service (LOS) and Vertical Severance (VS), using Agent-Based Modelling (ABM). Findings showed that multiple large lifts significantly improved inclusivity and service without increasing station size or cost, revising earlier pedestrian modelling theories. Study C was implemented, and a post-occupancy study at two Red Line stations in Tel Aviv generated new knowledge. Study D evaluated a new mined station, Farringdon Station, on the Elizabeth Line in London. Original contributions include developing a new theory of 'inclusive service' thinking by transferring the SD method from financial services; demonstrating that inclusive underground stations need not be more costly or larger; creating a new theory of design as discourse; revising early-stage design practice for complex underground stations; and establishing SD as a 'next-next' generation design method.

INTRODUCTION

Sustainability, as a concept, depends on economic growth, environmental protection, and social equity. The Brundtland Commission defines sustainability as "meeting the `needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987: 35). Moreover, the Rail Sustainable Development Principles call for customer-driven railway developments, putting rail in reach of people, providing an end-to-end journey, being an employer of choice, reducing our environmental impact,

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being carbon smart, supporting the economy, optimising the railway, and being transparent (RSSB, 2016). However, few stations provide access from street to train (GLA, 2010), with excessive gaps between train and platform leading to poor accessibility in underground train stations (Boyle, 2009: 20). Scholars argue that there is a long way to go before "we live and work in an inclusive world" (Clarkson and Coleman, 2015). And, while the rail industry aspires to enhance customer experiences, there is limited literature on what constitutes inclusive service in the BE sector or how to implement this (Harding, 2020b). Placing the study within the field of sustainable-inclusive-service transport buildings.

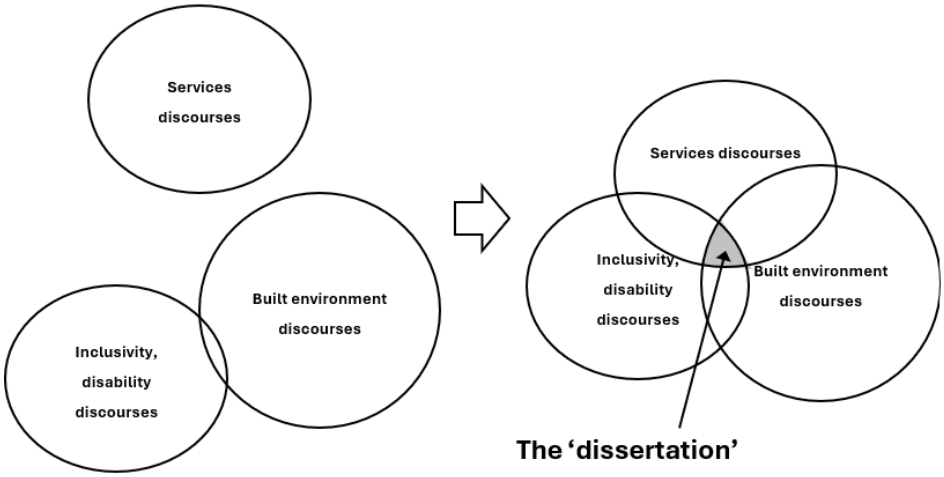

Figure 1. Closing the inclusive service gap in research and practice

Figure 1 illustrates the lacuna between services, disability, inclusivity, and BE discourses. To deliver inclusive service Harding (2020b) identifies service design (SD) as a potentially transferable 'designerly' methodology that could address this gap in the BE.

"Service Design is all about making the service you deliver useful, usable, efficient, effective and desirable" (Design Council, 2010)

Prior to this study, SD definitions, such as that of the Design Council, focused on utilitarian value, excluding inclusivity as a core element. To remedy the identified inclusive service gap, the study is placed at the intersection of sustainability, service, and inclusive BE fields of study, as illustrated in Figure 1. However, the extant literature on this intersection was limited (see Article 1). Consequently, by both centring and integrating 'inclusive services design thinking' within this investigation and closing the gap, the author makes a critical, original, significant contribution. The following section expands upon that rationale.

Integrating 'inclusive service design' theory and practice

Scholars working in the field of inclusivity in product design (Clarkson et al., 2003) and customer experience (Turner, 2003) informed Harding's (2011) thesis. Critical literature reviews (Harding, 2018a; 2018b; 2019) identified that IDEO, a service and product design company, developed the passenger journey concept (Figure 2) by applying the five-step service design (SD) model (Figure 3) (Bhavnani and Sosa, 2008).

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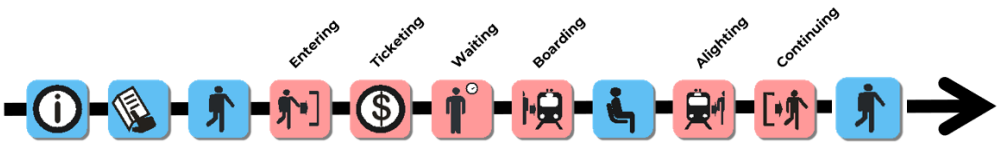

Figure 2. Passenger Journey conceptual model (derived from IDEO)

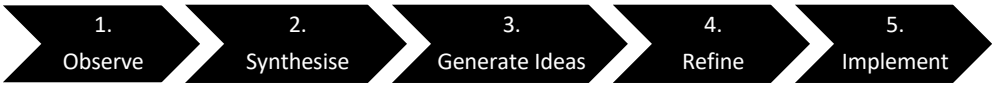

Figure 3. Five service design stages

SD was created by Shostack (1984) who specialized in the financial services industry. She identified SD as a way of thinking about the services people use, and the quality of experience these deliver. Services are neither a physical object nor a product. They are an experience. Significantly, while SD was transferred to the fields of customer experience (Turner, 2003) and computer interaction (Battarbee, 2004), it had not, until this work, been transferred to develop inclusive service research in the BE. This study, therefore, represents a pioneering and significant extension of SD, addressing a critical lacuna in both scholarship and practice.

'Wicked' problems in the built environment

Harding (2020b) argues that determining how many people require support with inclusivity is a 'wicked' problem, unsolvable through traditional scientific and engineering methods (Cross, 2007). 'Wicked' problems involve unresolved theoretical debates that hinder design progress (see article 1). Martens (2018) underscores this challenge in the context of transport for an ageing population, advocating a shift from universally designed (UD) transport systems towards inclusively designed (ID) systems. UD seeks to accommodate the widest possible range of abilities, whereas ID aims to provide access for everyone. The social model theory of disability underpins UD, on the other hand, ID is underpinned by an interactional theory of disability (Imrie & Luck, 2014). Interactional theory is supported by many philosophers and bioethicists (Riddle, 2013, p. 23) and focusses attention upon, i) removing the impairment from the BE and the body, ii) addressing socio-material-economic-political problems, owing to the lack of resources (Slack, 1999, p. 23), iii) including questions regarding feminist, racial, gender, ethnicity and sexual topics (Stainton, 2000), and finally, iv) investigating complex social-material interactions between people and their equipment needs and material constraints (Bichard, 2014). The UN (2006) endorses UD which seeks to provide access to a broad range of users; the nuance is that ID aims for afford for everyone (Martens, 2018: 122). Harding (2020) argues that without consensus on disability discourses, debates within the BE remain unresolved. Designers cannot determine whether UD or ID will deliver inclusive transport infrastructure. To develop scholarly agreement design studies C1~C3 address these concerns. Harding (2019, p. 27) further warns that ongoing disputes over the meaning of design may undermine the social benefit of inclusive service. Harding situates design as central to addressing these issues. To gain clarity and progress, this study proposes a new meaning: design as discourse. Knowing how many people are affected by what Harding (2013) defines as Vertical Severance (VS). Harding (2013, p. 13) defines VS as the "...separation

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from ground level to the platform that creates spatial mobility and socio-economic concerns for individuals. VS results in less diversity and more exclusivity within transport modes and the cities they serve." VS causes a significant pain point for passengers (see Figure 4) and is a particular 'wicked problem' that was probed in a design study (see study C1~C3). All studies probe this VS concern. (Figure 5).

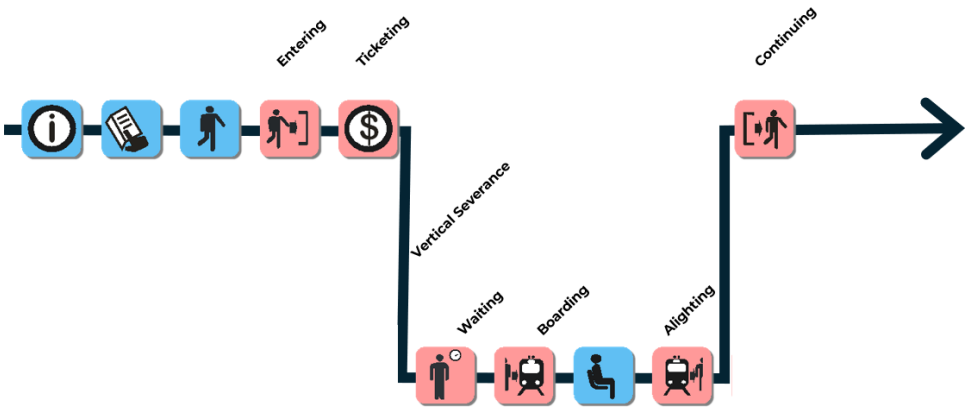

Figure 4. Encountering Vertical Severance within the underground station (Harding, 2024b)

Figure 5 summarises the development of the rationale in this study.

Figure 5. Rationale for the study

Research questions

Research questions were developed from the literature review (Harding, 2020). Table 1 relates the research question to the article to the empirical studies.

Primary Questions	Article (Section)	Empirical Study
1. It is not possible to integrate the five SD stages (Fig. 3) into the design of a building and this research project.	All	All
2. Providing a high level of accessibility for everyone (ID) in underground rail stations will cost more and require more space, compared to a minimal (UD) approach.	4, 5	C2
3.A new meaning for design, as a form of discourse, will not be useful for developing inclusive transport building design research in the BE industry.	2 (5.5)	A
	6(5.4)	C3
	7 (5.2)	C
	8 (4)	
Secondary Questions		
4.What SD qualitative methods could be used to observe inclusivity and service experiences in crowded underground stations?	2&3	A, B
5.What new ideas could be developed to improve inclusivity and service experience?	All	All

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6. What new quantitative tool could be used to refine inclusivity and service experience?	4 & 5	C2
7. When SD is implemented in new stations, how does the quality of the new inclusivity and service experiences compare to experiences in older stations?	6, 7	C, D
8.What conclusions can be drawn regarding the use of SD to improve inclusive service in stations?	8	A~C2
9.How does SD change practice, and what is next for SD in the wider BE sector?	9	A~C2

Table. 1. Research Questions

METHODOLOGY

To address the research questions and encompass all five SD stages a comprehensive longitudinal mixed-methods case study was chose

Figure 6. Integrating nine articles into the study

Case study research

Case study research enables comparison of rival theories, whether using quantitative or qualitative methodologies (Yin, 1993, pp. 112-113). Moreover, case studies may provide sufficient detail from fieldwork that is detailed, replicable, rigorous, and timely (Yin, 1993) and applicable across diverse disciplines, including education (Yin, 1993) and infrastructure management (Flyvbjerg, 2014). Further, case studies offer a compelling basis for change (Flyvbjerg, 2006). Significantly, this summary and an ennealogy of four empirical studies constitutes a cohesive research framework that delivered compelling scholarly and practical contributions in the field of inclusive service in the BE. To make the longitudinal project feasible, the PhD by Special Regulations route was chosen. Benefits included developing writing projects, obtaining timely peer-reviewer comments, and contributing to international discourse with professionally formatted material. This route allowed for post-occupancy reviews of the operational stations, pauses for unanticipated events, including COVID, work demands, health and life challenges, and family responsibilities. Figure 7 illustrates how the four empirical studies (A~D) relate to the five SD stages, conclusions, and next steps. Figure 8 indicates the research path taken by each constituent study through the four critical gateways.

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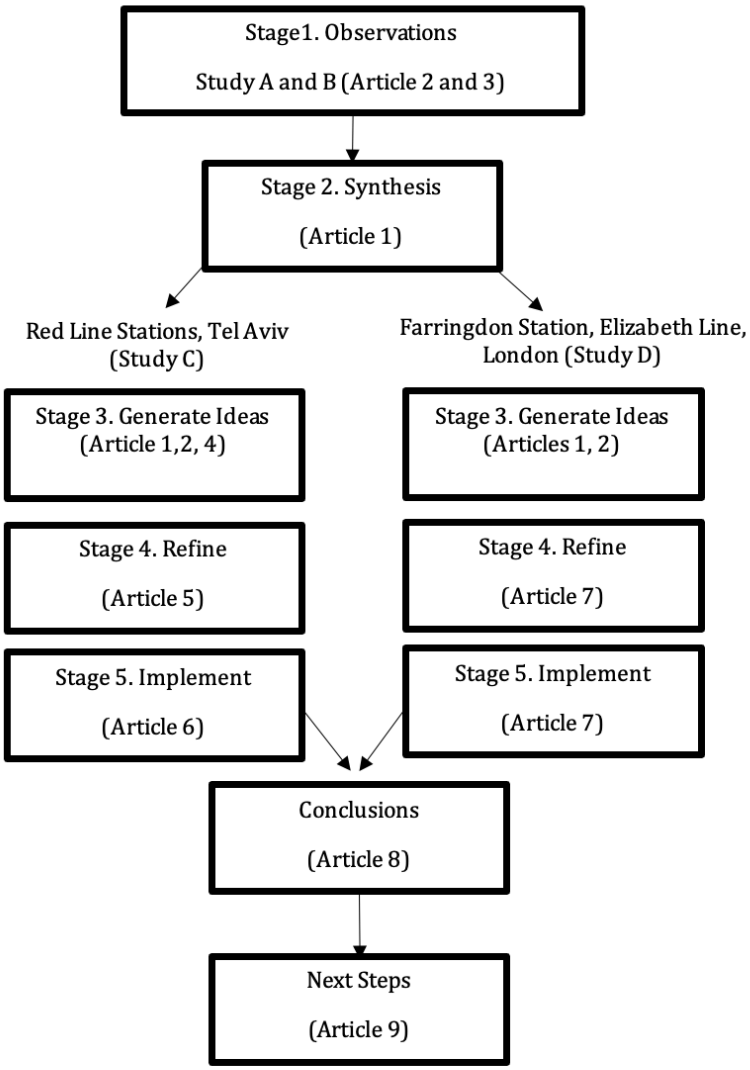

Figure 7. Relating the four empirical studies (A~D) to SD stages

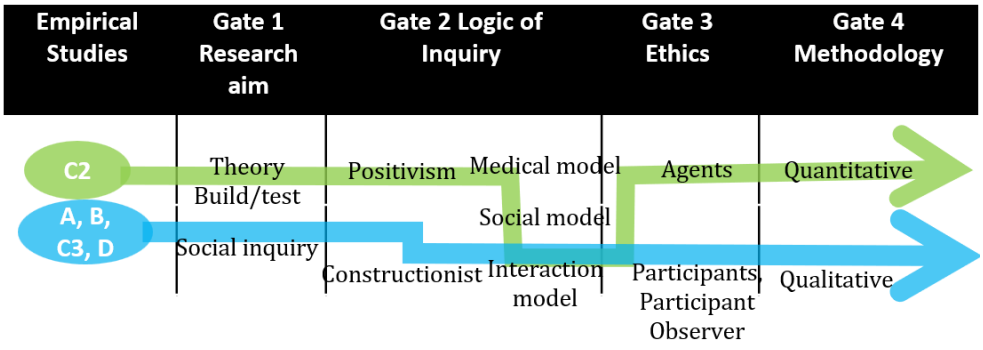

Figure 8. Mixed-Method pathways through four research gateways (adapted from Harding, 2018)

The quantitative Refine study C2 focused on theory-building and aim-testing to determine which theory, UD (case 1) or ID (case 2), provided a satisfactory inclusive service experience in an underground station, without increasing cost or size. The qualitative Observation studies (A and B) contributed new knowledge to the synthesis in article 1, the literature of which generated the research questions addressed throughout this study (see Table 1). Studies A, B, and post-occupancy studies, C3 and D, examined the designer-user co-experiences of inclusive service in-situ, motivated by social inquiry aims. These

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four studies produced nuanced, detailed observations, demonstrating how vertical and horizontal circulation elements in stations (the independent variables) impact passengers' experiences (the dependent variables). Figures. 9~11 summarise the methodology employed for each study

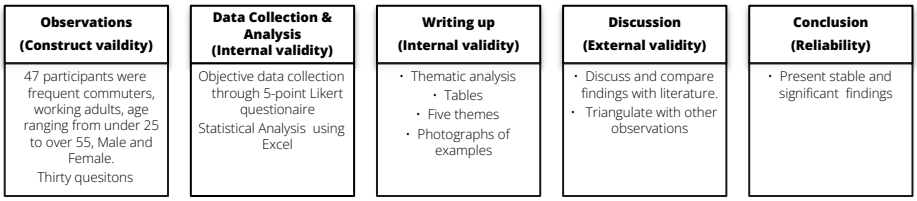

Figure 9. Post-occupancy questionnaire qualitative methodology: article 2 (study)

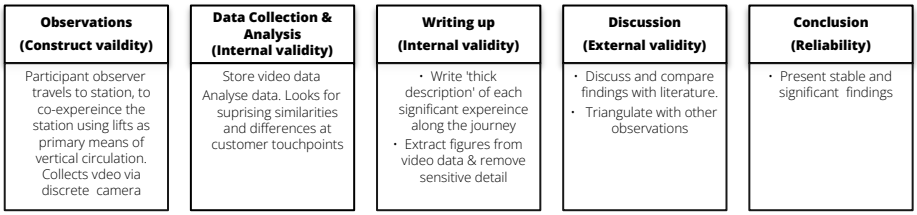

Figure 10. Post-occupancy auto-ethnographic qualitative methodology: article 3 (study B), article 6 (study C3) & article 7 (study D)

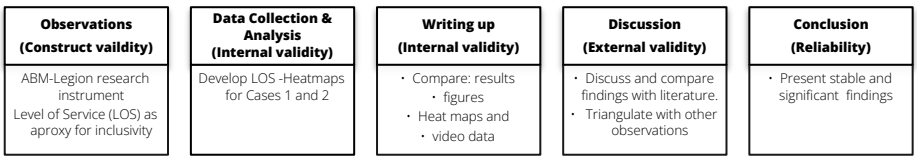

Figure 11. Agent-based modelling quantitative methodology: article 5 (study C2)

Logic of inquiry

Case study C2 had explicit theory-building and testing aims. Hypothetic-deductive logic (Popper, 1972) is a common method of investigation in science and design fields that is associated with positivism. Hypotheses were developed in the original research questions (Table 1), using abduction, 'the process of forming an explanatory hypothesis' (Peirce, 1955: 67 quoted in Stainton-Rogers, 2006, p. 85). Then, ABM was used as a research instrument to compare the two rival cases for inclusivity and service, using deductive logic to disprove the hypotheses. However, positivist epistemological and ontological assumptions create simplistic explanations with less detail and nuance (Stainton-Rogers, 2006, p. 81) and may result in simplistic guidance and standards that produce normative solutions and design fixation issues (Crilly, 2015). To create more detail and nuance, the observation studies (A, B, C3, D) had social inquiry and constructionist aims: these primarily identified inconsistencies, difficulties, and challenges for inclusivity and service. Constructionist theory raises pertinent and thought-provoking questions that helped hone the research aims, including: 'what does it do?', 'how can it be used and by whom', and 'to what ends?', 'whose interest does it serve?', and 'what does it make possible?' (Stainton-Rogers, 2006, p. 81). Analysis required 'looking for surprising similarities between things that are very different' or 'surprising differences between very similar things' (p. 87). Meticulous explication preserves complex details while creating a way to develop meaning from observations. As anticipated, asking such questions from the outset led to

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new insights and paradigm shifts (p. 81). Accordingly, four studies used constructivist theory.

Results

Table 2 summarises the contributions of each article to the longitudinal case study according to SD Stage, study, and method.

	SD Stage	Study	Summary	Method
1	**Synthesis**		The literature review synthesised critical literature to develop new research questions listed in Table 1 (Harding, 2020b)	Literture Review
2 3	**Observe**	A B	A Likert scale questionnaire survey of passenger experiences in existing Tube stations in London developed actionable insights (Harding, 2025a) This empirical observational study transferred auto-ethnographic methods to research inclusive service experience in a busy underground station built to late 20th Century accessibility standards. (Harding, 2024b)	Questionaire Auto-ethnography
4	**New Idea**	C1	A new idea was created to probe inclusive service in stations in crowded places, using agent based modelling was developed (Harding, 2018)	Agent Based Modeling
5	**Refine**	C2	A rival case study refined that new idea. It compared inclusive service within two station circulation systems (case 1 and 2) using agent-based modelling. Case 2 afforded the best inclusive service (Harding, 2019)	Agent Based Modeling
6 7	**Implement**	C3 D	Case 2 was implemented in ten stations , and this post-occupancy evaluation reviewed the inclusive service experience in two stations (Harding, 2025b) This post-occupancy evaluation reviews Farringdon Station in London, that was recently opened and developed with inclusive service thinking, (Harding, 2024a)	Auto-ethnography Auto-ethnography
8	**Conclusion**		This article reflects upon the earlier studies and concludes the study (Harding, 2020c)	Literture Review
9	**Next Steps**		This article demonstrates how focussing upon inclusive service changed a large interdisciplinary design practice (Harding, 2020a)	Literture Review

Table 2. Summaries

Methodological reflections

This study is guided by reflexive practice (Schon, 1984) and 'practice what you preach' theories (Reich, 2017) that enable continuous self-evaluation, enhancing the rigour, ethics and impact of the research. Alternative user-centric research approaches were considered. Action research, which seeks to increase understanding of a social situation by focusing on improving social processes and implementing change within a social context collaboratively (Hult & Lennung, 1980). Moreover, Ormerod (2005) claims it is unlikely that a single method or a wide range of participants will be practical in the BE context. To develop nuanced insights into inclusive service interactions in underground stations (Harding, 2020) this research necessitated that the researcher co-experience and empathise with the user (Battarbee, 2004), in both the physical and emotional interactions at critical passenger touchpoints (Bhavnani & Sosa, 2008). Thus, the co-experiential, auto-ethnographic in-situ

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approach was used in post-occupancy studies B, C3 and D. The use of the questionnaire and auto-ethnography is justified by the actionable insights they provide to early researchers and practitioners. Actionable insights were developed using qualitative methods adapted from the social sciences and computer interaction fields (Battarbee, 2004). A new quantitative methodology successfully used ABM to differentiate rival cases and disprove hypotheses in study C2. In conclusion, when the industry relies upon quantitative data for station planning decision-making (N.R., 2015), a mixed-methods approach that is both replicable and detailed is justifiable and desirable.

Generalisability and limitations

It is good practice to triangulate data from multiple sources (Yin, 1993). To increase generalisability and reduce bias this study triangulated data from survey questionnaires (study A), videos (studies B, C3, D) and ABM data (study C2). Nevertheless, to minimise bias, future research should include researchers and participants from a wider demographic background.

CONTRIBUTIONS OF THE STUDY

Theoretical impact

(RQ1) The study is innovative by transferring SD theory from finance (Shostack, 1984) and SD methods (Bhavnani & Sosa, 2008) to the design of underground stations. Study A generated new observations, insights and suggested proxies for inclusivity, showing how age and gender impact experiences of comfort, security, gentleness and confidence. These observations were synthesised and refined in study C2, and implemented at ten Red Line cut-and-cover stations in Tel Aviv (study C3) and implemented at Farringdon, a mined station in London (study D). The research demonstrates that integrating all five SD stages was successfully implemented in eleven underground stations, which are typically difficult to access (Boyle, 2009), suggesting that SD can also be implemented in simpler buildings. (RQ2) Study C2 case 2 demonstrated that providing a high level of accessibility for everyone was practical and desirable supporting Martens (2018) and underpinning interactional theory (Bichard, 2014; Imrie & Luck, 2014; Riddle, 2013; Slack, 1999; Stainton, 2000). Importantly, case 2 required no additional cost or space, compared to the minimal UD approach of case 1. (RQ3) The study creates a new interpretation that is helpful for theory and practice development: design as discourse. Some argue that research is discourse (Petre and Rugg, 2010: 114), and others argue that 'design is research' (reported by Macmillan, 2010). These studies demonstrate that to proceed to implementation, the design discourse needs agreement to develop and address 'wicked' problems, such as inclusivity. Similarly, if critical theories (e.g., social versus interactional) underpinning design discourses (UD versus ID) do not reach an agreement, practice will likely not improve quickly. This may explain why scholars such as Boyle (2009) and Clarkson and Coleman (2015) observe that it takes so long to deliver inclusivity in practice. (RQ4) Qualitative observation methods used in study B, C3, D, were typically used in the social sciences, and were transferred to review the experience of the inclusive service within busy underground stations in the BE for the first time. i) auto-ethnography, a social-inquiry method used in the social sciences (Buzard, 1997), and ii) co-experience methods developed in the computer interaction field for designers and researchers to observe socio-material interactions with

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the user (Battarbee, 2004). Article 3 advances methodological debate on exploring inclusive design from a user's perspective, and within empathetic design. These twinned methodologies enabled the researcher/designer to co-experience passenger interactions with station circulation. A new post-occupancy evaluation method, developed in study B, was replicated in studies C and D. This critical post-occupancy observation method provided novel insights unattainable through conventional industry 'tick-box' exercises, (Ormerod, 2005). Moreover, this observation methodology demonstrates theoretical and practical relevance for stations, and the broader BE. (RQ5) New ideas were developed to research inclusive service experiences. For example, Study A revealed new proxies for inclusivity (Table 32025a). To address the need for inclusive service training identified in the earlier survey (Q30 see article 2), new training materials (Harding, 2023) and methods using ABM and video data (Harding, 2016a, 2016b, 2016c, 2024) were provided to BE professionals. A new theoretical model, VS, was developed to explicate the importance of considering vertical movement (Harding, 2013). (RQ6) ABM proved a satisfactory new quantitative tool for examining inclusivity and VS in circulation systems, as illustrated in a rival design studies C1 and 2. The ABM study C2 of two rival underground station simulations revised earlier theories: i) case 1 based on UD paradigms - as favoured by UN (2006) and underpinned by social model theory – did not develop an inclusive experience, compared to case 2. Case 2 was created with multiple-lifts, aiming to provide access for everyone (Martens, 2018) according to ID paradigms, and underpinned by interactional theory to provide a satisfactory experience for everyone. ii) findings were triangulated with post-occupancy evaluations in studies B and C3. iii) case 2 challenges previous assumptions that lifts were of limited utility (John J. Fruin, 1971), or unnecessary at stations due to high cost (Goldsmith, 1976), or multiple lifts were only required for terminal or airport stations (John J. Fruin, 1992). This research critiques and inverts those earlier perspectives in the service of inclusivity. Critically, to develop inclusivity in theory and practice, inclusive design guidance (BSI, 2018), SD theory and its definitions (Council, 2010) require fundamental revision to integrate ID principles. (RQ8) It can be concluded that SD can be considered a 'next, next' generation design method, 'more relevant to architecture and planning' than first-generation approaches (Rittel 1973 cited in Cross, 2007, p. 1) similar to the RIBA Plan of Work (RIBA, 2020) which lack the critical observation and synthesis stages, prior to the ideation stage.

Practical impact

(RQ7) Post-occupancy evaluations of new cut-and-cover stations (study C3), and a new mined station (study D) showed that the application of SD improved inclusive service, compared to the older station (study B). Enhanced user experiences of comfort, security, gentleness, and confidence were observed in the new cut-and-cover stations in Tel Aviv (study c3) and the new mined station serving the Elizabeth Line in London, compared to the older Jubilee Line station (study B) when triangulated with the findings of study A. Significant progress in inclusive service was achieved by reducing VS at stations (Table 3 2025b). Therefore, the research demonstrates that inclusivity for all users improves when the ratio of lifts to escalators is weighted to the former. (RQ9) It was shown that customer experience and inclusivity in the BE were improved by integrating SD stages into a modified RIBA Plan of Work in the early design stage when critical design decisions are made (Figure 12).

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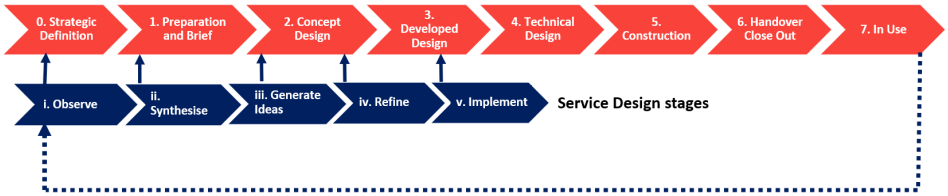

Figure 12. Integrating SD stages into a revised RIBA Plan of Work (Harding, 2020a)

International interdisciplinary research impact

The published articles contributed to the international interdisciplinary research discourse including: transport and inclusivity (Egger, Gemperli, Filippo, Liechti, & Gantschnig, 2024; W. Shi, Mahdzar, & Li, 2025; W. Shi, Mahdzar, Li, Cui, & Zhao, 2025; W. W. Shi, 2021), inclusive service in the BE (Busciantella-Ricci, Aceves-Gonzalez, & Scataglini, 2022; Zecca, McGinley, & Griffiths, 2023), urban design and sustainability (Patil & Gupta, 2023), art and wayfinding in stations (Adhialam, Timms, Sumabrata, & Adwitiya, 2025), and infrastructure project life cycle (Adamtsevich, 2025).

Final thoughts

The advancements to inclusivity in public realm design seen in this study are not guaranteed, given risks from a "woke wave" of opposing 'culture war' discourses that oppose feminist, anti-racist and environmental agendas (de Nadal, 2024), and threaten sustainability (WCED, 1987). As an alternative, this study frames design as discourse; integrates two previously separate fields of inclusivity and service into a new inclusive service theory that demonstrates that everyone may be afforded inclusivity in practice.

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SHORT BIO

John Harding is a practising architect, urban designer and researcher. He has 30+ years of experience in the design, construction and operation of railway buildings internationally. In addition, he has experience as an urban designer, designing new towns (Punggol in Singapore) and cities (Putrajaya in Malaysia). John's academic interests support his work in practice. These include developing practical ways to research and improve inclusive service within transport buildings. He is a PhD candidate and submitted his dissertation to the University of Cambridge in 2025. He has peer-reviewed ICE journals and is a member of the RIBA.

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