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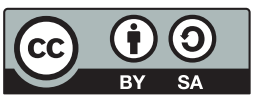

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Editors

Stella Boess, Ming Cheung, Rebecca Cain

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DRS2020
BRISBANE, 11–14 AUG
SYNERGY

DRS President's Foreword

Rachel COOPER

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The Design Research Society is a unique organisation comprised of people dedicated to the value of design and design research and its value to our people and our planet. Without a dedicated group of volunteers, we would not exist; people who offer their services to the management of the organisation, people who host conferences and people who submit papers and their combined intelligence to further knowledge of design and its contribution to the world. This year the fragile nature of the planet, of human relationships and the basis of our economy and society has been illuminated (fires, floods and a virus). We have seen the effect of radical changes in patterns of behaviour; both positive influences on the environment and negative influences on health and wellbeing and livelihoods. There are many design challenges and design researchers have come to the fore. This conference is a triumph of that creativity and fortitude, embracing the virtual world and bringing together all those people who so want to exchange ideas. Many of the papers are pre-Covid, and whilst we should not forget the conversations and research directions before this pandemic, it will, of course, shape our future and our conversations. People make the DRS and whether online or in person the conversations will continue. Let us together build a wider, deeper and stronger global design research community.

As a foot note I would like to say that 2020 marks a turning point for DRS in so many ways, we have a new structure of the organisation, that is a new International Advisory Council and executive who are eager to continue to move forward. We have a new virtual conference and I would like to thank the conference team for such a triumph in changing format and delivery mode, and also to you the members and delegates who are embracing this with your attendance. Enjoy the conference and the future DRS.



Rachel Cooper
DRS President 2020

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DRS2020 Editorial

Stella BOESS, Ming CHEUNG and Rebecca CAIN

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Never before has a Design Research Society Conference happened in such uncertain and changing times. When we embarked on planning the DRS2020 Conference in Brisbane, Australia, we were in a different time, when unrestricted travel and meeting-up face-to-face at academic conferences was the norm. Then the COVID-19 global pandemic happened, which prompted us to rethink and reimagine DRS2020 in a new format.

In recent times, the debate around the sustainability of physical conferences has been starting to surface. This was an issue the DRS was starting to grapple with, but the practicalities of a blended or entirely virtual conference were still uncharted territory. Even before the pandemic was born, the devastating Australian bushfires were causing people to consider whether it would be safe to travel to Australia. Ultimately, the pandemic made a physical conference impossible, and the conference host Griffith University made a joint decision with DRS to convene DRS2020 as a virtual conference. DRS2020 marks an important turning point in the history of DRS conferences, being the first conference to go entirely virtual. We are very grateful to Griffith University for embracing this challenge, and for their leadership and management of the virtual conference in such complex and difficult times.

DRS conferences are international biennial events, held to further and promote design research. They are inclusive conferences, bringing together a wide range of disciplines and communities related to design research, with the aim of fostering new debates on the important issues of the time. Historically, DRS conferences have always taken place through gatherings of delegates in physical venues at a host organisation, with face-to-face presentations and discussions, accompanied by written conference proceedings. New collaborative formats have been added over time – for example, Conversations which were introduced in 2014. DRS2020 took on the challenge of transforming these formats into a virtual experience. Also worth mentioning, the DRS2020 Postgraduate Research Day is pioneering in that it is inclusive of both PhD and MPhil students and of their theory-driven and/or practice-led research projects. In this sense, DRS2020 becomes a prototype for a new type of virtual and inclusive conference experience and continues to build on the legacy of innovation from the previous conferences.



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The 144 papers in these proceedings were conceived of and written in our pre-COVID world. Just three authors were able to make late additions to their papers addressing the current situation (165, 398 and 402). These proceedings therefore provide an interesting juxtaposition, whereby what is written represents design research in the world as we knew it, whereas the discussion that these papers will promote during and beyond the conference will almost certainly be viewed through the lens of the complexities and challenges we now face. The discussions and reflections in the proceedings are a timely barometer for what the international design research community is thinking about and working on, and they will surely prove inspiring and thought-provoking for design researchers worldwide. We hope that you enjoy reading them as much as we have enjoyed curating them.

Themes

The overall theme for DRS2020 is Synergy – the coming together of people and disciplines in design research to create a positive impact. On the one hand, design research champions the uniqueness of disciplinary knowledge and creativity, yet on the other hand, the complex world we now live in demands a more synergistic approach to creativity and problem-solving whereby different mindsets, backgrounds and perspectives come together to realise transformative visions of the future. DRS2020 celebrates these emerging synergistic approaches to design research and seeks to explore their exciting possibilities for addressing multi-faceted problems, supporting participation, and transforming problematic situations into desirable ones.

For DRS2020, we used an emergent approach to the development of the conference programme, with a general call for papers around five themes – Situations, Impacts, Co-Creation, Education and Processes. These themes emerged in discussions between the Organising and Programme Committees at an early stage of the conference planning and were felt to capture a broad spectrum of current design research topics from which we would be able to build more focused themed sections. Continuing the collaborative approach to theme building, we asked the international reviewers to indicate to which of these themes (or others) each paper contributed. Following the acceptance of papers, the reviewers' indications helped us to cluster the papers into the rich programme we have here, with the main conference theme of Synergy being an interwoven thread throughout.

Impacts and Co-creation are the biggest theme categories, reflecting the design research community's commitment to applied research. Situations are an emerging theme reflecting the community's increasing awareness of diverse circumstances and contexts. With Australia as the host country for DRS2020, it is worth noting that 12 out of the 144 papers mention Indigenous communities (108, 135, 165, 166, 177, 187, 198, 228, 277, 278, 387, 402). 32% of the accepted papers are from Oceania, 18% from Asia and 33% from Europe, compared with 5% each from Oceania and Asia and 64% from Europe at DRS2018. Themes such as pluriversal design and diversity, design for global health and wellbeing, collaboration, sustainability and education continue to attract new directions in research and illustrate the

potential of design research to change the world for the better. The theoretical foundation of research into (design) Processes continues to be an enduring theme, the development of which can be traced back through all previous DRS conferences. Some sections were additionally clustered by domain, such as graphics, mobility, experience design or data. A point to note is that the paper clustering differs somewhat between conference programme and these proceedings, as the former also needed optimising by time zones to allow presenters from around the world to interact in their session discussion.

A further way we grouped the papers was around existing themes of interest within the DRS: those of the DRS special interest groups (SIGs). These open and dynamic groups of DRS members form around current and emergent issues in design research, and they welcome participation. The DRS SIGs are one of the main ways that the DRS drives forward debates and keeps a pulse on ongoing topics as well as emergent topics of the day. The DRS currently supports eleven SIGs, all of whom have contributed to these proceedings by selecting and grouping just over a third (55) of the submitted papers into SIG themed sections. Some of these sections are chaired as sessions by SIG members at the conference. This way, the SIGs hope to give authors the opportunity to get to know the SIGs and their members and to get involved. The eleven SIGs are Health, Wellbeing and Happiness, Global Health, Design Pedagogy, Pluriversal Design, Design for Behaviour Change, Experiential Knowledge, Human-Object Interactions, Inclusive Design, Sustainability, Networked and Embedded Technologies and Design Innovation Management. While the SIGs selected their set of papers because the papers speak to current and future themes of the existing DRS SIGs, many more of the accepted papers also relate to the SIG themes and all authors are welcome to engage with a SIG. DRS members are also free to propose new SIGs. One of the aspirations of the DRS conferences is to catalyse the creation of new SIGs, through the collective community building and knowledge sharing which takes place.

Review

Despite moving to a virtual conference format, what stays a predictable constant is the academic quality of the work presented at DRS conferences. Our standards remain high, through the excellent work of the authors, our Programme Committee and the community of reviewers. The Programme Committee is appointed by the DRS and chaired by a member of the DRS International Advisory Council. We are privileged to have many eminent scholars in the design research community within our reviewer pool, but also early career academics who are supported in writing peer reviews, a core part of their academic development, and who form our reviewer pipeline for future conferences. We endeavoured to match reviewers' expertise with papers through topic selection and automation, with some manual adjustments. The reviewers provided feedback to authors on how to improve their papers.

In total we received 280 full paper submissions in a one-stage submission procedure, of which 269 were viable to go to review. In total the 192 reviewers wrote 553 reviews, using reviewer guidelines. The reviews averaged 350 words. Each paper received two, sometimes

three reviews. 87 papers (32%) were accepted with minor revision and a further 57 (20%) accepted following (major) revision. This represents a 52% acceptance rate. As in previous conferences, we used the ConfTool system to manage the submission process. The ability of authors to rate and comment on their reviewers as in previous years, helps to drive up the quality of the review process. The authors rated 237 (43%) of the reviews with an average of 4.4 on a scale of 1-5 on the criteria *justified*, *constructive*, *encouraging*, *fair* and *convincing*.

Words of thanks

DRS2020 would not have been possible without the contributions of many excellent people who have devoted their insight and experience to the conference. We would sincerely like to thank the Local Organising Team at Griffith University for their remarkable work in transforming the conference into a virtual experience, and the extra time, effort and resources that this has involved. In particular, undertaking this transformation 4.5 months before the conference launch has entailed a significant level of creativity, courage and perseverance. We also thank the DRS for their expertise and guidance in the programme and review aspects of the conference. The authors, the Programme Committee and all the reviewers all deserve thanks for their valuable time and expertise in ensuring the high academic quality of this conference, as well as the SIG convenors for their role in curating themed tracks. Finally, we thank Griffith University and the Design Research Society for supporting the conference.

We hope that you enjoy these proceedings, and that they provide a thought-provoking and inspiring read.

Stella Boess, DRS2020 Programme Chair
Ming Cheung, DRS2020 Conference Chair
Rebecca Cain, DRS2020 Conference Co-Chair

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Volume 1
Theme Situations

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Editorial: theme Situations

Stella BOESS, Rebecca CAIN

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Situations are an emergent theme in design research that reflect the community's increasing awareness of positionality, diverse circumstances and contexts. How is design research situated in cross-disciplinary collaboration, navigating cultures, diversity, ethics, sense of place and sense of materials, and the habits of different design communities? Under which conditions does design research flourish and is it able to help create positive impact? What are the dynamics between design research, governments and industry contexts?

This theme is the newest among the five sub-themes of the conference, and the papers in it are the most diverse. It is also the smallest theme by numbers of submissions that the reviewers associated with it, indicating that it is still in development within the design research community.

The first sub-theme presented is that of **Languages and Values**. Paper 148 takes us into design managers' strategic contexts and how meaning is made – either reproducing or denormalising historical assumptions, thus opening up a space for critical reflection. Paper 177 takes on the effects of similar reflections on interpersonal relationships in design and social innovation and charts a path towards establishing mutuality and building reciprocity. Paper 183 provides a theoretical contribution on values and how to address and reconcile when these diverge among stakeholders.

The next type of situations with which design research is concerned is represented in the sub-theme **Design for Belonging**. Paper 278 describes enhancing a city's status of wellbeing and engagement with diverse cultures by means of student projects engaging with arts and culture in New Zealand. Paper 324 describes how social design can engage with identity formation in the family context through narrative theory. Paper 318 goes to an even more personal topic – paediatric palliative care – to invite design to engage with Life design, Legacy and Difficult conversations.

Sub-theme **Localities and Data** moves from the personal and relationships context to look at digitalization in relation to the material lifeworld. Paper 183, one of the most highly reviewed among the submissions, takes a derelict temple site as a starting point for transformative reuse through virtual embodiments and craft knowledge, and framing this

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activity as cosmopolitan-localism. Paper 218 adds a theoretical angle for approaches like this, by anchoring AI in a material perspective for a more considered use. The third paper in this group, 293, engages with the next frontier in IoT infrastructures, which is keeping data in the geographical locality where it originates to improve privacy – this is called Edge Computing - and presents two design fictions illustrating it.

Sub-theme **Experiential Knowledge** turns to the situation of the designer themselves. Aside from the rich repertoire of methods available to designers, their own meaning-making is the focus here. Paper 187 analyses what is typically tacit in the reflective doodling we often do and illustrates how it actually has and could have more of link to designing for transitions. Paper 350 expands on this theoretically by exploring the cognitive process involved in visual metaphor creation and metaphoric thinking. Paper 350 complements the previous by adding the reader's perspective. Within a very specific focus of typographic emphasis in headings, it compares how these headings are perceived differently by readers than by those who designed them.

Sub-theme **Research through Design** ties in with the previous sub-themes' concerns by explicitly focusing on both the design and life situation and which knowledge can emerge from them. Paper 220 starts with an intimately intertwined life and design situation: the design researchers' own wedding and the design artefacts involved in it, taking place in a highly politicized border context. The authors articulate three forces as shaping the design outputs and as forces of design agency: profile, politics and potential of the border. In paper 108, in contrast, the designer anticipates on someone else as user: in 3D ceramics printing, they develop hybrid design artefacts. They are hybrid both in focusing on 'user-completion', and in fusing processes and techniques from the different disciplinary modes of digital fabrication and ceramics. Lastly, paper 362 makes a first attempt at clarifying what connects and separates different RtD approaches – the diversity has been illustrated by the very contrasting concerns in papers 220 and 108. Paper 362 identifies 11 themes of concerns among a research community of practitioners of Research through Design.

The theme Situations is completed by two DRS SIG themed sections. The papers in these sections span the themes of Situations, Processes and Impact, illustrating how they are connected.

The Pluriversal Design SIG conveners have curated five papers that span the themes of Situations and Processes. This special interest group of the DRS is one of its youngest and takes as its goal "promoting radical, liberatory, intercultural and pluralistic conversations about design" (DRS website). The SIG conveners introduce the papers in the editorial that follows, followed by the papers themselves.

Closing out this theme section, the Inclusive Design special interest group of the DRS, who takes as its goal "inclusive and wider participation in design" (DRS website), has curated that fall within the Situations theme as well as within the Impacts theme. The SIG convener introduce the papers in the editorial that follows, followed by the papers themselves.

The papers in the theme Situations have provided insights pertaining to all but the last of

the questions raised at the outset of this section. Insights on the dynamics between design research, governments and industry contexts are addressed under the Co-Creation theme.

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Design Languages in the Design Space: Silicon Valley

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Abstract: This interdisciplinary article explores the nature of language in design managers´ strategic contexts. Taken-for-granted assumptions behind language influence the way cues are selected and elaborated on through actors´ frames to ultimately become meanings. Language suggests and passes on cues and frames through which strategizing evolves. The design space is depicted as an entanglement of in-betweens where actors are immersed in language and materiality in their ongoing sensemaking. The hermeneutic analysis revealed that design languages partly extend managerial concepts, thus broadening horizons. Designers´ sensemaking in this longitudinal research showed traits of normalising and denormalising language use balancing between frame adoption and frame extension. Normalising language risks reproducing historical assumptions easily omitting ethics or harmful consequences. Designers´ denormalising language with material–linguistic strengths could trigger critical reflection on strategic assumptions. In addition, a design contribution is made to strategy and sensemaking studies.

Keywords: design space; critical theory; strategy; sensemaking language

1. Introduction

This article explores in-house design managers and external design consultants´ language use in Silicon Valley-based design-driven organizations. The fourth stage of design broadens the scope of design from products to systems, environments and organizations (Buchanan, 2015) which are strategic issues. The article discusses language through which taken-for-granted assumptions might guide actors in their sensemaking pursuits of noticing, selecting and interpreting cues in strategic sensemaking contexts.

Designers are increasingly involved in strategising (Brown, 2009; Buchanan, 2015; de Mozota, 2017; Liedtka, 2015). Strategy can be understood as a situated, social activity accomplished through the actions and interactions of actors (Vaara & Whittington, 2012) or as ongoing future-oriented sensemaking which involves fantasizing (Sajasalo et al., 2016). Designers may provide actors with situated, embodied and creative means to select and elaborate on related cues. Sensemaking is triggered by cues, such as issues or events for which the

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meaning is not clear (Maitlis & Cristianson, 2014, p. 70). *This research proposes that the language behind cues and frames is crucial for their selection and interpretation.* Language not only describes but changes the world (Rorty, 1970, as cited in Krippendorff, 2007).

Strategic concepts are central micro-level tools in strategic sensemaking in the language-based view on strategising (Balogun et al., 2014; Jalonen et al., 2018; Mantere, 2014). In this article, strategising is ongoing sensemaking in a design space of entangled material–linguistic elaborations influenced by languages and facilitated by designers. Strategic concepts are 'linguistic expressions, essentially words or phrases with established and at least partly shared meanings, which play a central role in an organization's strategy discourse´ (Jalonen et al., 2018, p. 2795). *This article thus suggests that cues are filtered through individual and collective frames (Figure 1) and negotiated into meanings through different languages* (cf. Suddaby & Greenwood, 2005).

Earlier sensemaking research mainly focused on top management (Maitlis & Sonenshein, 2010, p. 559) strategic change (Gioia & Chittipeddi, 1991) or on middle managers (Balogun, 2003; Rouleau & Balogun, 2011). Sensemaking is suggested to be an essential activity in organisations (Maitlis & Cristiansson, 2014) regarding strategic change, decision-making (Gioia & Thomas,1996; Sonenshein & Dolakia, 2012), innovation and creativity (Drazin et al., 1999; Hill & Levenhagen, 1995), or organisational learning (Calvard, 2016; Gephart,1993; Weick, 1995).

Strategising, designing and sensemaking can be understood as one phenomenon. In this view, strategising supported by design is an ongoing search for cues that are meaningful enough for actors to change course and, at times, challenge an existing strategy or clarify its content (Pääkkönen et al., 2019.) In strategic sensemaking, by being in a constant state of becoming and evolving in an iterative fashion, designers may enable participants in reframing (Dorst, 2015; van der Bijl-Brouwer & Dorst, 2017) strategic issues. According to Gadamer (1970), the actors are supported in broadening their horizons by understanding the world through conversation that may transform the viewpoints of those involved. Actors in design-driven organisations are embedded in languages that suggest or pass on cues and frames.

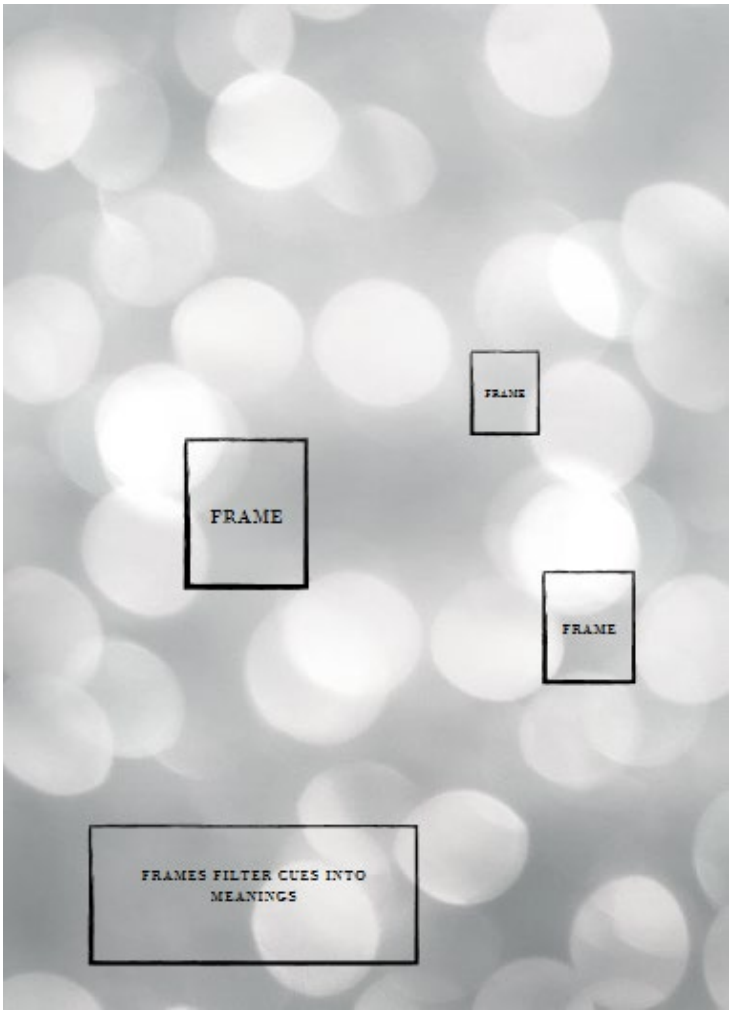

Figure 1 *In the design space, numerous cues are available. Selected cues are filtered into meanings through frames. Languages suggest frames. (Copyright: Pääkkönen, 2020).*

Individuals seek to understand unexpected or confusing events (Maitlis & Cristiansson, 2014). In their search for meaning and meaningfulness, strategising takes the collective form that the actors in the design space try to understand while simultaneously creating it (cf. Maitlis & Cristiansson, 2014; Pääkkönen et al., 2019). *This article suggests that cues are filtered through individual and collective frames (Goffman, 1974) evolving into meanings (cf. Benford & Snow, 2000, p. 614) not only through concepts but additionally through denormalising design languages*. Thus, the research was directed to answering the following questions:

> RQ1: What are the kinds of language used by design managers when they discuss their work in the context of Silicon Valley-based design-driven organisations?
>
> RQ2: How might languages affect the selection of cues and frames and their interpretation in the design space of sensemaking?

The sensemaking of the design managers is entwined with that of the organisation and other

actors in the broader context, *the design space*. Various entangled in-betweens (Ventres, 2016) are suggested as being integral to the forming of the design space where languages emerge. These in-betweens are areas of sensemaking where designers interact with strategic, organisational or user-related issues, society and ecosystem concerns and other challenges. A critical perspective (Burrell & Morgan, 1980; cf. Johansson & Woodilla, 2017, pp. 461–479) is suggested.

2. Methodology and philosophical considerations

This interdisciplinary article used Weick´s (2005) sensemaking perspectives for studying the languages and frames amongst designers through critical reflection (Burrell & Morgan, 1980; cf. Constantinides et al., 2012) and hermeneutic interpretation (Tomkins & Eatough, 2018).

An ontology of becoming (Hernes, 2014; Tsoukas & Chia, 2002) is enacted in practice. Sensemaking processes are ongoing and, at least, partly anchored in material settings (Bakke & Bean, 2006, p. 1). Sensemaking, designing and strategising are jointly enacted through material–linguistic entanglements and conversations in organisational becoming.

For Gadamer, 'language leads its tension-filled life in an antagonism between conventionality and revolutionary awakening´ (Gadamer, 1970/2006, pp. 18–19). However, Gadamer´s hermeneutic philosophy stresses the open and dynamic nature of horizons (Barthold, n.d.; Gadamer, 1992) in line with design principles to see reality as pliable.

The in-depth interviews (Johnson, 2002) were conducted during benchmarking visits to professional designers holding middle or senior managerial positions in Silicon Valley-based organisations (Table 1). Most of the participants worked with or within large technology-driven international manufacturers or design consultancies. The term 'design manager' or 'designer' refers to these participants who had 10 to 20 years of experience. Snowball sampling (Saunders & Townsend, 2018) was utilised through existing networks and partners who, in turn, provided access to sufficient relevant contacts in Silicon Valley. The anonymous participants were selected from organisations that had acknowledged a role for design in their innovation processes.

Table 1 Interviews from 2013 to 2016.

Code organisation field	**Position**	**Date**
C1 design consultancy	Design Manager	17.10.2013
C2 Design consultancy	Head of Operations	26.4.2016
	Lead Designer	26.4.2016
S1 Start-up healthcare	Service Design Lead	17.10.2013
S2 Start-up IT	Chief Design Officer	25.4.2016
IT1 Information technology	Senior Design Manager	26.4.2016
IT2a	Senior Design Manager	18.10.2013
IT2b	CEO	18.4.2016

IT3	Senior Design Researcher	28.4.2016
IT4a	Innovation Lead, Design Strategist	16.10.2013
IT4b	Principal XD Researcher	27.4.2016
IT5	Strategic Project Director	25.4.2016
IT6	Design Researcher	25.4.2016
IT7	Designer	23.6.2016
M Manufacturing	Innovation Manager	23.6.2016
E Education	Design Lead	02.05.2015
U UX analysis workshop, manufacturing	Head of UX Design	02.05.2015

Altogether, 16 interviews, including one analysis workshop, from 2013 and 2016 yielded 20 transcribed recordings (from 18 minutes to 1 hour and 41 minutes) covering various domains such as service, interaction, industrial, graphic, HCI, UX and experience design.

This article presents one cycle of sensemaking in an effort to understand how these designers working in Silicon Valley-based design-driven organisations made sense of their contextual industrial settings.

The hermeneutic analysis (Alvesson & Sköldberg, 2018; Tomkins & Eatough, 2018) focused on uncovering features and assumptions in the designers´ language for understanding their historically determined situatedness (Malpas, 2018, para. 3). The qualitative analysis (Berg, 2001) extracted normalising language conveying ideas behind critical success factors in business (see literature review by Saleh & Watson, 2017, pp. 710–711) and the historically developed strategy concept (Knights & Morgan, 1991). Denormalising language use was identified inductively by selecting words and phrases, as well as contexts, in which designers´ language differed from that of the business-as-usual frame. This led to the identification of material–linguistic features (4.1) and contextual verbal language (4.2.) in the participants´ denormalising language use, conveying assumptions and practices that differed from those of normalising language.

3. Theoretical framework: language in the design space

3.1 The design space of sensemaking

In the design space, sensemaking, language and materiality are not limited to specific design units, creative spaces or immersive labs. The material and cognitive are entangled and merge. The material and the embodied are embedded in the social and the cognitive (Pääkkönen et al., 2019). The design space expands the strategy-as-practice view concerned with 'the way that socio-material aspects such as tools, locations and spatial arrangements configure strategic interactions between bodies and things' (Balogun et al., 2014, p. 187; Jarzabkowski et al., 2013) as the design space is suggested to become the phenomenon itself where strategising, designing and sensemaking unfold through languages. Interacting with

the world, 'making sense of a world' through conversation and collaboration, moves towards action (Pangaro, 2016) becoming that which is made sense of (Weick, 2011). The frame of an organisation or ecosystem is thus opened for reflection.

The world forms the material that the designer uses in making sense of alternatives. Be it concrete facilities or digital experiences, the design space offers material–linguistic pliability, with cues flowing around and available for elaboration of frames. Also, from an interactive system viewpoint, first-order cybernetics evolves through recursion, learning and co-evolution (Glanville, 2014, as cited in Dubberly & Pangaro, 2015). Yet, designing requires second-order cybernetics which involves awareness and conversation on frames (Dubberly & Pangaro, 2015) and ethics (Chan, 2018) while language conveys beliefs and values.

From a critical viewpoint (cf. Johansson & Woodilla, 2017; Kimbell, 2011), the language of goals implies collective justification (Weick, 2011, p. 7). This is of importance regarding consequences or unintended harm (Vargo et al., 2017) for people or environments resulting from underlying strategic assumptions. Rittel, amongst the first, framed design as politics—as discussion and argumentation (Dubberly & Pangaroo, 2015; Rittel & Webber, 1973).

Ventres (2016) suggested the concept of a space-in-between as a way to notice co-occurring, paradoxical truths: '… a creative construction in which differences are honoured while being explored for meaning. There is a genuine willingness to understand rather than a need to be "right" about polarized issues' (p. 345). In their in-betweenness in the design space, designers try to understand other actors' contextual frames while seeking their own, balancing between frame adoption and frame extension.

3.2 Normalising and denormalising language in the design space

The design space entails uncountable contextual frames and cues. Weick (1995, pp. 106–111) referred to minimal sensible structures. People pull words from diverse sources, such as society, organization, occupation or experiences to make sense. Frames and cues are vocabularies in which more abstract words (frames) include and point to less abstract words (cues) that become sensible in the context created by the more inclusive words (p. 110). According to Weick, the substance of sensemaking is based on a cue, a frame and a connection between them, thus causing meanings to be relational and momentary. Language and materiality merge in framing and reframing strategic issues through *normalising and denormalising languages*. These languages which shape sensemaking can broadly be considered as languages either *normalising or denormalising* current understandings. Buchanan's (2015) description illustrates a design perspective on *denormalising*:

> "The principle of design that stands behind the organizational culture reform movement in which design thinking is central is grounded in the quality of experience for all of those served by the organization. This includes the individuals who directly use the products and services of the organization, but it also includes those who are affected by the internal and external operations of the organization and by those in society at large who are ultimately affected by the vision and strategies of the organization. The search for such a principle is a dialectical task." (Buchanan, 2015, p. 17)

In contrast, systemic power offers a view on more *normalising language*. Systemic power is present indirectly and over longer periods of time, easily remaining unnoticed in sensemaking (Schildt et al.,2019). Organisations reproduce the beliefs and institutional practices of the societies in which they are embedded (Tsoukas & Dooley, 2011, p. 731). The language of strategy may thus be present in the design space as normal and taken-for-granted. However, power might be ubiquitous and difficult to notice (Fleming & Spicer, 2014). To discuss strategy-related issues designers might be drawn towards more traditional management assumptions in which strategy is given rather than created. Strategic discourse (Knights & Morgan, 1991) forms the normalised context for proponents *and* opponents of issues related to available vocabulary, such as *competitive advantage* or *value,* easily neglecting potential harmful consequences. Past irresponsibility may be forgotten, as well (Mena et al., 2016, p. 720). Such existing frames limit or enable sensemaking through languages that may influence interpretations. Possibilities emerge within the limitations of the assumed frame. In Weickian terms (1995, p.115) premises as suppositions made early in the sensemaking process may powerfully control subsequent steps.

Normalising language is exemplified in business language by such terms as critical success factors (see Saleh & Watson, 2017, pp. 710–711) or historical strategic concepts (Knights & Morgan, 1991). At times, the languages of design and business merge. However, when people 'agree' on a paradigm, they are more likely to agree on its existence than on its rules and rationalised form (Weick, 1995, p. 120; quotation marks original). Vague concepts, such as value, allow the participants to seemingly agree and proceed, without the need to be too specific (Majchrzak et al., 2011). The risk is that difficult questions, such as those involving sustainability, may become neglected. Collective justification is social and tied to the actors' frames; as Gadamer noted:

> 'Understanding and interpretation thus always occurs from within a particular "horizon" that is determined by our historically-determined situatedness. Understanding is not, however, imprisoned within the horizon of its situation—indeed, the horizon of understanding is neither static nor unchanging' (Malpas, 2018, para. 3.2)

Gadamer expanded this as follows:

> 'Only in the process of speaking, as we speak further, as we build up the fabric of a linguistic context, do we come to fix the meanings in the moments of meaning of our speaking, only in this way do we mutually agree on what we mean'. (Gadamer, 1970/2006, p. 25)

Strategic concepts develop into new meanings in different contexts despite the illusion of a shared concept (Seidel, 2007). Designers with numerous others enable this conversation towards action (Dubberly & Pangaro, 2015) as part of organisational becoming.

3.3 Material–linguistic elaborations in the design space

The language of design is often intertwined with design approaches and materials beyond verbal expressions. Design languages are rich, produced in situations where design facilitates dialogical interaction (cf. Tsoukas & Dooley, 2011) and the inclusion of participants with

social, material and embodied means. It is a productive language open for interpretations and modifications based on iteration. It is potentially powerful in involving people with their bodies, senses and minds that all work towards more intensive participation than with verbal means such as routine meetings with bullet points and speeches.

In designers' strategic contexts, 'materialization of cognitive work' facilitates the transition from individual to collective prospective sensemaking (Stigliani & Ravasi, 2012, p. 5). Majchrzak et al. (2011, p. 5) suggested that rapid co-creating of temporary 'scaffolds' allows tensions between team members to emerge, claiming that 'collective enthusiasm rather than logical argument' and knowing through action invoke collective sensemaking.

Designers might influence framing contexts by adopting surprising ways of acting. When stakeholders are surprised, sensemaking is triggered (Maitlis & Cristianson, 2014; Weick, 1995). Gadamer (1970/2006, p. 14) agreed: 'So, all efforts at trying to understand something begin when one comes up against something that is strange, challenging, disorienting'. A common situated language develops when people seek understanding. Yet, Gadamer argued, human beings are played by the ritual structures of the past (Malpas, 2018).

When designers use both their verbal and specific material–linguistic approaches they remain embedded in the evolving design space in which actors seek to articulate strategic issues through collective sensemaking (cf. Weick, 2011). However, ethical consideration is part of designing (Sweeting, 2018), and power may serve socially progressive ends (Fleming, & Spicer, 2014, p. 38), diverse interests and strategic beliefs. Conventional strategies seeking the status quo (Burrell & Morgan, 1980) meet with design aiming at change (Buchanan, 2015).

4. Design languages in Silicon Valley

The language use of designers in Silicon Valley is discussed through material–linguistic features (4.1.) and through denormalising and normalising verbal language use in the design space (4.2.).

4.1 Three material–linguistic features in the language used by designers

The designers used material–linguistic elaborations for sensemaking by involving diverse stakeholders. Beyond the verbal means, the language that the Silicon Valley designers drew on may be characterised by three features: *embodiment and materiality, social interaction* and *enthusiasm.*

Embodiment and materiality occurred by inviting participants, for example, to use their hands, or boundary objects (Carlile, 2002; Hargadon & Sutton, 1997), rapidly co-created (cf. Sanders & Stappers, 2014) for provisional understandings or experiential learning (cf. Elsbach & Stigliani, 2018). Specific spaces were built and modified, and camps for employees were organised. One participant explained this effort:

> And I think the company's getting more used to doing some more user experience and actual

> service design execution, so I want them to do more of this prototyping and also some bodystorming and things like that. I think when we open up the design centre, we'll have more opportunities to do that. (Participant IT2a, 2013)

Materials might encourage playfulness, crafting and improvising for articulation and reflection. However, much is dependent on the way such events become framed. The strategy frame as usual might entail different premises (Weick, 1995) than an open frame:

> So, what a probe is? It's not a prototype, it's before a prototype… They're very low-fidelity… by making and playing with these probes is when we begin to interact with these participants. (Participant IT6, 2016)

Design is social and interactive, yet aiming at empowerment or transformation.

> We've always had a philosophy about teaching these new skills, that it needs to be experiential. It needs to be immersive. You need to have gone through the experience in order to be transformed. (Participant IT4a, 2013)

Most of all, one would get the impression that the designers in Silicon Valley enjoy ´*the golden era of design*´ (Participant S2, 2016). Transformation relates to design becoming adopted by the organisation:

> They spent two years trying to develop the organisation to adopt design, so that it would be the air you breath in. (Participant IT4b, 2016)

> So, then they let go of the idea of design thinking needing to be a process. There are just principles you can use anywhere. And, these three ideas were the key; empathy, …quick prototyping… go broad, go narrow is the third part of it. (Participant IT4b, 2016)

The interviews confirmed the impression of designers' optimism (Brown, 2009; Desmet & Pohlmeyer, 2013; Michlewski, 2008) and enthusiasm. However, empathy (Haag & Marsden, 2019; Holmlid et al., 2015) seemed to focus on users and (business) stakeholders. At times, the designers paid attention to the work conditions of the employees:

> So it's like integrating for making the building work for all the employees as well. (Participant IT2a, 2013)

By taking different stances and reframing (Dorst, 2015; Paton & Dorst, 2011) designers may exercise power by filtering frames and cues, even unconsciously. Design languages stretch beyond dialogical or virtual communication (Baralou, & Tsoukas, 2015) strengthened by material–linguistic means that may filter or direct attention. However, all organisational actors may protect occupational or career interests; even identities can be at stake (Carlile, 2002, p. 446, 2004, p. 556; Orr, 1996). What was specific to the designers in Silicon Valley was the mandate they felt for design, built over decades of business–design cooperation in the area (cf. Katz, 2015) supporting the design community.

4.2 Normalising and denormalising verbal language in the design space

The design space entails material–linguistic entanglements in various contextual in-betweens. Five in-between contexts in verbal language were identified in the interviews

regarding the hermeneutic interpretation of different languages and the assumptions behind them.

Strategic language in general

The designers had adopted conventional strategic language in general. They tended to be involved in framing the organisation's strategic future, mediating between a pre-existing strategic frame and potential reframing. Yet, when explaining their ideas, the designers referred to normalised business concepts. Despite the urge to transform and reframe strategies, their verbal language repeated the assumptions behind critical success factors that aim at surviving competition by enhancing competitiveness, value, the bottom line and similar factors:

> The innovation outcome is more efficient as it influences the financial bottom line of the company directly. (Participant M, 2016)

Broader consequences of strategies for environment or society remained largely opaque. Visualisations and storytelling served rather as communication methods for a set strategy. While multiple methods were mentioned, the strategic frame remained largely intact. Some designers explained they had learned business language so they would be able to work professionally. Core beliefs of organisational strategies were not directly challenged; rather, they were concretised or discovered. Sensemaking through material–linguistic elaborations thus crafts and ´´talks events and organizations into existence´´ (Weick et al., 2005, p. 413). Yet, normalising language and frames (cf. Knights & Morgan, 1991) were common:

> The market is full of potential, and users might be about the same time looking at competitive landscapes. So what are your competitors doing and how can you gain an advantage? And what are your current advantages and how can we make use of that? (Participant IT6, 2016)

> Competitors around and losing market share is often the starting point… and then they have heard somewhere: 'Oh, design thinking, you get some kind of innovations with that. Let´s try that'. (Participant S2, 2016)

Thus, normalising language maintains the status quo supporting frames that are believed to be professional, appropriate or justified.

Organisational language

The design managers found themselves between siloed functions. Their in-betweenness meant crossing cultural, functional or other domains such as navigating and orchestrating amongst diverse groups (engineering, management, various stakeholders and customer-users) for an enhanced understanding of the issues at hand. Interdisciplinary teams were viewed as a source of innovation rather due to than despite the tensions that such diversity may cause. This cross-functional fluidity depicts designers as middle managers forming the 'hub through which most strategic information flows' (Floyd & Lane, 2000, p. 164). Beyond business or engineering language, the designers used denormalising language towards change by speaking about breaking silos, teaching design, enhancing employee experience or:

> …transforming the language, mindset and the mission to include passion. (Participant S2, 2016)

Some designers stressed management support and worked closely with their boards. Their offices were located next to the board members' offices. In this way, organisational power then supported the designers' identities (cf. Knights and Morgan, 1991).

> Designers who can speak to designers, but also to directors in the wardrooms, they are sought after. The terminology is quite different out there, I mean. (Participant IT4b, 2016)

At other times, the designer can face difficulties, being the only designer:

> There you are, with the board, on your own. (Participant S2, 2016)

According to Beck and Plowman (2009), as middle managers, designers mediate between the managerial and other frames and may enrich the interpretations due to their proximity to the interpretations of both strategic and frontline managers. Some designers mentioned enlightened managers. Teaching others about design tools served as a catalyst for embedding cultural change in the organisation:

> Big projects are cultural change projects; there are design outcomes, but quite often it is the way you act. (Participant S2, 2016)

One might interpret transformation by design either as increasing participation (cf. Sanders & Stappers, 2008; Elsbach & Stigliani, 2018) or as a means of managerial regulation (Burrell & Morgan, 1980); often, it was noted by participants, the transformation was initiated within a high level of hierarchy.

User-related language

The designers often felt connected with users with a genuine desire to improve their lives. A consultant redesigned employee spaces for an industrial client:

> …canteens, reception …it´s like a nice hotel now. (Participant C2, 2016)

> ...you iterate with people …probes …storytelling. (Participant M, 2016; Participant U, 2015)

Business and design languages merge in vague concepts such as value. However, business value differs from user value. Many designers referred to people or human beings, rather than customers, as profit factors. Some mentioned storytelling around the brand being improved through design. Everyday lives of consumers or digital traces were explored for *customer insights* (Participant IT4b, 2016), for example through *journey maps* (Participant IT6, 2016; Participant IT2a, 2013) or *touchpoints* (Participant IT6, 2016; Participant IT2a, 2013). While, for example, brands suggested values and behaviours, one might have expected more reflection on the use of customer data or storytelling. Customer experience as a business concept was adopted (cf. Saleh & Watson, 2017) rather than doubting whether pleasure would lead to enhanced quality of life (cf. Desmet & Pohlmeyer, 2013; Sanders & Stappers, 2008).

Technology-related language

It was noted that, while transcending complex material–cognitive spaces, the designers needed to simplify and orchestrate both customer interactions and backstage services.

> …we use these digital traces …every single product we use, there's analytics. *(Participant IT3, 2016)*

At times, this entailed human aspects more than hardware and software:

> It's more for like innovating social relationships of people, not about technology or engineering. (Participant IT7, 2016)

A *seamless fit* emerged when the core company brought in technology and aligned this with other aspects of the final offering. Users' lives were eagerly traced through technology:

> We analyse that person's tweets and social media, and because we have their e-mail address, we can link it to other social media. (Participant IT5, 2016)

Yet, framing and justification of choices and the responsibilities following them (cf. Dubberly & Pangaro, 2015) were not discussed.

Ecosystem and society-related language

Designers navigated in the design space of organisations, networks and social actors. Some looked beyond their own industry for extracting new cues.

> …your product stays in a kind of an ecosystem, so you have to understand the whole ecosystem…. (Participant IT1, 2016)

Participants believed that orchestration of the whole process with stakeholders was needed. Normalising language largely prevailed assuming that a business ecosystem was separated from consequences elsewhere. Stakeholders were often business clients, sometimes end-users.

The designers' language throughout the interviews related to material–linguistic elaboration methods. Critical success factors formed part of the verbal language the designers had adopted. The underlying core ideas of strategic frames were seldom questioned or reframed (cf. van der Bijl-Brouwer & Dorst, 2017). Surprisingly, ethics, a critical success factor in business (Saleh & Watson, 2017) was barely mentioned. On the other hand, concepts such as experimentation and creativity, which were often mentioned, had become part of business vocabularies.

5. Discussion on the in-betweenness of design languages

The sensemaking processes of designers entailed traits of using normalising and denormalising language that supported *frame adoption* or *frame extension* (cf. Dorst, 2015; van der Bijl-Brouwer & Dorst, 2017). In frame adoption, core assumptions behind strategies remain easily unchanged even when design methods are used.

Normalising language prevailed when strategic language in general was adopted: business vocabularies were learned by some designers consciously. To advance the conversation, the designers partly adopted the languages of those they encountered. However, potentially harmful consequences were barely mentioned.

Denormalising verbal design language appeared more clearly in organisational contexts. User or employee insights offered new perspectives. In respect to technology-related issues, social interaction enabled by technology was the focus for a seamless fit, without prejudice. Yet, designing systems requires the framing of wicked problems (Rittel & Webber, 1973), a conversation on values and the responsibility to justify them, thus including subjectivity and second-order cybernetics. Second-order cybernetics, or understanding frames, requires conversation (cf. Gadamer, 1970/2006) for learning together (Dubberly & Pangaro, 2015; Krippendorff, 2007).

Variation in the designers' language use was natural due to their occupational in-betweenness. The design principles (Buchanan, 2015; Fayard et al., 2017) guiding the designers include empathy (Suri, 2000), ethics (Chan, 2018; Sweeting, 2018) and designing for human flourishing or sustainability (cf. Desmet & Pohlmeyer, 2013). The relative silence around values and ethics was therefore surprising. The designers barely mentioned the harmful consequences for the natural environment or issues such as user data transparency (cf. Betzing et al., 2019; Introna, 2007, pp. 22–23; Introna & Pouloudi, 1999) or doubtful consequences of digitalisation (cf. Morley et al., 2018; WEEE forum, 2017). Instead, there was enthusiasm (cf. Majchrzak et al., 2011) about the possibilities of design. However, questions about the consequences of automation and AI would have required more serious debate (cf. Dubberly & Pangaro, 2019).

Limitations admittedly apply to the interviews and the authors' interpretation. However, design management literature has tended to follow functionalist perspectives (Johansson & Woodilla, 2017) with innovation being the driving force. Seeking pleasure through consumption (Sanders & Stappers, 2008) is not what the aim of design has been (Buchanan, 2015).

One might expect more conversation on the taken-for-granted business ideas. For example, exposing children to branding stories requires criticality (Gunter, 2016; Jordan, 2004, p. 477). The concept of value reflects a business-as-usual perspective where users turn into profits and digitalisation becomes a cost-cutting measure. In a business-as-usual frame, genuine radical innovations are hardly likely. Sensemaking enabled by design facilitation risks reproducing (Knights & Morgan, 1991) the prevailing order. However, understood as an ongoing conversation, design and ethics can inform each other (Pangaro, 2017; Sweeting, 2018). Designers may create possibilities for others to have conversations, to learn and to act, while being explicit about values (Dubberly & Pangaro, 2015).

Designers have gained some power in strategising. As co-strategists, they might receive support from top management for critical reflection on consequences. Designers embedded in historically situated frames remain limited in the very sensemaking that is required for

change. There have been signs of denormalising language where designers have managed to broaden not only their own but some existing frames (cf. Baldassarre & al., 2017; Bocken et al., 2014). Gaining legitimation has been suggested to be about talking new ideas and interests into being (Vaara & Tienari, 2011). Designers additionally have material–linguistic strengths. By using design languages in micro sensemaking events, designers could select cues to concretise harmful consequences at early stages. They might initiate more critical reflection on strategic frames and, by doing so, broaden horizons.

6. Conclusions

This article focuses on design languages in design managers' strategising contexts. *Normalising and denormalising language*s were found to influence strategising through actors' selective noticing and elaboration of cues and frames. Designers may act as supporters and challengers of evolving strategies while mediating between *frame adoption and frame extension*. At times, the design managers seemed to pass on strategic concepts, thus reproducing historically developed strategic frames. Ethical issues or consequences of design were rarely discussed.

Denormalising design languages entail the possibilities for triggering sensemaking and reframing through material–linguistic elaborations and inclusion, as well as by encouraging empowerment or critical conversation on issues such as unintended harm, environmental consequences or design transparency. However, conventional strategic assumptions may prevent fully exploring broader meanings such as those for the environment or greater good. This article contributes to sensemaking and strategy research from a design perspective.

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Mutuality and reciprocity: foregrounding relationships in Design and Social Innovation

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Abstract: Although the importance of interpersonal relationships to processes of design and social innovation (D&SI) has been acknowledged, there is limited research in identifying what constitutes a relational approach in D&SI. In spite of their importance for relationship formation and maintenance, questions of respect, reciprocity, power and trust –and their intersection with various cultural practices– are often left untouched in design discourse. This paper reports early findings from interviews with design and social innovation practitioners in the Asia Pacific region, detailing the significance of putting relationships first, establishing mutuality and building reciprocity. The paper contributes insights into how practitioners perceive relationships as both meaningful and essential and suggest areas for further research to develop a more nuanced understanding of relationships in D&SI.

Keywords: design and social innovation; relationships; mutuality; reciprocity

1. Design and social innovation: a relational practice

Social innovation processes can be described as starting with a more or less serendipitous emergence of actors who share common or relatable issues; these actors go through the negotiation or definition of shared goals, elaborate ideas and solutions, and eventually implement and systematise them (Zapf, 1991; Mumford, 2002; Mulgan, 2007; Heiskala & Hämäläinen, 2007; Pol & Ville, 2008; Franz, Hochgerner, & Howaldt, 2012; Manzini, 2015; Akama & Yee, 2016). Often, the resulting innovation is not a material object, but a social interaction or practice (Choi & Majumdar, 2015). Therefore, social innovation creates new relationships (Mulgan, 2007) but also stems from relationships: relationships can be considered both the precondition and the result of social innovation.

In this context, designers can "play a strong and relevant, even leading role" (Manzini & Rizzo, 2011, p. 202) triggering new collaborations, facilitating conversations, strategically connecting local initiatives and people. Recent literature suggests that the formation of

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relationships is a phenomenon that professional designers embed in the design process and is therefore within their agency and responsibility (Dindler & Iversen, 2014, p. 43); however, the processes through which relationships are built in design projects are not always made explicit in research accounts. A large part of the work aimed at forming, nurturing and consolidating relationships is done in the "backstage" of the design process (Dindler & Iversen, 2014) in the form of one-to-one conversations, asynchronous work such as email or text message exchange, and even personal reflection; these activities are usually considered a by-product of design compared to "front stage" activities such as workshops or presentations, but they are a fundamental element of relationship formation in a design context.

Current explanations of how people come together to initiate and sustain social innovation processes – particularly the definition of "collaborative organisations" offered by Manzini (2015, p. 83), with its emphasis on independence and free will to join and leave the process – resonate with Western ways of thinking but do not offer an account of the value of intimate, interdependent relationships in design and social innovation (Akama & Yee, 2016). The literature foregrounding relationality in design and social innovation (D&SI) often comes from a non-Western or Global South context. For example, Akama and Yee (2016) invoke the framework proposed by Kasulis (2002) to explain traditional design's tendency to present itself as objective and universally adaptable. In his book Intimacy or Integrity, Kasulis presents two fundamentally different ways of relating: although a society is rarely "culturally monolithic", it may have a mainstream system of thought that values intimacy over integrity, or vice versa (Kasulis 2002, p.17). The integrity orientation poses an emphasis on public objectivity, independence and external relations, while the intimacy orientation tends to favour belong-togetherness, interdependence and internal relations. In an integrity paradigm, knowledge (including design knowledge) is viewed as independent from context, universal, and transferrable. The knower is assumed as separate from the design knowledge, with models and tools as a bridge between them. An intimacy paradigm, on the other hand, perceives knowledge as embodied, inseparable from its context, and only transferrable through relationships and situated practice. However, it is unclear what these terms actually mean in the lived experience of people working in D&SI projects, and what their significance would be for designers in the development of a relational approach to D&SI.

This paper aims to elaborate on aspects of relationships as discussed by design and social innovation practitioners in Asia Pacific. It describes the preliminary findings of an exploratory qualitative study, conducted as part of a PhD study which aims to explore what role relationships and relationality have within D&SI. The paper reports on early thematic analysis of interviews with 12 practitioners who detail the significance of putting relationships first, establishing mutuality and building reciprocity. These themes describe important features of professional design practice focused on social impact and change that are rarely discussed in D&SI literature. The paper contributes further insights into how design practitioners perceive relationships as both meaningful and essential to the work of design and social innovation and suggests how future work can build on these perspectives.

2. Relationships, design and social innovation

2.1 Defining relationships

Since current literature directly relevant to relationships in design and social innovation is scarce, the study draws from research in other fields such as Relationship Science (Berscheid, 1999), Leader-Member Exchange (LMX; Graen & Uhl-Bien, 1995), Employee-Organisation Relationship (EOR; Shore et al., 2004), and research on social networks and social capital (Claridge, 2018; Granovetter, 1973) to identify the different factors at play in building and maintaining work relationships. The research focuses on dyadic relationships (those happening between two individuals) which are considered the "key element or building block of groups" and "represent key components of social networks" (Liden, Anand, & Vidyarthi, 2016, p. 140).

Ferris et al. (2009) offer a review of the literature and propose an integrative model of work relationships. The authors describe initial interactions as characterised by instrumentality. The quality of the relationship depends on the expectation that each participant in the dyad holds and might be influenced by each participant's interest in establishing or maintaining an important role within the organisation. Trust, respect, affect and support play an important part in forming a judgement about the other participant (Pratt & Dirks, 2007; Graen & Uhl Bien, 1995 as cited in Ferris et al., 2009). The relationship can remain 'low-quality' and instrumental, or it can evolve so that participants start to see it not as a means to an end, but as an end in itself (Cropanzano & Mitchell, 2005 as cited in Ferris et al., 2009). Flexibility is required to handle incompatibility and disagreement, with each participant needing to show the ability to compromise and negotiate (Ferris et al., 2009). As the reciprocal commitment grows, the need to maintain a shared relational identity increases, with loyalty, commitment and accountability playing a key role (Sluss & Ashforth, 2007). Other elements characterising relationships are the passing of time; physical and psychological distance; reputation; and dissolution or redefinition of the relationship.

2.2 Cultural plurality in relational D&SI

Processes of design and social innovation are centred upon creating dialogue and surfacing the perspectives of a heterogenous group of people with varying relationships, with the goal of enhancing its capacity to act. However, some scholars doubt that traditional design education and training stimulate the designers' awareness of questions such as power, decision making, responsibility and reciprocity, which are central to relationship formation and maintenance within and outside of design processes (Akama, Hagen, & Whaanga-Schollum, 2019). Exploring relational approaches to D&SI requires welcoming the idea that people – design professionals, laymen, communities – engage in design activity in a plurality of ways that cannot be disentangled from their social, cultural, economic and physical context. The plurality of ways of understanding and doing design is increasingly discussed in academia, as demonstrated by the rising numbers of books, papers and conferences on the matter. For example, the Design Research Society (DRS) has introduced a Pluriversal Design

Special Interest Group which aspires to a "'re-orientation' of design to incorporate multiple perspectives and views and a focus on multiple ways of doing and understanding design" (DRS, n.d.); the discourse around design "decolonization" is surfacing often marginalised design practices from non-Western cultures (see for example the work by the Decolonising Design Group, 2016; Tunstall, 2013; Akama and Yee, 2016; some academics and practitioners are problematizing aspects of design that are normally taken for granted and foregrounding respect, reciprocity and relationality over, for example, replicability (Akama, Hagen & Whaanga-Schollum, 2019), while others urge us to embrace plurality as "grounded, situated, self-reflexive and ever evolving" (Light, 2019, p. 4).

3. Methodology

3.1 A note on positionality

We acknowledge that reflexivity is a key aspect of relational D&SI. As co-authors we identify as design practitioners and researchers with differing cultural experiences to bring to the inquiry. All three authors have been trained in fairly traditional Anglo-European art and design education and we acknowledge our educational and professional background will therefore influence our approach and critical lens we bring to the research. Therefore, we feel it is important for us to a) to provide a brief account of our background and our practices and b) to reflect on how we critically engage with accounts that come from non-western cultures. The first author, Viola has practiced predominately in Italy and in the UK, but spent 6 months working with an Indonesia-based organisation on a series of public space projects funded by the United Nations. It was this project that initially raised questions on the role of relationships in D&SI practice. Her unfamiliarity of the Indonesian language encouraged her instead to observe and notice how relationships between the project team and the different stakeholders (from villagers to high-ranking government officials) were initiated and nurtured throughout and beyond the project. These connections seemed to enable projects to happen, they sustained them, were cultivated long before the start of the projects and long after their completion. Similarly, the second and third authors also have extensive experience of investigating, observing and being part of cross-cultural design projects where relationships are considered to be vital. The second author, Joyce co-founded the Designing Social Innovation in Asia-Pacific (DESIAP) in response to a growing trend in the appropriation of 'universal' Anglo-centric design methods in different cultural contexts which may inadvertently dislodge indigenous practices and knowledge. Her attunement to cultural nuances and appropriation has been shaped by her background growing up in post-independence Malaysia, as an ethnic Chinese in a Muslim dominated country, and as an Asian woman living and working in a dominant group in the UK. The third author, Rachel has a background in participatory arts in refugee contexts predominantly in the UK. More recently she has been working with Arabic communities in Palestine and has established a network with international researchers working across the middle east and north Africa, exploring decolonizing participatory design practices in the context of indigenous place-

based knowledges.

Our professional experiences attests to designing as a deeply relational practice; however, the variety of frameworks, toolkits and models available to designers (e.g. Frogdesign, 2012; IDEO, 2015) made little to no mention of the complexity of relationships and of their intersections with D&SI. Therefore, we started to reflect on and explore the role of relationships through Viola's own practice, which has become a core focus of her PhD with support from Joyce and Rachel. Part of the reflexive practice process also includes drawing on experiences and examples from other D&SI practitioners working in different cultural contexts in order to enrich understandings of D&SI, while also using the variety of perspectives and cultural nuances to surface attitudes and values that may be assumed as universal in design discourse. The following section describes how these different experiences and perspectives were elicited and analysed.

3.2 Semi-structured interviews and analysis

The findings presented in this paper are initial results based on data collected during semi-structured interviews with 12 practitioners in 10 organisations from different countries in the Asia Pacific region. Participants were interviewed through a VOIP (voice over IP) call through Skype or Zoom, with each conversation lasting between 45 minutes and 1 hour and 30 minutes depending on the availability of the interviewee and on the time spent in introductions and informal chat. The conversations were loosely based on an interview guide that Viola shared with participants prior to the interview; after transcription, a Thematic Analysis approach was adopted to analyse the data and draw initial insights. At this stage of the research, we were focused on capturing practitioners' view on relationality in their practice that spoke to their experience. We did not assume that they had the right or permission to speak on behalf of the indigenous perspectives of the community that they work with.

3.3 Sampling strategy

The sampling of D&SI practitioners began with the construction of a database of potential contacts who could offer a non-Western perspective on design and social innovation. The selection was based on the following criteria:

- Expertise of the interviewee in the social innovation field;
- Perceived interest in the questions guiding this research;
- Likelihood that the interviewee would have an approach to their work that emphasises the importance of relationships;
- A position in the organisation to initiate and build relationships;
- Previous contact, or possibility of being introduced.

Through a partnership with the DESIAP network, we were able to access a database of contacts to whom we could be introduced and who could offer a non-Western perspective on design and social innovation. Most of the contacts were collected from this database,

with the exception of two people which was recruited from Viola's professional contacts. Participants work in different countries: Aotearoa New Zealand, Cambodia, Indonesia, Japan, Malaysia, Myanmar, Philippines, and Thailand. Below is the list of participants with their related role and context of work; their names were replaced with pseudonyms to preserve anonymity.

Table 1 List of participants.

Name (pseudonym)	**Professional role**	**Scope of organisation / project / activity**
Anne	Director of Philanthropy	Grant-making foundation
Thomas	Executive creative director	Design and branding studio working with social innovation initiatives
Gloria	Executive director	Social innovation project within an academic and research institution
Victor	Co-founder	Social enterprise incubator (1)
Carlo	Co-founder	Social enterprise incubator (2)
Rose	Venture support director	Social enterprise incubator (2)
Lamai	Co-founder	Social innovation design consultancy
Lucy	Co-design lead	Government-led project
Leon	Co-founder	Organisational design consultancy working with social innovation initiatives
Alba	Co-founder	Organisational design consultancy working with social innovation initiatives
Keiko	Co-founder and managing director	Company collaborating with government to create social innovation ecosystems
Somchai	University lecturer	Working on social innovation projects with students

3.4 Thematic Analysis

Since the goal of the research is to develop a deeper understanding of relational dynamics through rich descriptions and the exposure of taken-for-granted assumptions, a phenomenological approach to research (Spencer, Pryce, & Walsh, 2014) paired with Thematic Analysis seemed fitting. The "reflexive TA approach" proposed by Braun and Clarke (e.g. Braun & Clarke, 2006; Braun, Clarke, Hayfield, & Terry, 2019) was adopted. It conceptualises TA as a wholly qualitative approach that emphasises situated, contextual meaning, with the researcher having an active role in the production of meaning and knowledge. Initially, inductive coding was performed manually; after turning to the literature

to develop and refine the codes and the main concepts, a well-known qualitative data analysis software, Nvivo was used to sort the codes and explore particular themes.

4. Discussion: relationships come first

All participants identified relationships as central to their work. Three participants explicitly mentioned having a specific relationship-building mandate as part of their formal role in their organisation, while others described building relationships as a priority in their work. The approach to relationships varied, with some participants acknowledging an underlying goal to building relationships, such as opening up opportunities for collaboration or acquiring support and resources. Others foregrounded relationships and framed projects as their consequence: "It's like relationships come first. […] the outcome of what you do when you are together, that comes later" (Alba). In all cases, participants related a positive perception of relationships built before and during the project to an overall positive perception of the project activities and outcomes.

Different features of relationships were identified in the interviews, along with several strategies to build and maintain relationships, establish and expand networks of relationships, deal with challenges and overcome obstacles. In this brief space, two themes are identified as fundamental to describing positive, vibrant work relationships in the context of D&SI: establishing mutuality and building reciprocity.

4.1 Establishing mutuality

We define mutuality here as the extent of agreement between the dyadic parties about the nature of their relationship and its specific terms (Dabos & Rousseau, 2004)research directors were identified as primary agents for the university (employer. It implies a 'respective' relationship in which certain actions are performed by two people with respect to one another (Graumann, 1995). Mutuality was identified as an important concept that D&SI practitioners consistently described in their work; it is underpinned and enacted by and through core features of trust, role-taking and learning.

Mutual trust

Supporting the findings of previous research (Bratteteig, Bødker, Dittrich, Mogensen, & Simonsen, 2012; Clarke et al., 2019; Pirinen, 2016; Warwick, 2017), mutual trust among members of the same organisation and among project partners at all levels, from government to community, is considered valuable in collaborative design practice. In the participants' words, trust is "the core of everything we do" (Anne) and "[t]here should be a certain amount of trust before we even start the work" (Thomas). While trust building as described by participants relies on reciprocity and is therefore discussed in the next section, participants stressed the mutuality of trust in that they felt it "works both ways" (Anne): it has to be mutual to enable the construction of equal partnerships and allow transparency in communication and the open sharing of issues and problems. These elements generate a

positive feedback loop that reinforces mutual trust building over time.

Role-taking and mutual expectations

References to mutuality also highlighted anticipated obligations associated with role-taking and expectations of what each party would bring to the relationship. Showing consistency in fulfilling obligations and conforming to the other party's expectations was reported to increase trust: "there has to be, to a certain extent, predictability, which means you don't change all the time" (Thomas). However, practitioners discussed the need to balance and integrate different roles – and therefore different obligations and expectations – including being a trusted advisor, a facilitator of conversations and co-design activities, a critical friend and "thought partner" (Anne), a member of the community or an outsider, a connector with other people, with resources or knowledge, and a host of events. These informal roles were described as overlapping with more consistent, formal ones such as funder, design consultant, professor, trainer, or representative of local government.

Anne is a director of philanthropy, but her roles go well beyond distributing funds to different projects:

> "The money of course is vital, but it's much more about we then becoming a connector and actually often just a friend to have a glass of wine with and have someone to say 'Oh my gosh, I'm really struggling with this.'" (Anne)

While deep, trusting relationships can generate and sustain projects, failing to balance different roles can generate contrasting expectations or even conflict:

> "They invite me to join [a community event]. I cannot refuse that I am from uni[versity], I'm pretty well known in [country]. But I try to be my own individual representing my own [self]. I'm not trying to be like, "Okay, I'm the lecturer and I'm knowledgeable about this and I want these people to do this and that." (Somchai)

> "[A]t the beginning of the project, even though I try so hard to be friendly with everyone, to be close, connect to the one I think would be a good key informant for me, I need to be aware that maybe I need to keep some distance, because I come from outside anyway. If there are conflicts in the community and it seems that I am pro this guy, maybe I will not get any help from them. So that's why it's so hard for me to balance my roles in the communities." (Somchai)

Roles taken are also influenced by power dynamics where the ability of one party to have power over the other and exert some control over its behaviour, including imposing obligations, occurs (Fasli, 2006). Participants have reported experiencing power imbalances, particularly in teacher-learner or funder-grantee relationships or in interactions with members of disenfranchised communities. Trying to establish mutual relationships in D&SI can therefore challenge this dynamic. While assuming 'equal' agency and providing tools for participation without questioning the quality and nature of engagement can reproduce imbalanced power structures (Pierri, 2016), deconstructing power dynamics has its challenges, particularly in contexts and cultures where social hierarchy is firmly rooted in the society and open disagreement is undesirable (see for example Tjahja & Yee, 2017). One

participant from Thailand commented:

> "[I]n Thailand, because it's very relationships based, when someone disagrees, they wouldn't say it in the meeting […] you need to respect the elders. You can't say, you know, you can't really express how you feel."

Another participant, who is originally European and has worked in D&SI in Myanmar and Indonesia, offered a counterview:

> "[P]eople sometimes see you as this this person who knows some stuff and then they kind of more or less automatically trust you […] people just listen to you and don't question what you tell them […] This changes the dynamics of some relationships."

Consistently with Sluss & Ashworth (2007), the ways roles occupants enact their respective roles in regard to each other (i.e. 'relational identity') are fluid: they integrate personal qualities and role-based characteristics (including authority), and they are socially constructed through interaction, observation, negotiation, and feedback. A mutual understanding of respective roles facilitates the construction of a positive work relationship, but when the construction of a shared relational identity questions the role- and person-based identities that constitute it (for example by challenging one party's authority and the other party's submission to it), parties might resist the change and it might take longer for the relationship to transcend the bounds of the roles.

Mutual learning

Enabling mutual learning is one way to encourage the levelling of hierarchy and work towards achieving and maintaining equal partnerships. Two participants who have experience of working alongside Indigenous communities in Aotearoa New Zealand offer a compelling example of how equal partnerships can be created and maintained by following Indigenous cultural protocols that emphasise mutual respect and mutual learning. The process begins by finding common ground, building trust and exploring mutual consent to respectful collaboration:

> "The first thing you have to do with in Maori culture is whakawhanaungatanga, you have to get to know who's in the room […] you don't start the work until you've established who you are, where you come from and what your shared values are around".

> "A wānanga might look like a workshop, but it will be on marae, so it would be on a cultural site and you will follow in practice cultural protocols. So you have to be welcomed onto the site".

> "[It was] a whole ceremony, which took hours, of being invited, like enthusiastically and genuinely invited onto the land and given permission, given a sense of 'We claim authority on this land and we have some values and some ways of being that are crucial. And if you're willing to adhere to those ways of being, then you can consider yourself as entitled as any other local'".

After establishing mutual consent and aligning values, the design process continues with a pattern of mutual learning. The Maori term "ako" encapsulates the mutuality of the learning

process and the levelling of power: “[T]he design process from Maori lens is very much about ako. Ako means to teach and to learn at the same time. So it’s both”.

The concept of mutual learning as a way to equalise power relationships is often discussed as a motivation and an outcome of participatory design heritage (Kensing & Greenbaum, 2012, p. 21). In their work on Participatory Design and infrastructuring, Bødker et al. (2017) build on the work of Engeström (2007)their ideas had a widespread refreshing impact on studies of learning. Acquisition was replaced by participation as the key metaphor and mechanism of learning. Analysis was extended beyond the skin of the individual, to encompass the entire community involved in a given productive practice. Learning was shown to be an inevitable aspect of all productive practices, not a specific process mainly or exclusively limited to schools and other institutions of formal learning. Subsequently Wenger’s (1998 to describe “knotworks”, fluid assemblies of heterogenous participants working in “symbiotic agreement” through mutually beneficial or explorative partnerships. Knotworks, together with more stable “networks” of relationships, form the infrastructure of a project; relational agency, which is exerted by all stakeholders and dispersed among people and organisations, involves engaging with this infrastructure at various levels of authority, recognizing and respecting the resources and understandings that other people carry.

Indigenous perspectives on PD highlight the importance of “preserv[ing] difference, opposition and division in the knowledge that we all inhabit a living mutualism”(Sheehan, 2011, p. 69)my work in Aboriginal cultural contexts is situated among the most gifted and productive population of artists, storytellers, and performers. This creativity is amazing, considering that the life conditions of Aboriginal people in Australia are among the worst in the world. A conception of this disadvantage can be seen in the life expectancy of Aboriginal peoples living in Queensland, which is 20 years less than the Australian national average. At present, we are conducting design-based social and emotional well-being research projects with Aboriginal community groups in partnership with Link Up Queensland. 1 As an Indigenous Knowledge (IK. Indigenous knowledge applied to design foregrounds deep situational awareness, respect and care; through an openness to mutual learning, collective well-being can be pursued even from a plurality of positions. As one participant described it, it is about

> “focusing on the quality of the present moment and the lived experience of the subject of individuals that are in the space and like, how are they doing? What needs do they have? Can I adjust my posture in a way that meets their needs more effectively?”

Far from the heteronomy of universal, standardised design practice, Indigenous perspectives allow for autonomy (Escobar, 2017; Sheehan, 2011)my work in Aboriginal cultural contexts is situated among the most gifted and productive population of artists, storytellers, and performers. This creativity is amazing, considering that the life conditions of Aboriginal people in Australia are among the worst in the world. A conception of this disadvantage can be seen in the life expectancy of Aboriginal peoples living in Queensland, which is 20 years less than the Australian national average. At present, we are conducting design-based social and emotional well-being research projects with Aboriginal community groups in partnership

with Link Up Queensland. 1 As an Indigenous Knowledge (IK grounded in relational cultural practices and enabling communities to change the norms from within. The difficulties of Western conceptualisations of PD to fully adopt a relational paradigm (exemplified by the tendency to consider relationality as a skill designers bring to the project, rather than as a way of being) are, as notes one participant, "completely resolved within an Indigenous worldview, because those things [are] already settled". Another participant explicitly noted that this approach is key to studies focused on relationship in D&SI: "you've got a research question, and I think the answer is Indigenous approaches to design".

4.2 Building reciprocity

The term 'reciprocity' is used here to indicate what Sahlins and Graeber (1965, p. 147) call 'generalised reciprocity': a type of transaction in which one party commits an act of generosity by offering or sharing something (resources, help, hospitality) without expecting a direct, material return. While reciprocity does generate sense of counter-obligation, this is a 'diffuse' obligation to reciprocate when the donor will need it, and if the recipient will be able to reciprocate. The nature and amount of the reciprocation can also be very different from what was initially given.

As mentioned, mutual trust is an essential element to the construction of positive work relationships in D&SI. However, "it doesn't happen overnight" (Anne): time, care and patience are required to build the base for a solid relationship. Participants described different strategies they put in place to gradually build trusting relationships; many of them involved reciprocity or, as Lucy described it, "putting generosity into the system": contributions in the form of economic resources, knowledge, connections, time, emotional availability are made without expecting immediate reciprocation but in the hope that, one day, efforts will be reciprocated. Thomas eloquently describes this process:

> "[I]f you choose to be the one to trust, to take on the lead to trust certain people, they will trust you in return. I think there's a beauty of humanity that if you take the first step, I'm sure the other side, they will take some steps, maybe slower, but they will take the steps eventually. […] I always see the return. It may not come directly from the party who has benefited from your program, but it will come back, in some other time."

Carlo describes this process as being about "creating courage, […] the courage of really saying, 'Ok, look, we can do something together', right? So now I trust you, and I find the courage of putting it out there". This might require "model[ling]the same behaviours we look for in partners" (Anne) such as showing vulnerability, openly admitting mistakes, or being patient. From this initial demonstration of trust, the relationship is maintained by keeping in touch through text message, meeting up for coffee, offering continuous emotional support, being invited to and attending community events even outside of normal work days, and generally building a personal, more intimate relationship than what would happen in a work setting.

Often, reciprocity involves brokering a relationship with a third person, or welcoming the

other party within one's social network. Sharing a contact can be beneficial to a relationship: triads have been studied for decades, demonstrating that dyadic relationships are strengthened if both parties are linked to the same third person (Simmel, 1908/1950; Heider, 1958; Krackhardt & Kilduff, 2002), while more recent research uncovered the importance of social networks on dyadic relationships (Goodwin, Bowler, & Whittington, 2009; Sparrowe & Liden, 2005). Though the relationship is strengthened, Carlo explains that "in the majority of cases, [building relationships] would not be a direct benefit for our company, but it would be, could be, a potential benefit for the entrepreneurs we are supporting, so for the real social innovators." In Gloria's organisation, project partners are introduced through referrals and, for a project to be funded, its proponents must have strong pre-existing connections with the target beneficiaries and must be willing to grant open access to previous knowledge and work results.

Significant amounts of time and money can be put into the development of a work relationship: Anne's foundation distributes early stage grants to, "sort of crudely, [buy] time to build a stronger relationship and get to know each other better as people and organisations"; Lucy comments that, in situations where local government has repeatedly let down communities, "we don't expect there to be a readiness [for innovation] when there's been so much fracture. So we might have to sit in a pre-readiness phase with those communities for a couple of years before […] there is enough trust or enough stability in the chaos that you can start to work forward".

All this generosity is not selfless: many participants mentioned the need to understand that people have different motivations to enter a relationship and openly shared having a self-interest in relationships. All the reciprocity-based strategies, however, expose them to risks such as potential rejection, loss of face, loss of time or money. Sometimes the risk is of being hurt: "if there was a betrayal of that trust […] it would be a viscerally personal issue for the team" (Anne). One participant expressed frustration at the "years of maintenance" of relationships that do not lead to any "concrete output or outcome", while others mentioned the risk that the generosity would be taken advantage of, rather than recognised or reciprocated. Finally, some participants mentioned becoming "entangled" in relationships, having to maintain them beyond the end of a project or being held accountable in the long term for the behaviour of people they have introduced.

5. Conclusions

The participants stressed the importance of relationships to their work in D&SI and understood themselves as active agents in the creation and maintenance of relational bonds. The practices described by D&SI practitioners are deeply relational that involves collective sensemaking, dialogue, storytelling and knowledge-sharing and is embedded within various cultural practices (Akama, 2017; Akama & Yee, 2016; Escobar, 2017; Salazar & Borrero, 2017). Participants have described openness to others, being present, continuous alignment and attunement to the other's needs and values, a non-transactional approach to reciprocity,

and a focus on consent and consensus as elements to build a successful relationship. This suggests further research is needed to acknowledge the plurality of experiences of working in D&SI; and the use of suitable frameworks to notice and reveal the various dimensions relating to establishing mutuality and building reciprocity. For example, here it might be useful to refer to use Kasulis's (2002) framework to further observe mutuality and reciprocity through the lens of cultural practices foregrounding intimacy or integrity.

Our research has revealed that there is limited recognition of indigenous and non-western 'design' practice within accounts of D&SI, and yet this could be of value to invigorating relational understandings of design. It is therefore important to consider these accounts in a critically reflexive and nuanced understanding of positions, accounts and ways of being and operating in D&SI (Akama, Hagen & Whaanga, 2019). Our understanding of D&SI, and what we are able to see and hear however remains influenced by our histories and experiences, despite trying to be respectful of other ways of being in design that does not attempt to appropriate or take on or speak for others, particularly those who have had their cultures and practices denied in violent and oppressive ways. Our understanding and interpretation is therefore always going to be very different from those who have grown up with indigenous ways of being. Therefore, as researchers, we should be mindful of what it means to try and take on these ideas from indigenous cultures as transferrable to different contexts.

Insights from the participants experiences is being used to inform the next stage of the research. Viola will be seeking a deeper engagement with the practitioners and the communities they work through planned field work in order to observe first-hand how the guiding principles of mutuality and reciprocity are being enacted in order to further sensitise her practice in Italy to these elements.

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A framework for designing for divergent values

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Abstract: Designers increasingly collaborate with other actors to deliver designs that address diverse stakeholder needs. Such multidisciplinary design processes revolve around integrating various, often divergent values, including the ideals that collaborating actors have, and the different kinds of worth that they attempt to realize. As values are multidimensional and continuously in flux, the process of designing for divergent values requires conscious action. Existing theories of values and methods for integrating diverse, possibly competing values are still scattered across disciplines, leaving designers with little overview and handles for what they have to deal with. Synthesizing insights from workshops with architects and literature from a wide range of scholarly domains, this paper presents a first step towards an integrative framework that can help designers and design students to effectively discuss and reconcile divergent values in multidisciplinary settings.

Keywords: values; value co-creation; value framework; multidisciplinary collaboration

1. Introduction

To successfully co-create value for clients, users, government, society and other stakeholders, divergent values need to be integrated in the design process. On the one hand, a design needs to generate different kinds of worth to stakeholders who may have differing values (Boradkar, 2010). On the other hand, collaborating actors will bring various underlying ideals and motivations to the table that have to be reconciled (Bergema, Kleinsmann, & Valkenburg, 2011). Actors often refrain from identifying, explicating and discussing the values that play a role in their design process, or only focus on specific types of values, thereby overlooking others that may also be important (Van Onselen & Valkenburg, 2015). This may lead to tensions in the process or a result that is less desirable to certain stakeholders.

Designers could play an important role in opening up discussions about values, as they are able to analyse and visualize complex phenomena and processes, and connect different disciplines through their designs (e.g. Dorst, 2011; Manzini, 2009). Although designers are trained to operate in increasingly collaborative and multidisciplinary processes, and to

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design solutions that satisfy diverse stakeholder needs (Bergema, Valkenburg, Kleinsmann, & de Bont, 2012; Calabretta & Kleinsmann, 2017); they have limited knowledge and tools to oversee and handle the multiple, possibly competing values that underlie these design processes. An understanding of the plethora of divergent values that can play a role in multidisciplinary design processes can be highly beneficial to designers. It could assist them in opening up discussions about actors' values and motivations, to avoid or mitigate conflicts and collectively work towards a successful design process and end result from the perspective of all actors and stakeholders involved.

Existing research on how to design for values has either predominantly focused on the human values at stake, such as work on Value Sensitive Design (Friedman, Kahn, & Borning, 2013); or the worth that is co-created, such as in value-centred design (Cockton, 2006) and Bocken, Short, Rana, and Evans (2013)'s value mapping tool. Even though authors have argued that human values and worth are both present in design processes and continuously influence each other (e.g. Den Ouden, 2012), work that departs from and integrates multiple perspectives towards value into one overarching framework, such as the work of Den Ouden (2012), is rather complex and can be challenging to use in daily work settings or design education (Bocken et al., 2013).

In this paper, empirical insights from 24 workshops with architects and theory from different strands of literature are synthesized with the aim to provide a simple, integrative overview of values that designers can easily employ in their projects. The following research question was answered: Which types of value play a role in multidisciplinary design processes? The resulting framework distinguishes between 'values as guiding principles' and 'values as qualities with worth', and presents three degrees of value specificity. It raises awareness of and understanding for the different value perspectives and values that can play a role in multidisciplinary collaborations, thereby enabling designers and design students to become more receptive to potential value conflicts and opportunities for enhanced value creation.

2. Theoretical background

As Den Ouden pointed out in her book 'Innovation design: Creating Value for People, Organizations and Society' the term value is "widely used but barely understood" (2012, p. v). Definitions of value are numerous and differ across domains. While it is evident that differences between actors' perspectives on values exist, these differences are also quite often overlooked in a design process. Value is rarely explicitly discussed, or discussions are either very abstract or overly specific (Van de Poel, 2013). As a consequence, actors may think that they speak the same language and have the same goals, while they actually pursue different things. This can lead to submerged and sustained value conflicts that can quickly escalate when the collaboration process is subjected to a sudden change, such as the departure of one of the actors or a change in design requirements (Van Onselen & Valkenburg, 2015). To prevent this from happening, actors need to be aware of, and discuss the values that play a role in their collaborative design process.

According to literature, two core perspectives towards value can be distinguished: 1) considering value as guiding principles, and 2) considering value as qualities with worth. A detailed understanding of these two perspectives and how they relate to each other, can be instrumental for designers when working in multidisciplinary contexts, as both perspectives will be present and continuously influence each other. The two perspectives – which have also been described as 'values as ideals' versus 'values as worth' (Martinsuo, Klakegg, & van Marrewijk, 2019) or the plural form 'values' (i.e. ideals) versus the singular form 'value' (i.e. worth) (e.g. Boradkar, 2010) – are presented in more detail below. By adopting both perspectives towards value, this study aims to embrace the different perspectives with which one can look at the theoretical construct of value, rather than searching for consensus regarding its definition.

2.1 Considering values as guiding principles

A first core perspective towards value in a design process, is to consider the values of actors as guiding principles. Scholars of psychology (e.g. Rokeach, 1973; Schwartz & Bilsky, 1987), sociology (e.g. Williams Jr, 1968), anthropology (e.g. Kluckhohn, 1951) and philosophy (e.g. Griffin, 1986), use the notion of value to refer to the ideals that people have. They argue that values represent criteria or guiding principles that people use to evaluate and select their behaviour and give meaning to what they consider important in life (Cheng & Fleischmann, 2010; Friedman et al., 2013; Schwartz & Bilsky, 1987).

In their seminal work, Schwartz and Bilsky (1987) distinguished several motivationally distinct values that people use as guiding principles for their actions and activities, such as enjoyment, security, achievement, self-direction, social power and maturity. They used the term 'human values' to refer to these universal types of values, which stem from people's individual biological needs, the requirements for interaction with other people, and the needs of groups to survive and be well (Schwartz, 2006a; Schwartz & Bilsky, 1987).

Values that are used by people as guiding principles do not only stem from human needs, they can also originate in the social relations of individuals. 'Cultural values' are values that nations, regions, but also professions, organizations and teams may share, such as autonomy or embeddedness, egalitarianism or hierarchy, and harmony or mastery (Schwartz, 2006b). According to Schwartz, emphases on certain cultural values shape and justify the beliefs, actions and goals of individuals and groups, making them part of a certain culture. The fact that certain values share the same underlying assumptions, makes it easier to affirm and act on them simultaneously (Schwartz, 2006b).

Rokeach (1973) argued that human and cultural values can be categorized into two sets of values: 'terminal values' and 'instrumental values'. Terminal values are desired end-states that individuals or groups of people wish to achieve. Instrumental values are defined as the preferable modes of behaviour, or means to achieve a desired end-state (Rokeach, 1973).

2.2 Considering values as qualities with worth

In contrast to conceptualizing values as guiding principles, value can also be considered a certain quality with worth that is or could be realized by means of a design. Economists (e.g. Smith, 1776), management scholars (e.g. Bowman & Ambrosini, 2000; Laursen & Svejvig, 2016; Lepak, Smith, & Taylor, 2007; Vargo, Maglio, & Akaka, 2008); and certain design scholars (e.g. Boradkar, 2010; Den Ouden, 2012) view values as qualities inherent in objects, projects, or ideas that represent a certain amount of worth. Extending on classical works from economy and management, this worthiness can not only be monetary – which will be referred to in this paper as economic value – , but also non-monetary, including values such as use value, social value and ecological value. Worthiness is perceived differently by each individual, as people value different things. The common consensus nowadays is that this worthiness is also fluid. It is the effect of multiple, constantly changing factors in the interaction between diverse actors (Boradkar, 2010; Ramirez, 1999; Vargo, Akaka, & Vaughan, 2017).

'Economic value' is the worthiness of a certain product, service, or idea in monetary terms. Boztepe (2007) uses the similar term 'economy value' to refer to the economic benefits something has. Economists and management scholars often use the term 'exchange value' to refer to the price that a customer pays at the moment of exchange for a quality or set of qualities inherent in a purchased product or service (Bowman & Ambrosini, 2000). While these scholars specifically focus on the pursuit of monetary worth by commercial firms through the exchange of goods or services; economic value is also important at the individual level (i.e. pursuing a good salary), group and societal level.

The term 'use value' is employed by classical economists and strategic management scholars to refer to a customer's subjective perception of the qualities or utility that the activities, products or services of a firm generate (Bowman & Ambrosini, 2000). It has been widely acknowledged that this focus is too narrow to represent everyday reality, as use value is not only created for a customer (e.g. Vargo et al., 2008). Each design or design process may also represent qualities with worth for others, such as citizens, organizations, or society at large. It is important to acknowledge the broad range of values that underlie the concept of use value. By referring to perceived quality and utility, the use value of a design should not be seen as narrow as mere 'utility value' (i.e. being appropriate for a certain use), which is expressed in values such as functionality, convenience, efficiency or durability (Boztepe, 2007; Den Ouden, 2012; Ramirez, 1999). A design also results in benefits that can be derived from its quality. For example, it can contribute to well-being or have symbolic meaning, because it expresses identity, signals social status or has certain historic or aesthetic qualities (Boztepe, 2007). Designs can also lead to emotional meaning. Referring to Desmet and Hekkert (2007), Boztepe (2007, p. 60) describes 'emotional value' as the affective benefits that may be generated through sensory experience, meaning that comes from personality or character related experiences, and provoked emotions.

Worth can also be realized in the form of social value. Den Ouden (2012, p. 42) refers to the Oxford Dictionary of Environment and Conservation in defining social value 'as the

non-economic value that society puts on a resource and that is recognized by most, if not all, people, such as the benefits to human health of clean air and water'. Thompson and MacMillan's study (2010) was one of the first works in the field of management that discussed the role of businesses in the generation of societal wealth improvement. They argued that visionary businesses could open up new markets through the creation of social value, such as addressing challenges of poverty and human suffering. The idea that organizations can gain economic value by creating value for society has also been echoed in other works (e.g. Porter & Kramer, 2011; Yunus, Moingeon, & Lehmann-Ortega, 2010).

Finally, 'ecological value' and the broader term 'environmental value' refer to worthiness that is created for the physical environment. Ecological value is typically seen from a holistic perspective, covering also the social relationships of people. However, to avoid confusion, ecological value is here defined as the value that is created for the planet (cf. Den Ouden, 2012). Ecological value is often driven by motivational goals of environmental prosperity or preservation of the planet. Values that may play a role are emission reduction, re-use of existing materials and sustainability.

2.3 Dealing with divergent values

When collaboratively creating qualities with worth in a multidisciplinary design project, actors may have different opinions of which worthiness should or could be created (and eventually captured), and how to do this. The ideas, decisions and actions of actors are also heavily influenced by their guiding principles, which may differ from one person to the next (Rindova & Martins, 2017). This all leads to a plethora of divergent and possibly competing values that are of importance at the same time, and that actors somehow have to reconcile.

Working towards a 'value hierarchy' can support actors in developing an approach for the situation they are in. Scholars propose two different ways in which a value hierarchy can be employed. These are not mutually exclusive and can, especially when used together, build a strong value framework to support decision-making. First, a value hierarchy can be used to prioritize certain values over others, such as placing instrumental business values below values of the individual, society, and economic system (e.g. Bernthal, 1962; Friedman et al., 2013). Second, a value hierarchy helps to translate abstract, general values into concrete design requirements. Van de Poel (2013) uses the term value hierarchy to discuss how overarching values (top of the hierarchy), via norms (middle), can be operationalized into design requirements (bottom of the hierarchy) and vice versa. He argues that constructing a value hierarchy requires systematic discussion and reflection of values and related judgements, which allows actors to collectively establish clear links between the values they pursue and the design decisions they make (Van de Poel, 2013).

Some scholars argue that overarching values should not be specified with concrete examples, as each situation is different and involves different values. Over-specification may limit actors' creativity in the design process (Friedman, 2020). Yet, others have shown that difficulties in design projects can often be brought back to values that have not

been explicated or discussed; and that designers frequently struggle to engage in such conversations due to a lack of overview and experience with this (Bos-de Vos, 2018). This paper therefore aims to provide a simple, integrative overview that designers can use as a theoretical backbone and inspiration for their projects, while encouraging them to tailor it to their own specific situation.

3. Methodology

To arrive at an integrative framework, it was chosen to study both literature and design practice, so that different theories of value could be connected to designers' daily work. In this section, the methodology for the development of the framework is described, paying attention to the collection of literature, the collection of empirical data, the analytical procedures that were followed to synthesize insights from both types of sources, and the development and validation of the framework. The different parts of the methodology are described separately for the purposes of clarity, but in reality coincided.

3.1 Collection of literature

Value-related literature sources were gathered during three consecutive phases. In phase 1, a previous research on value co-creation in the creative industry was revisited by re-reading all relevant sources and the notes that were taken during interactions with other researchers, students and practitioners. In phase 2, additional readings were gained in multiple iterations by checking the sources that authors had used in their discussions of value. In phase 3, conversations with researchers from other academic disciplines were organized. These researchers were asked to provide what they considered to be key sources of value literature in their respective fields. These were then studied and used as a way to find additional literature. The three phases of literature collection resulted in an overview of scholarly work from a variety of academic fields, including philosophy, psychology, anthropology, ethics, sociology, economics, strategic management, project management, marketing, service science, engineering and design.

3.2 Collection of empirical data

During phase 2 of the literature review, also empirical data were collected in 24 workshops with architects from diverse types of firms (17 in-company workshops and 7 workshops as part of a professional training program). In each workshop, which lasted approximately three hours, participants were asked to jointly fill in the Project Value Modelling Blueprint (Bos-de Vos, 2020) for one of their ongoing projects (see Figure 1). This method, which consists of an ordered set of questions, helped participants to identify and discuss which values could or should be created in their project, and come up with concrete steps for how to do that (Bos-de Vos, 2020).

Participants were given post-its or erasable cards to fill in the blueprint, encouraged to engage in continuous discussion about their answers, and change or further specify answers

over the course of the workshop. The in-company workshops were moderated jointly by an external facilitator and the author. The other workshops were moderated by the author. Over the course of the workshop, several pictures were taken of the filled-in Blueprint (see Figure 2) and the discussion was documented with video-recording (expect for the professional training workshops) and an event log. In each workshop, the moderator(s) followed the proposed order and questions of the Project Value Modelling Blueprint closely, which led to a robust empirical data set with a high level of comparability.



Figure 1 Workshop



Figure 2 Intermediate result

3.3 Synthesis of theoretical and empirical insights

The analysis of the literature and empirical data was executed in three iterative steps that were performed while data collection was still ongoing. To enhance qualitative rigour in the analysis and synthesis process, a qualitative coding procedure inspired by the Gioia methodology was used (Gioia, Corley, & Hamilton, 2013). Although the Gioia methodology is specifically designed for developing interpretive theory from interviews (Gehman et al., 2018), it proved particularly helpful for the purposes of this study, as it helped to cluster values mentioned in literature or the workshops into overarching categories.

For the literature, a first step consisted of close readings of the sources and filtering out parts in which authors mentioned or discussed specific types of values. Based on these parts, a list of 'informant-centric 1st-order' values was generated, including the sources and scholarly domains in which the respective values were mentioned, and how they were defined. In phase 2, a similar list of informant-centric values was deducted from the end results of the workshops. The event logs were used to play back specific parts of the video recordings and gain more detail of how participants had exactly described the values.

Next, the analysis focused on searching for similarities and differences between the values in both lists to arrive at 'researcher-centric 2nd-order' themes (see Gioia et al., 2013). This led to a categorization into three 'degrees of value-specificity' (cf. Van de Poel, 2013): 1) overarching value dimensions, 2) underlying motivational goals, and 3) specific value examples. Examples of values that participants or authors gave were clustered when it appeared that they shared the same motivational goal. For example, several architects mentioned that 'developing new tools' or 'establishing a commercial relationship' allowed

them to generate a different type of economic value than money. This was labelled as the motivational goal 'other economic value'. Together with the motivational goal 'money', it was captured within the overarching dimension 'economic value', which described the type of value it actually concerned.

Finally, the analysis focused on finding aggregate dimensions that could, on a higher level of abstraction, explain differences between the values, and why certain values seemed to belong together (cf. Gioia et al., 2013). The empirical data clearly indicated that actors not only considered the values that could be realized for the stakeholders of their project, but also values that served as a compass to guide their decisions and activities in the project. For example, participants often described trying to do 'what is best for the client', thereby expressing altruistic motives. Values such as 'conforming to what is expected of designers', 'happiness at work', or 'an equal relationship with partners' were also frequently mentioned. On the one hand, the emergence of idealistic values was surprising as the Project Value Modelling Blueprint only focuses on the value that actors wish to co-create and capture (Bos-de Vos, 2020). On the other hand, it is not that unexpected as architects and designers work on the basis of professional code-of-conduct, which translates into all their work-related activities and decisions. It clearly indicated the importance of integrating both perspectives towards value in the framework.

3.4 Framework development and validation

The process of framework development was executed concurrently with data collection and analysis and consisted of several iterations in which draft versions were evaluated with researchers, students and practitioners and further developed. A first draft version was developed during phase 1 of the literature review on the basis of a previous research in which literature and empirical data were studied from a value co-creation (i.e. qualities with worth) perspective (Bos-de Vos, 2018). The aim of this conceptual framework was to raise awareness of the different values and potential value conflicts involved in value co-creation in design projects to offer practising designers and design students handles to identify and deal with these conflicts. It visualized three crucial phases in generating qualities with worth: the value proposition, value co-creation, and value capture phase (e.g. Clauss, 2016), as well as the important types of values that these phases concerned. The existing theoretical concepts 'use value' – which according to the empirical data should also refer to other stakeholders than the paying customer, such as users, government and society –, and 'exchange value' were complemented with an additional concept 'professional value', which emerged from the analysis of empirical data. Participants mentioned reputation, professional development and work pleasure as underlying motivational goals (see Bos-de Vos, Wamelink, & Volker, 2016). Draft version 1 is shown in Figure 3.

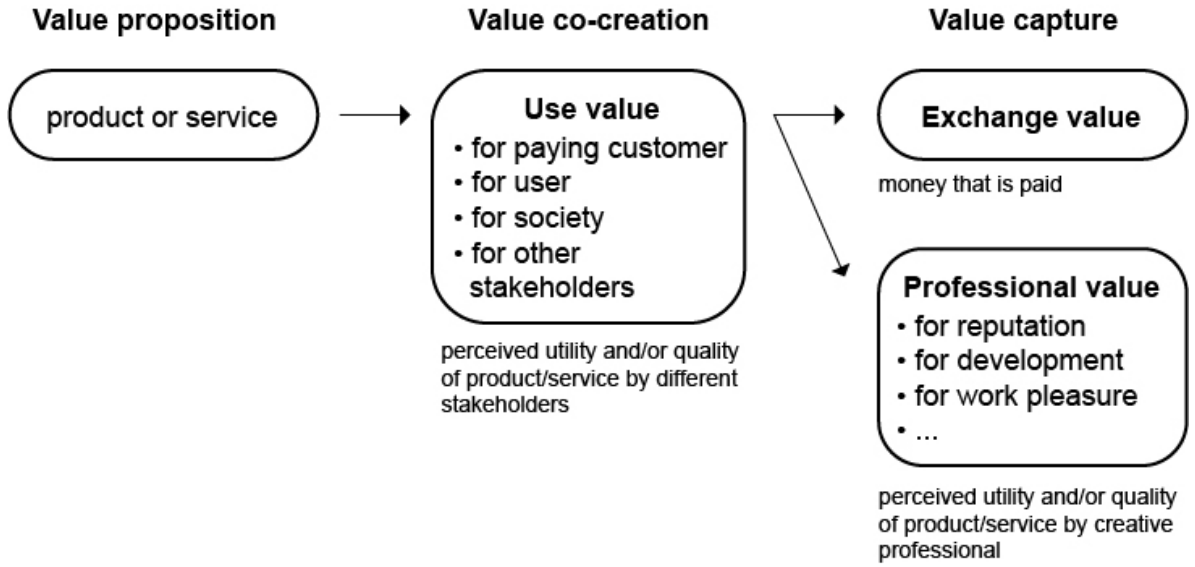

Figure 3 Draft version 1

The conceptual framework was presented and discussed at several meetings with audiences of academics, students and practitioners. Participants referred to the framework as insightful because it captured many struggles present in design projects and allowed practitioners to consider the origins of and potential solutions to these struggles more consciously. Despite this positive feedback, the first draft version of the framework also evoked discussions beyond its original aim. Academics from other disciplines raised questions about the definitions of values and why certain values were or were not included. Many questions seemed to originate from a moral perspective towards values instead of an economic/quality perspective. It became evident that this perspective needed to be included in the framework to avoid confusion or miscommunication in value-related discussions with people from different disciplines. This was also supported by the empirical data, which indicated that designers' actions and decisions related to value creation were strongly influences by their professional beliefs.

In draft version 2, the 'values as ideals' and 'values as worth' perspective that were used by (Martinsuo, Klakegg, & van Marrewijk, 2017) were taken as two distinct perspectives towards values that were both visualized in a separate section of the framework. For the 'values as ideals' section, a distinction was made between human values and cultural values, as two overarching types of values that are commonly represented in scholarly work from multiple domains (see Section 2.1). Also professional values were included, as the workshops in practice had shown that participants were often driven by their professional morals and ideals. For the 'values as worth' section, use value, social value, ecological value, economic value, and professional value (the latter referring to professional worth instead of professional ideals) were included. These values resulted from the comparison of the list of values mentioned in literature and the values that emerged from the empirical data. Since in literature, specific value labels sometimes have different definitions, or different labels

are used for values with the same definition; labels were chosen that best represented the empirical data. Draft version 2 also included a distinction between three degrees of value specificity (see Section 3.3), which appeared to be a helpful way to structure the many values that were mentioned. Draft version 2 is presented in Figure 4.

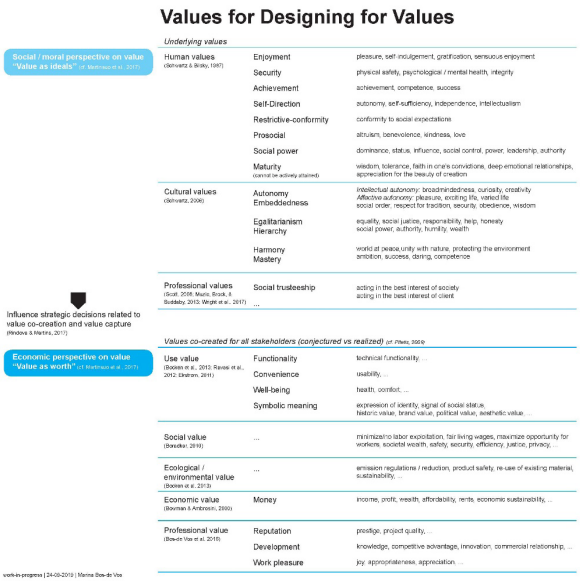

Figure 4 Draft version 2



Figure 5 Feedback session with peers (top) and practitioners (bottom)

Draft version 2 was discussed with peers from multiple domains, who are all working on value-related topics, such as value operationalization, value conflicts, value dynamics, and value assessment. Also teaching staff, students and practitioners were asked for feedback. Over the course of a year, 16 individual meetings and five feedback sessions with larger groups of people were organized to validate the structure and contents of the framework and to explore potential use-scenarios (see Figure 5). People were asked if they missed things, if the framework raised any confusion, and if they would organize the framework differently and why. Participants were also asked which benefits the framework could potentially have for them, if any, and which suggestions they had for working towards these benefits.

Based on the feedback received, a new version of the framework was made. As the distinction between the terms 'values as ideals' and 'values as worth' was often not or not directly clear to people, these were changed into the more descriptive labels 'values as guiding principles' and 'values as qualities with worth'. For the values as guiding principles section, a distinction was made between individual-level values, which are embedded in a single person; and group-level values that are shared by a certain community of people, such as a family, organization, profession, or society. The values as qualities with worth section came to distinguish between people-related and environment-related values.

Finally, the professional values, which were a bit of an odd-duck and confusingly mentioned in both sections of the previous framework, were redistributed and placed in categories that they fitted with.

4. An integrative framework for designing for divergent values

This section presents the framework in which empirical and theoretical insights from different academic disciplines are synthesized. The framework , which is shown in Figure 6, provides a first step towards helping designers successfully facilitate and participate in processes of designing for divergent values, by encouraging conversations and reflections about the values at stake in a project. By providing concrete examples of values that may play a role in the field of design, it provides inspiration and a comprehensive basis for actors to understand which values to discuss. The matrix structure of the framework allows users to focus on specific parts that are relevant to them, while being aware of the bigger context that they leave out.

On the vertical axis, the framework is subdivided into a section 'value as guiding principles' – which distinguishes between guiding principles that stem from human nature and principles related to social interaction –, and a 'values as qualities with worth' section, which includes values to be co-created for people and planet. As discussed in the theoretical background, the two sections of the framework are highly interconnected. Actions and decisions related to co-creating worth (bottom part of the framework) are continuously influenced by actors' guiding principles (top part of the framework) (Rindova & Martins, 2017). In turn, the guiding principles of actors are also shaped by the value creation opportunities and constraints that actors encounter in their work (Wright, Zammuto, & Liesch, 2017).

On the horizontal axis, the framework consists of three degrees of value-specificity, making a distinction between overarching value dimensions (left), underlying motivational goals (middle), and specific value examples (right). In this way, the framework provides designers and other actors with the means to recognize and discuss connections between higher-level value-related issues and the specific design opportunities and constraints of a project. Although some scholars argue that specification of values may not necessarily be needed nor good, the framework helps students and practitioners to oversee what may be important based on concrete examples and then select, develop and customize the parts that are relevant to them.

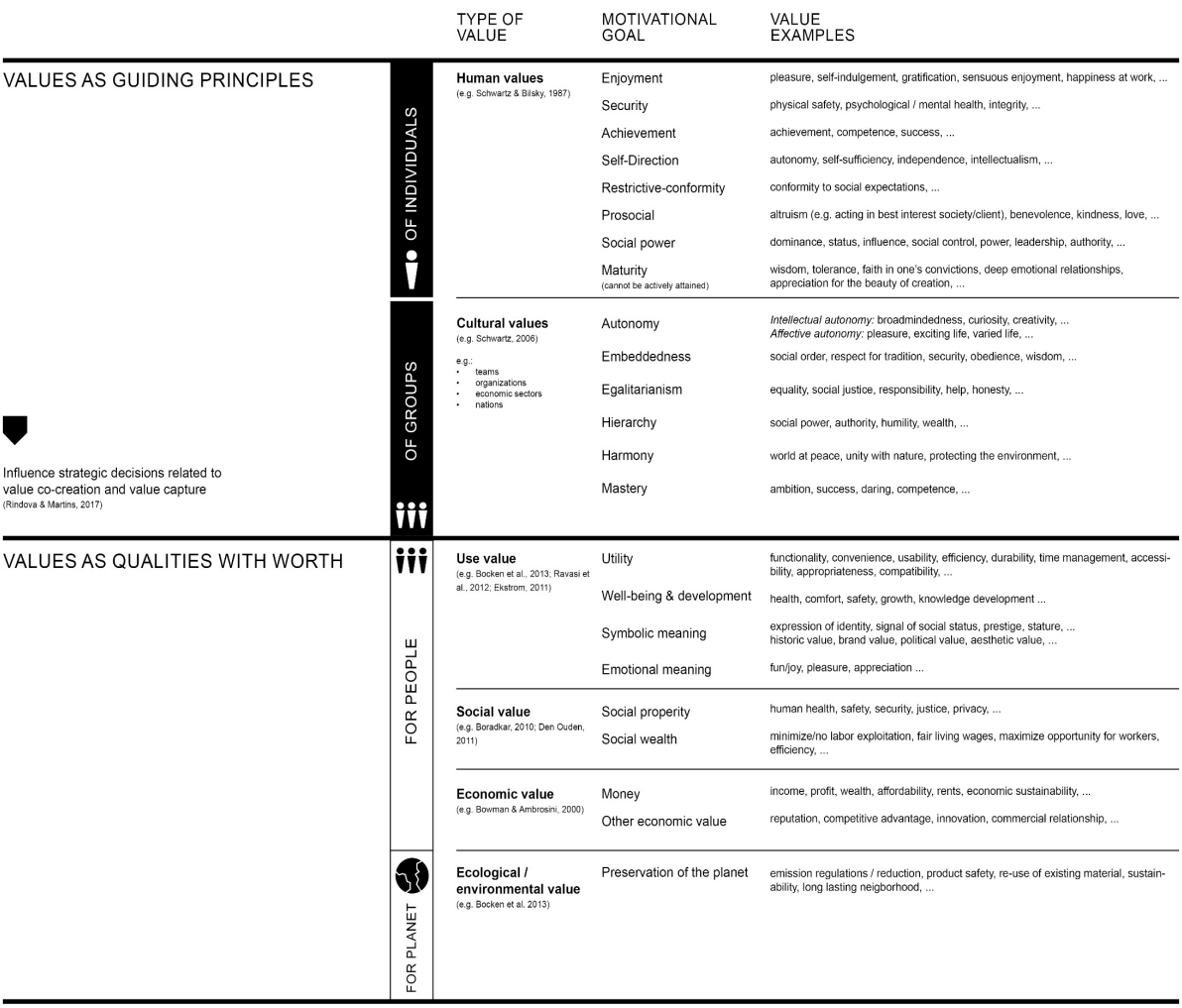

Figure 6 Framework as a basis for designing for divergent values.

5. Discussion & suggestions for further development

This paper presents a first step towards the development of an integrative framework for designing for divergent values. Designing for divergent values can be seen as a temporal and fragile process. Contexts, involved actors, and their perceptions of value continuously evolve over time. As Vargo et al. (2017) argue, value is always multidimensional and emergent. To accommodate actors' different perspectives on values, interests and motivations, as well as the fluidity and interconnectedness of values; an integrative and reflective approach is needed. The research and framework presented in this paper offer a way to better understand and oversee the complexity of multidisciplinary collaboration from a value-perspective, which is currently still underemphasized in literature, education and design practice. This novel contribution has benefits for three areas in which design work is manifested.

First, it can help design researchers to further develop their understanding of

multidisciplinary design processes by focusing specifically on the values, linkages between values and potential value conflicts that are involved. It helps researchers to more clearly position their studies in relation to other value-related work, discuss how it connects with other studies and what its core distinctive features are. Second, it allows educators to teach design students a basic understanding of values in design and develop exercises/projects that let students practice with designing for divergent values and reflect on their process. Third, the framework can serve as a theoretically informed, easy-to-use overview, that practising designers can employ in their projects to identify, discuss and translate different notions and priorities of value that people from different disciplines have, thereby avoiding miscommunication and bringing any underlying differences to the surface. It may also support designers in helping multidisciplinary teams deal with the complexity of value co-creation, thereby strengthening their own position as a linking pin in the interaction of these diverse actors (e.g. Bohemia, 2002).

The work presented in this paper is by no means exhaustive nor complete. It is meant to serve as a first stepping stone towards future research and the development of tools or guidelines for designing for divergent values. To further develop the theoretical basis, a more extensive and systematic literature review is needed. It should also be investigated how the framework could exactly be used in design projects. An interesting direction for further development is to build, test and iterate different types of tools, which could, for instance, be dynamic to allow for nuance and overlap between certain values or include different time horizons.

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Design considerations for the transformative reuse of a Japanese temple

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Abstract: This paper concerns the transformative reuse of materials from a derelict Japanese Buddhist temple in a transcultural context. The process of 3D scanning and photogrammetry modelling for a virtual experience of the building and its furnishings is described in reference to the development of a later study: the proposal to test the reuse of materials by international team of designers working remotely with digital models. The capacity for designers using digital data and metadata to inform transformative reuse applied locally in Japan, via either handcraft or robotic fabrication, is discussed as a challenge for virtual embodiment and craft knowledge. The steps required to progress the research are discussed. Framed by theories of cosmopolitan-localism, the ongoing project proposes new methods for design-led transformative reuse that address the globalised problem of waste flows and test the use of emerging technologies to innovate cultures of repair, reuse and circular economy.

Keywords: reuse; repair; waste; virtual reality

1. Introduction

The global flows of resources, materials and products means waste is a global problem. Waste is also a political problem, as illustrated in 2018 when China stopped accepting foreign recycling waste. Repair and reuse are first responders to the emergency of waste: they use less energy than recycling, and conserve material and the embodied energy used to extract and craft that material.

However, both reuse and repair are marginalized by dominant paradigms that privilege the creation of new products from newly extracted resources (Shultz, 2017). At the economic and community level, repair industries are in global decline as more and more nations embrace a hyper-consumerist 'break and replace' model of material use that developed within capitalist economies in the 20th century (Slade, 2006). The break and replace

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mentality departs from earlier traditions of repair in global cultures and an intriguing problem to consider is whether the cultural knowledge that is materialised and embedded in designed products and structures becomes lost when repair traditions disappear and materials are increasingly sent to waste. This problem would persist with recycling, a process that by industrial convention destroys the formal and contextual knowledge of objects in the process of their conversion into feedstock for the manufacturing of new products. Recycling has the additional problem that it is industrial. It cannot be done easily at home or in the community, so requires collection and sorting. But waste in the consumer landscape is *a*ssorted. Product-material marriages are not standardised, and neither is collection, sorting and recycling capacity, even in the one city or suburb (Norman, 2020). However, between conventional forms of repair and the reuse of materials by recycling, there exists a spectrum of object-material transformations variously known by terms such as transformative repair, adaptive reuse, transformative reuse, upcycling and visible mending etc. As discussed in a number of special volumes on repair published in the last few years, these practices occur across a range of design disciplines including product design, textiles, craft, architecture and jewellery (Graziano & Trogal, 2019; Strebel, Bovet & Sormani, 2019; Reeves-Evision & Rainey, 2018; Houston et al., 2017). These practices occur in a range of cultures, traditional and industrialised, around the world and together comprise one aspect of circular economy design, a framework for conserving material and embodied energy in recognition of the expanding needs of a global population on a planet with finite resources and an environmental and climate change crisis.

Emerging technologies such as 3D scanning and robotic fabrication appear to have potential to innovate circular economy cultures of repair and reuse – just as they have for linear economy design and production. The capacity to attach metadata to digital models of real world materials and objects, such as in Building Information Management (BIM), is well understood for linear economy design methods in architecture, including those that attempt to reduce construction waste and produce more energy efficient buildings (Wong & Fan, 2013). The use of BIM explicitly for circular economy mostly lacks real-world applications and has recently been described in aspirational terms (Krygiel et al., 2017: 201) though Cheng and Ma (2013) have developed a system to estimate waste from building demolition that works with BIM datasets (which they believe will soon exist for “most buildings, including historical buildings”). There is also a proposal for the use of BIM to facilitate design for deconstruction (Akbarnezhad et al., 2014). But beyond the use of BIM for building material reuse, the impact of 3D scanning and related technologies, such as virtual reality (VR) or augmented reality (AR), on reuse practices in design more broadly appears under-researched. Generally, use of emergent technology in the scholarly discourse for repair and reuse is lacking. For example, within three journal special issues on repair published in the last few years (Strebel, Bovet & Sormani, 2019; Reeves-Evision & Rainey, 2018; Houston et al., 2017) repair-based applications of 3D scanning or robotic fabrication processes are barely mentioned.

This paper discusses a pilot case study comprising the first phase of an ongoing project

testing the hypothesis that *3D scanning can innovate circular economy cultures of transformative reuse for product designers and craftspeople primarily in ways that are locally sensitive and globally relevant.* This paper thus serves to:

report on preliminary research comprising non-destructive 3D scanning and virtual modelling of its case study, including review of human research conducted in the case study's locality, and

discuss the ethical, theoretical and methodological considerations needed to proceed with transformative reuse of the case study's materials, components and objects in subsequent research investigating the above hypothesis.

2. Case Study Background



Figure 1 *Anyoji Temple, Shinano, Nagano, Japan, dating from the Edo period. Photographed May 2019.*

Anyōji (安養寺) is a Buddhist temple in Shinano, Nagano prefecture, Japan, that, absent of community funds needed to restore the temple, has been scheduled for demolition by the local council for health and safety reasons (figs.1–3) Due to increased secularism and urbanisation, temples throughout rural Japan struggle to maintain the patriarchal lineage of caretaker monks (McCurry, 2015). This temple is a rich example of Edo period Japanese temple architecture and operated for more than 300 years (Watanabe, 2019) (fig. 6 & 7). Without a caretaker monk for more than 20 years, the temple has fallen into disrepair

from snow and storm damage. AIR Myoko, a nearby ski lodge in the neighbouring Niigata prefecture, has planned to purchase the building's material and objects with the intention of reuse to prevent the materials from going to waste. This intends to be a 'transformative reuse' (Keulemans 2018; Keulemans, Rubenis & Marks, 2017). Though the largely timber components of the building potentialise a variety of reuses, including architectural reuse at a new site or transformation into timbercraft products such as furniture or homewares, the perception and appeal of such possibilities is only partially known within the local cultural context. The temple's interior objects appear largely untouched since the temple ceased operations, with a few key exceptions including the relocation of a significant buddha statue and some other items to nearby temples (Fujiki, 2019). The remaining objects potentialize a range of reparative approaches including simple restoration and sale, or more design-intensive forms of repair, transformative repair or reuse. The large number of interior objects that remain, comprising ceramics, furniture, ritual objects and books among many other things, would be well served by some form of inventory.





Figures 2, 3 Interiors, debris and roof structure within the temple. Storm damage is exacerbated by snow build-up during the winter months.

Preliminary research undertaken in May 2019 included photographing the temple and its objects (figs 1–5) for later reconstruction in photogrammetry models, plus a small scoping human research study, comprising short semi-structured interviews with local people to gather cultural and contextual information, and gauge community support and perception (undertaken with ethics approval).





Figures 4, 5 Temple objects: carved wooden debris and Showa era (1926–89) Buddhist Women's Association flag.

3. Theoretical Framework

This project is firstly framed by known problems and theoretical solutions within the field of design. Over-production and excessive exploitation of planetary resources presents an existential threat of climate change caused by greenhouse gas emissions from extraction, manufacturing and shipping. Waste and waste-related pollution, both local and global, are key topics of concern to sustainable designers. Material reuse is a key means to preserve embodied energy, avoid unnecessary production of materials from raw resources and form a closed loop material flow; as such it forms part of the xR (reduce, reuse, recycle etc) principles within Design for Sustainability frameworks (Ceschin & Gaziulusoy, 2017: 126).

Within the Design of Sustainability framework, transformative repair and reuse are design-led forms of visual arts and craft practice that transform an object or material's form, function or cultural value (Keulemans, 2018). It has been recognised there is a need for transformative practices in design and craft to shift paradigmatic, harmful practices of design, consumption and waste towards sustainable making cultures (Kiem, 2011). Schultz (2017) has argued that the "transferability" or repair and reuse cultures should be investigated, but that transnational or transcultural studies should be done with a concern for decolonial imperatives, as will be shortly discussed.

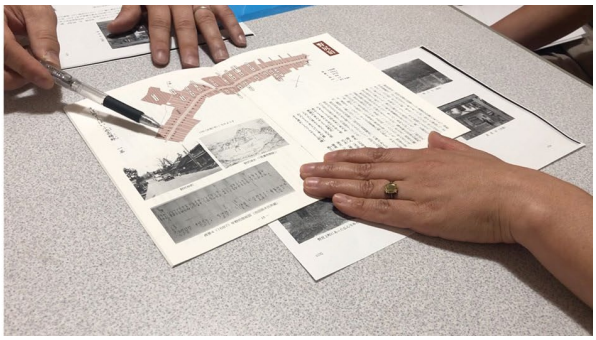
Given this initial framing, this project has number of both complementary and competing considerations:

- The research team is transnational, based in both Japan and Australia, and there is scope to bring in more international designers, for example, transformative reuse practitioners from the UK, the Netherlands or Australia, as well as broader Japan (see Keulemans, 2016: 27–29 & Keulemans, Rubenis & Marks, 2017 for a discussion of the field).
- There is expected international interest in the outcomes of the temple's

transformative reuse, but a. there may be local objections to export of transformative reuse products, b. international shipping of materials comes at a carbon emissions cost and c. shipping to Australia in particular comes with biosecurity implications due to the preponderance of organic material.

- Preliminary interviewing (figs 6 & 7) has provided only a partial insight into local sensitivities regarding the temple's transformative reuse. Reuse would be appreciated (Watanabe, 2019), especially if the reuse maintained a link to the temple (Fujiki, 2019), and the quality of the temple materials is noted (Suzuki, 2019).
- So while there is a sustainability imperative to avert the temple's material going to waste, there are only partially known local capacities to fabricate transformative design, and unknown local needs and market viabilities for transformative reuse products.





Figures 6, 7 Archaeologist Tetsuya Watanabe discusses the significance of the temple for Edo period travellers.

Such considerations place local and global flows of information, material and capital into consequential relation. For example, how can an international team of designers work to solve local problems of waste without physically interacting with that waste material? While it is not a key aspect of this pilot study, financial viabilities are also an issue: what might motivate designers and fabricators (beyond the research team) to work on this project in respect of time, money and market? Crucially, in regards to the material encounters that craftspeople experience making physical objects (Ingold, 2013), this proposal presents a particular challenge of interest to the authors: what are the capacities of virtual embodiment for designers working remotely with digital captures of real world materials for locally applied repair and reuse? And, how can this challenge be theoretically framed?

'Cosmopolitan-localism' is a set of theoretical and practical concepts for the planet-wide networking of place-based communities to facilitate the exchange of knowledge, technologies and resources for sustainability transitions, and as such it appears to appropriately frame this challenge. It is a convergence of two developed traditions, cosmopolitanism and localism, that respectively attempt to realise a global humanity connected beyond borders, while preserving and protecting the freedom of local communities to manage their own affairs. Kossoff (2019) notes that this convergence,

through the work of Sach (1999), Manzini (2011) and others, is still nascent in the present day, but finds a pressing potential agency in the fight to prevent the destruction of local cultures and communities from dominant, homogenising forces of globalisation. Cosmopolitan-localism proposes that local cultures need not be undermined by trade and cultural exchange, but can develop with regard for interconnected global diversity and be enhanced by trade and cultural exchange that is carefully considered. A key insight is that place-based communities must develop in response to bio-regional conditions and resources, rather than rely precariously on ever-increasingly traded goods, transported at carbon cost, from mystified global supply chains with unethical labour conditions or negative environmental impacts. So, just for example, local building materials, might be prioritised over imported building materials. In complement, foreign knowledge and technologies that may be transferred informationally and digitally without high carbon cost can guide the use of local resources at many places, advancing global society while respecting the ecological limits of individual bio-regions (Kossoff, 2019). Bioregional design theorist John Thackara (2019) calls such scenarios “knowledge ecologies”.

In consideration of this framework, it is proposed that virtual capture of the temple materials, objects and architecture might be attached to metadata contextualising their local culture (e.g narratives obtained through human research in the temple’s area) and/or bio-regionally specific metadata for sustainability evaluations (e.g material ecology information and material life cycle analyses) in order to offer scope for remote repair and reuse by an international team of designers working with digital materials. Methodologically, some interesting hypotheses to test are:

- how can this be done technically, remotely, using only digital materials and with a level of virtual embodiment sufficiently analogous to that experienced by designers and craftspeople working with physical materials,
- how downstream workflows should be designed so that remote, virtual transformations can be manufactured locally, with
- the use of emerging manufacturing technologies such as robotic fabrication (e.g CNC milling) that leverage production efficiencies from digital workflows, and/or
- engaging responsibly with traditional craft in the local community (in acknowledgement of Japan’s historical expertise in timbercraft and other craft practices).

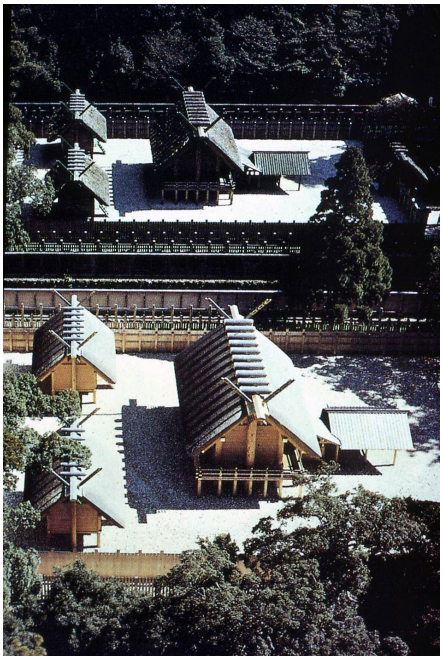
To be clear, the development of studies that test these hypotheses is ongoing, so this paper only discusses the context in which these hypotheses emerge and how they are informed by preliminary research, including the results from an initial photogrammetry scan of the temple and some of its objects.

It should also be noted that the temple has been legally deconsecrated and, subject to an impending demolition/disassembly by order of council, has no heritage restrictions (Watanabe, 2019). There are still heritage implications though, and the transformative reuse of a religious building using Western-originating information capture technologies

such as photogrammetry raises ethical research considerations. The cosmopolitan localism framework can and should correspond with advancing imperatives from the broader Design for Sustainability cannon, but especially those from transition design (Irwin, Kossoff & Tonkinwise, 2015) and decolonial design (Schultz et al., 2018) that concern the consideration of Euro-centric biases, learning from "different modes of being-in-the-world" and amplification of plural and diverse migratory cultures in a global context (Schultz, 2017: 226 & 231). Euro/science-centric origins and practice of photogrammetry have been noted to be perpetuate Western biases concerning the extraction and isolation of knowledge out of social-cultural context (Harle, 2018). Likewise, it has been proposed that the reuse of heritage buildings should be undertaken within a wholistic framework assessing social and cultural dimensions alongside practical, economic and environmental aspects (Yung & Chan, 2012). These arguments highlight the need to give attention to Japanese cultural perceptions within a research project that involves the transformative reuse of a Japanese religious building by transnational designers.

4. Precedents

4.1 Japanese religious precedents





Figures 8, 9 The Shinto Ise Jingu is reconstructed every 20 years using wood from nearby managed forests. The old shrine is torn down and its wood sent around Japan to repair other shrines. Source: Agematsu Tourist Association, 2005.

Contextually, Japanese culture has a long engagement with repair and reuse. Care for material is expressed in the Japanese concept of 'mottainai '(Keulemans, 2016; Wallinger, 2012) and is notably apparent in Japanese craft traditions; such as those of 'kintsugi'

(ceramic repair) (Keulemans, 2016) or 'boro' (textile reuse or upcycling) (Wada, 2004). Contemporary Japan has similar levels of industrial and municipal waste recycling as Germany, France and the UK, and while Japan has better systems for managing waste accumulation (a consequence of very high population densities), they nonetheless face similar problems with landfill and waste pollution (Amemiya, 2018). There is increased application of xR systems (e.g reduce, reuse, recycle etc) (JESC, 2014), but the dominant focus is on recycling systems that have little capacity to preserve material culture traces in the manner of traditional repair and reuse crafts. There is tradition of material reuse in the ritual rebuilding of the grand Shinto shrine Ise Jingu (Vallely, 2014) (figs. 8 & 9) (a significant example of how material traces are preserved for cultural enrichment), but there appears to be little evidence in the English language discourse for similar practices for Buddhist buildings. Triplett notes that redundant Buddhist objects of special significance are typically burnt – a tradition noted in one of our interviews (Fujiki, 2019) – but there is also a history of transformation practices for Buddhist objects that may categorise and substantiate the transformative reuse of the Anyoji Temple within a theological framework, termed "benevolent iconoclasm" (Triplett, 2017).

4.2 Design-based / technological precedents

Regarding the proposal to develop digital workflows for transformative reuse via 3D scanning and robotic fabrication, Greg Lynn's Toy Tables (2009) (figs. 10–13) is an interesting precedent. Mass-produced roto-moulded children's toys were 3D scanned and their virtual models arranged together into a new structural design capable of supporting a table top. Model intersections were exported as tool paths for a 5-axis robotic router, which then cut the real world toys into their new forms for later assembly using a plastics welding gun (Lynn, 2009). Despite being developed more than a decade ago, this workflow does not seem to have been well taken up for adaptive reuse since.

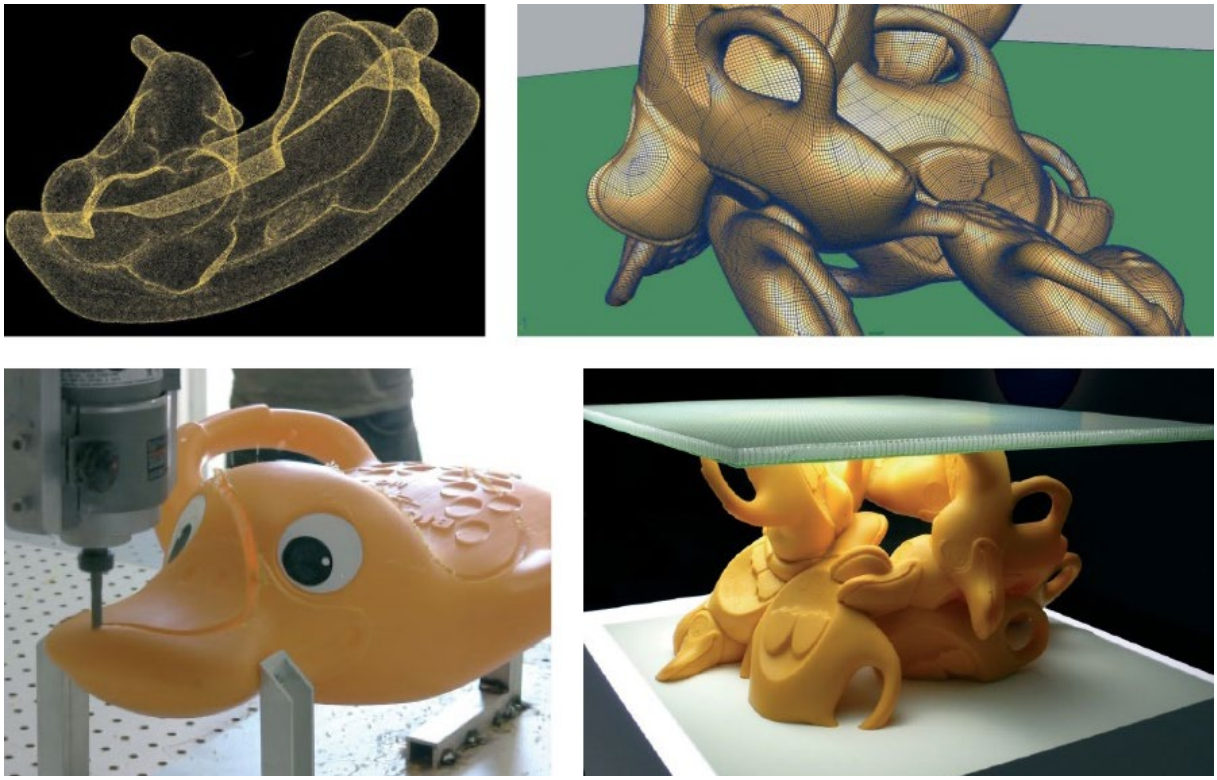


Figure 10-13 Greg Lynn's Toy Tables. Toys are 3D scanned, reconfigured in Maya, toolpathing is exported to a CNC mill, and the parts reasembled into furniture. Source: Lynn, 2009.

The possibilities of such a digital workflow for designers working remotely can be considered in relation to what's already possible in the craft-led transformative reuse context. Liam Mugavin's *Gonbei* bench (2017) (fig. 14) was made in the Niigata region using waste wood from a farmhouse that fell after the 2011 Tohoku earthquake. Joinery details are visible in the design, conveying the character of the wood's prior purposes and suggesting an intent to conserve material. While this object was made using traditional craft processes, its possible to imagine how this process could be replicated for remote, virtual design. For example, the virtual transformation of 3D scanned component models could generate tool-pathing commands that are subsequently exported for local, on-site robotic fabrication by a CNC router.



Figure 14 *Liam Mugavin's* Gonbei *bench (2017) made from waste material from a Japanese farmhouse destroyed by the 2011 Tohoku earthquake.*

However, there is a caveat that concerns the tactile and embodied practices in timbercraft. For example, the sensory information that allows the carpenter to habitually inspect the quality and structure of wood, make appropriate material selections and decide upon the placement of cuts and joins. Such knowledge is haptic, tacit and may develop incrementally across both the lifetime of the craftsperson and the time-span of the job. How such knowledge can be captured, embodied and instrumentalised in a virtual workflow requires research. Hybrid practices, for example in which a craftsperson might annotate virtual models with metadata obtained from physical inspection during or before 3D scanning may be a viable solution, though scope for later inspection during the design phase may be limited. Yet, the potential of solutions driven by emerging technologies are indicated in the following precedent, in which 3D scanning is used to capture structural details about tree forks for architectural purposes.

For repair and reuse within circular economy, it is considered important to preserve as much as possible of a material's embodied energy and structural capacity. The UK Architectural Association's *Woodchip Barn* (2016) (figs. 15 to 18) suggests how 3D scanning and robotic fabrication workflows may serve this need. 3D structured light scanning was used to create digital models of forked tree sections. Digitally arranged using a generative evolutionary algorithm to exploit their natural, 'anisotropic' qualities of wood grain and structured growth, the tree sections were then robotically cut for on-site glue-less joinery into a barn

structure (Mollica & Self, 2016). This capture of anisotropic information is important because Mollica and Self note it is a “wasteful redundancy” to over-process material to replicate structural properties that were extant in the original material before processing. (A common example of this redundancy is plywood or glue-lam composites that ‘cleverly’ cross-layer and glue wooden sheets to emulate the strength of the source timber). Such redundancy can be avoided by applying a similar design consideration to the Anyoji material in order to capture ‘thick’ data within a bioregional-cultural context. For example, the grain direction and age of wooden post and beam components, their internal and external condition (e.g. cracking, rotting, wood knots, structural tendencies, but also metadata resulting from an analysis of human design, craft or use, such as joinery style (method of construction, e.g blade or saw marks), secondary uses (e.g. furnishing attachments) and decorative finishes, all with the potential to inform design-led transformative repair and reuse.



Figure 15-18The Tree Fork Truss design process of the Woodchip Barn. Natural tree forks are 3D scanned, selected for structural and anisotropic properties, then CNC milled for glue-less on-site joinery. Source: Mollica & Self, 2016.

5. Methods

In May this year, most of the co-authors visited the temple and interviewed a small number of local residents, plus a local archaeologist, council representatives and relatives of the

temple's last monk. They discovered a sad story of a once grand temple and its community unable to afford its repair. The situation, left as it is, could mean the temple will be demolished and its remains go to landfill, but local residents were supportive of the general proposal to make use of the building materials via transformative reuse (as discussed in various interviews conducted May 2019 in Shinano).

As an initial step towards the goals outlined in the previous section, the temple was photographed and the data used to construct a preliminary photogrammetric model of the temple capturing some of the material quality and structure of the temple, its wooden posts and beams, ornate carvings, tatami floors and superabundance of sacred and non-sacred junk: discarded objects of ritual, worship and craft.

6. Discussion



Figure 19 Photogrammetry model of the Anyoji temple, front view.

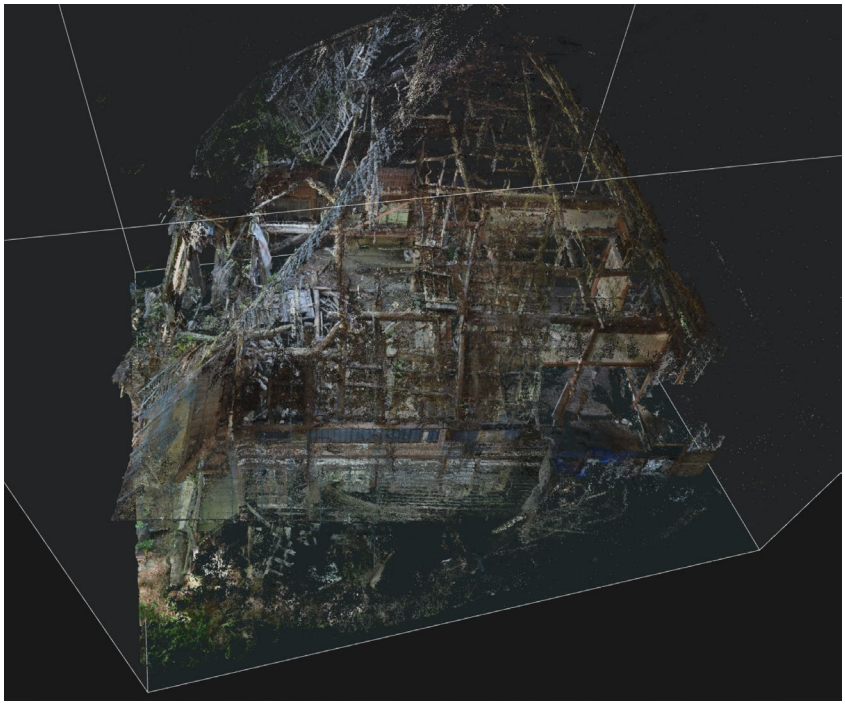


Figure 20 Photogrammetry model of the Anyoji temple, top view showing internal roof structure.

Figures 19 to 23 show screenshots of a virtual model of the temple generated by first and second run of photographic data using the software RealityCapture. It should be noted that due to time constraints and inaccessibility, some areas of the temple were not well scanned. Additionally, work to develop the existing dataset into a more resolved model, experienceable in virtual reality, is planned for subsequent steps, so these images only illustrate an interim phase of the research. However, the images nonetheless provide visual material on which discussion can hinge.

It can be seen that broken and dishevelled materials in and around the temple are visually intermixed with areas of low image information. This visual confusion does not arise because disordered materials are harder to photogrammetrically process. Conversely, the lack of structural order and rich organic detail facilitates photogrammetry techniques (Harle, 2018). But, some of these dishevelled areas were hard to access and photograph. It was dangerous to walk in many places due to collapsed floors and visibly weakened overhead structures, so photographs from these perspectives are missing from the dataset. However, the photogrammetry method provides many possible viewing angles in the model that are difficult to obtain in the real world, including a ‘see-through’ capacity to view the complex design of the roof and ceiling structure (fig. 20).

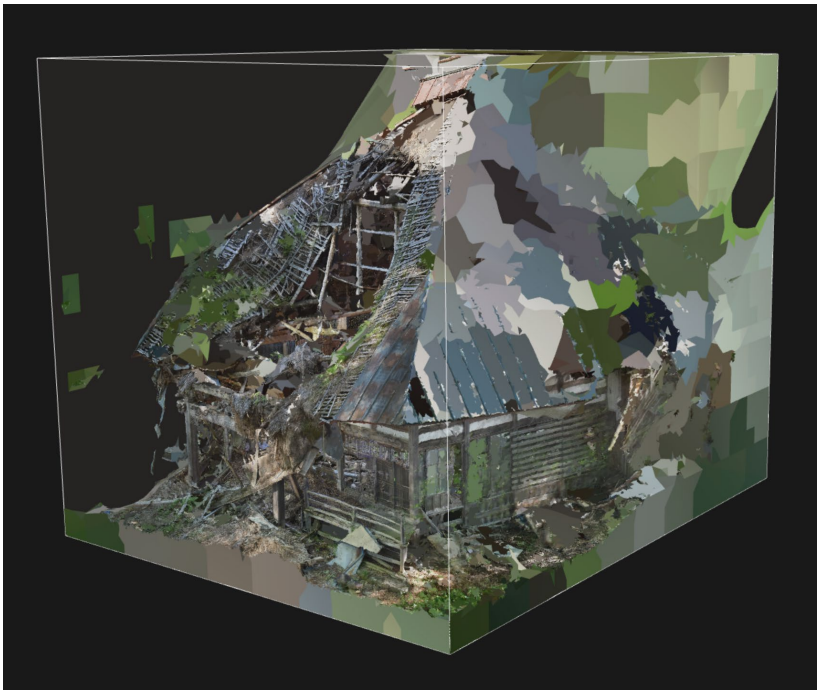




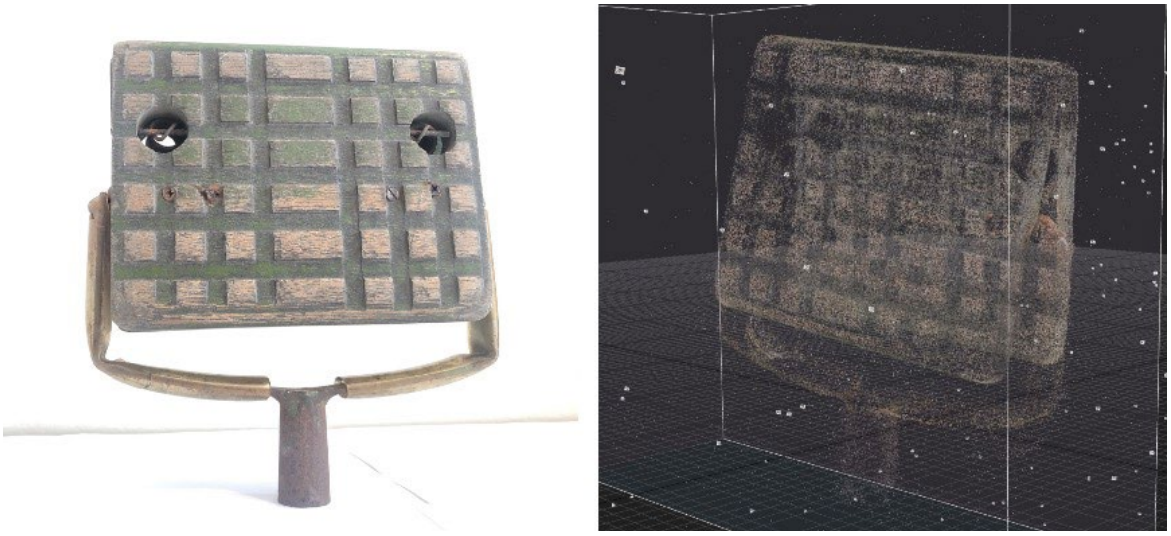


Figure 21-23Mesh reconstructions of the Anyoji photogrammetry model

The disordered appearance of some areas is in part a consequence of it being hard for the human eye and mind to 'make sense' of what is being seen in the model. This is especially true for the images of the model with a preliminary mesh construction in which visual qualities lack some physical world fidelities, such as realistic light and shadow. It was also true during the site visit, though, simply because ruinous areas of the temples are visually more complicated. Both aspects need to be considered for successful use of the model for virtual reality (VR).

The primary purpose of a future VR experience of the temple is conceived to contextualize the temple for designers working remotely on individual components. Preliminary 3D scans of a few temple objects was also conducted (figs. 24 & 25) and this is conceived as a conceptual start for an inventory design that links 3D models of individual objects to their viewable placement in situ within the temple VR model. Findings from this aspect of the study has potential to contribute to the discourse on human embodiment of digital objects (Munster, 2011). There are potential discoveries relevant to the field of digital heritage research (Kenderdine, 2015), and a VR experience of the temple for a local history museum could be a secondary application. The VR experience of the temple may also have value for architectural design, should funding be found to restore or renovate the temple itself.

Furthermore, an idea that arose through inspection of these images is the fragmented VR model can itself be repaired, conceptually and digitally using CAD modelling tools. This is, on the face of it, not surprising, because human interaction with digital workflows are typically reparative. For example, designers constantly repair mesh constructions and other errors or artefacts in 3D digital workflows. Innovation, however, may lay in the explicit use of transformative repair concepts – a creative remaking to improve appearance, role or cultural value – when applied to the temple model. That VR experiences can be time-based and animated expands the potential for virtual transformative repair. A time-based design might even reverse the decades of decay and entropy the temple has suffered as a virtual experience, in a way that transcends the limitations of the physical world. The potential of such ideas requires further research and studio experimentation, but importantly also community consultation. As with the proposed transformative reuse of the real world materials and components of the temple, the digital transformative repair of the temple may encounter unknown cultural sensitivities.



Figures 24,25 Comparison of photo and dense point cloud of a tool object found inside the temple.

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What's it like to be Alexa? An exploration of Artificial Intelligence as a Material for Design.

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Abstract: Technology is a material, though we don't often perceive it as something we can easily manipulate with sensuous knowledge. In particular, we don't consider digital algorithms within Artificial-Intelligence (AI) as a material we can design with as we generally lack the intimate knowledge a carpenter has of the grain of wood and the chisel in hand. Despite this lack of understanding, designers are contributing to the rapid implementation of AI in diverse areas, having a profound effect on the lives of millions. If designers lack a material knowledge of AI, how are they to adequately consider the desirability of its use? How do we pierce the veil of something that is perceived as intangible, where the interplay between materials and forces are obscured? In this paper, we present a design approach that utilises philosophical lenses to help designers adopt a material perspective of AI aiming towards a more considered use.

Keywords: artificial intelligence; object orientated ontology; material; design.

1. Introduction

What is AI? There are many theories as to what this weighted, and in some contexts, uncertain term means, and a great deal of speculation as to what it can achieve. To some, notably Stephen Hawking and Elon Musk, the creation of superhuman intelligence, or artificial general intelligence is inevitable, to others, it is merely a geek myth (Kelly, 2017). Some experts advocate that we should reconsider what we call AI, given that AI in most applications is what is known as narrow AI, carrying out a few relatively simple tasks such as recommender systems for television, a stark contrast to 'general AI' which might be considered an enabler of a human-like robot. Despite the many applications of AI, it is opaque, often viewed as a digital black box with access limited to those in privileged positions, leading even experts to question how the machine works, how it has been trained and if it is always correct. Yet despite not fully understanding the effects, constructs or the arrival of outputs, AI technology is being hastily utilised in a wide variety of applications, rather than cautiously implemented by design.

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Our approach to this design challenge is to focus on the materiality of AI, to redefine it and make legible its complexities. This approach rejects considering AI as simply an abstract concept. Instead, AI should be seen as a material in the original sense – as "active constituents of a world-in-formation…. relentlessly on the move – flowing, scraping, mixing and mutating" (Ingold,2011, p.28). A tangible thing to design with rather than the current incorporeal entities which increasingly manage and manipulate people's lives producing an imbalance of power. In this paper, we present a material approach of AI and suggest design tools to facilitate a philosophical materialistic-tinted perspective.

To develop alternative perspectives of AI, our approach presents alternate ways of viewing it. Here we introduce the notion of philosophical probes as lenses to augment the design process and to assist in constructing a theoretical framework for the materiality of AI. The complexity of AI concerning its entanglements with and experience of the world is often misinterpreted, not known or simply overlooked. The application of philosophical theories, such as Object Orientated Ontologies (OOO), within the design process, provides an alternative approach and potential for designers to interrogate and reinterpret the complex nature of objects and their interactions (Lindley et al,2019).

There are many interpretations of OOO, and in this research, we have embraced OOO from the theoretical understandings of the philosopher programmer Ian Bogost. In particular, we present a design framework consisting of three philosophical probes developed from Bogost's OOO concepts of Ontology, Metaphorism and Carpentry.

This paper is organised as follows. Firstly, we provide the necessary background on AI and OOO that will subsequently enable us to introduce the philosophical probes with interwoven examples of their use and demonstrate how they offer novel perspectives on the materiality of AI.

We subsequently bring all these constructs together into a design process of an ontological artefact to illustrate such an alternative perspective and morphology of Amazon's AI assistant Alexa. Finally, we conclude by reflecting on the use of philosophical probes in the design process and the fruition of a materialistic and tangible perspective of AI.

2. Artificial Intelligence

The increased magnitude of quantitative data sets generated via various sources has coincided with significant enhancements in computational power, catalysing considerations of what AI can achieve (Pilling & Coulton, 2018). To this effect, AI has been plugged into a myriad of applications from parole to financial management, positioning algorithmic decision making as an emerging governing power. The consequences of such technology on society are already significant. Though we are increasingly exposed to AI, it is often not perceived as such, and even when it is, the inner workings and parameters of its decision-making process are obscured and therefore challenging to contest (Burrell,2016). This obscurity is fostered by the ambitious historical visions of creating a machine with a human-level of general (or strong) intelligence. The desire to create an AI capable of human-level intelligence is a

dominant catalyst for anthropomorphising AI-infused technology. In reality, the typical AI applications in use (e.g. Bayesian networks, machine learning and artificial neural networks) are narrow or weak AI, which is arguably the outcome of failed attempts to develop strong/general AI.

An extensively implemented application of narrow AI is machine learning (ML). Computational algorithms often process devices of socially consequential classifications and rankings, and in contemporary practices, it is more common that ML algorithms are determining these classifications. In our present era of big data, trillions of data and properties of data, termed features are analysed, adding to the complexity of an already complicated ML code. It is also worth noting human bias resonates and is amplified through ML processes, via the data and the coding, which disseminates from both into learning bias. In detail, the internal decision logic that has been coded in the ML algorithm is altered as it learns from the data, where the configuration of learning is intelligible to humans. Processing at such an elevated level, the ML techniques face computational resource limits and manage this using, again, procedures written into the code known as 'principal component analysis', which emphasise variation and bring out the strongest patterns in a dataset, once more adding to the opacity (Ibid). ML is applied to various 'problems' for which encoding an explicit logic of decision-making does not work, and that the act of coding is a two-sided operation and communication, where the human codes for the machine to learn (Ibid). Simply put, the algorithm evolves beyond human intelligibility and understanding, to work out problems concealed within the matrix of the machine's logic.

To this end, narrow AI facilitates a myriad of functionalities such as facial recognition and natural language processing, which are implemented into diverse contexts including surveillance, personal assistants such as Alexa, chatbots and recommendation services like Netflix. Though, the two categories of AI (strong/general and weak/narrow) have a long-shared history, which has materialised into often confusing one category for the other. This historically entrenched confusion, whereby it is difficult to distinguish between these two 'AI pillars', together manifests as 'AI's definitional dualism' (Lindley et al, 2020). A term used to label the co-evolution of meaning across these two very different and broad interpretations of AI. With that in mind, the popular discourse around AI leans towards strong AI. A field that is no doubt dramatically entertaining, though highly speculative, hypothetical and the stuff of science-fiction. However, it is frequently believed to be the reality of AI technology for several reasons; an echo of the historical ambition of AI, the openness of (the theoretical) discussions regarding strong AI, scaremongering from the media about the impending doom of Skynet and the predisposition to anthropomorphise AI. Though, the obscure nature of narrow AI on many different levels is problematic. Such as, its implementation into diverse, profitable trade secret applications, the algorithmic processing that is rendered unintelligible to humans and the complex layers of independent motivations (i.e. business model, data gathering etc.) which are roles of interdependent systems delivering services like Alexa.

To this end, the adoption of OOO into design approaches can enable the designer to compose alternative perspectives on AI, its assemblage, and map the morphology of things,

which can, in turn, facilitate the process of designing systems that are legible to users and designers alike. The philosophy of OOO, which will be detailed in the next section, directly addresses the multiple perspectives of things, by which different things can be considered beyond what may be presented to an observer.

3. Object Oriented Ontology

OOO is a relatively new school of philosophy emanating from a materialist line of thought. OOO is submerged in the philosophical thinking of Speculative Realism, the belief of a reality outside of the mind that exists independent of human experience. Thus, OOO theorises that every individual 'thing' has its *own* reality, which does not necessarily correlate with human experiences. Consequently, it is a rejection of Correlationism - the view that being exists only as a correlate of the mind, in other words, if things exist, they do so only for us (Meillassoux,2008). As a collective, these philosophical speculations offer different perspectives regarding ontology, considering "being a problem of access, and human access at that" (Bogost, 2012a, p.4).

Speculative Realism broke away from continental philosophy and emerged from a one-day symposium that featured presentations aimed at forging a new positioning distinctly different from Idealism, by the distinguished philosophers Harman, Grant, Brassier and Meillassoux. Despite the unanimous rejection of Idealism amongst these philosophers, their own philosophical interpretations have slightly furcated and broken apart into various splinter groups that bear little resemblance to one another. Harman's OOO is constructed with and from the notion of phenomenology, particularly in challenging Heidegger's theory from *Being and Time* (1927). To anchor this thinking, Harman makes clear that phenomenal experience is a process of showing us numerous different qualities by which we can distinguish between different things (Harman, 2018, p.153).

Heidegger advocated that 'things' are impossible to understand in themselves, but instead are related to purposes: if a thing is ready-to-hand one can concentrate on the task rather than the tool; it is present-at-hand when such concentration is broken. This is simply described by Harman: "[w]e generally notice equipment only when it somehow fails" (Ibid,2011a, p.38). Harman's counterpoint to this view reveals that things are not merely defined through human use but through any use, including object to object situations.

Objects are seen in OOO as existing independently of their relations with other objects. An attempt to examine an object based on its relations is what Harman calls *overmining* and *undermining*. When an object is undermined, it is treated as a composite of things which are themselves built of more fundamental things; "in the crude present-day materialism that holds objects to be nothing more than conglomerates of molecules" (Ibid, 2011b). Harman states that we can also dissolve them upwards or to overmine, where objects are real only insofar as they perceive or affect other things. An example of where this happens often is in scientific materialism, where undermining occurs when it identifies components from which our everyday objects are built, but overmines when it thinks these tiny pieces are nothing

over and above their mathematizable properties. In a nutshell within the realms of OOO, the experience of a thing cannot be reduced to scientific description. Which is a divergent perspective from the common undermining positions to "understand reality as smaller bits, be they quarks, DNA or mathematics", or overmining positions to "take objects to be less real than the processes and circumstances that produce them"(Bogost, 2012b). For clarity, Bogost further explains that the sciences tend to undermine, and the humanities to overmine (Ibid). The philosophical history, for Harman, from Aristotle to Zizek is overshadowed by ideas that overmine and undermine the reality of objects.

"In place of undermining and overmining" asks Bogost, "what if we decide that all things are equal - not equal in nature or use or value, but equal in existence" (Ibid). This ontological positioning is not customary in philosophy or more generally for that matter. In a flat ontology as defined by Bryant, everything exists: even things of the imagination, such as unicorns and magic, exist. A flat plane emerges where existence is non-hierarchical, no existence is more primary and no more original than any other, where "humans are not at the centre of being, but are among beings" (Bryant, 2011, p.249). This open-mindedness is necessary for OOO, forging the concept that the term 'object' is not limited to material things but extends to any given idea or construct.

An eminent example of placing humans at the epicentre is the construct of AI. The intelligent aspect demonstrated by machines is used to describe functions that mimic the cognitive functions, such as learning conjuring principles of the human mind. Alan Turing's influential paper *Computing Machinery and Intelligence* (1950) begins with a question that continues to dominate the technological discourse of AI: 'Can machines think?' in the section unironically titled the *Imitation Game*. We can ascertain, without knowing the details of the game, that the objective is to relate machine behaviours and functionalities to those of a human, conforming to the singular human correlation. A computer is considered intelligent if successful, though paradoxically as soon as an AI solves a problem, it is frequently declassified as non-intelligent, and merely computational or used "brute force methods" of crunching massive amounts of data (McCorduck, 2004, p.433). The theory of AI is always positioned to be out of reach. Regarding the current ontological System Operations, science assumes that the nature of the computer is correlated to the nature of human experience, as Bogost positions it "[t]o discover the true nature of computation is also to discover the true nature of human reason" (Bogost, 2012a, p.15). It is apparent that in the six decades since Turing's question, the operation or the thought of machines has been entangled with humanistic conditions. The construction, programming and improvement of machines are a global industry worth billions, where there is little room to understand the machine as a thing in itself.

Within OOO, there is an appreciation that the machine possesses its own existence, and "capable of more than the purposes for which we animate it" (Ibid, p.16). OOO opposes the human world correlate, but it does not reject human beings or their place in the world, a posthumanist ontology is one where "humans are no longer monarchs of being, but are instead among beings, entangled in beings, and implicated in other beings" (Bryant,

2011,p.44). Bryant theorises that there can be a 'democracy of objects', where, rather than there being two distinct ontological domains, a flat ontology can unite and synthesise the human and nonhuman into a common collective (Ibid, p.24-5).

4. Bogostian Proposition

To better understand how OOO can provide an alternative material perspective on AI and a way of assisting design practice, we turn to the Bogostian proposition of OOO; he called *Alien Phenomenology*.

Bogost points the way to the application of his theory to AI with his flat ontology of the doomed 1982 video game E.T.: The Extra-Terrestrial for the Atari Video Computer System (Bogost, 2012a, p.17-8). Bogost's initial point to flatten the ontology is to ask, 'what is E.T.?'. His flat ontology takes the form of a diverse list of ontological things thrusting alien units together, from the human-made, or the naturally formed, to theory and everything in-between. Thereby amplifying the potency of a flat ontology by speculating on an alien experience. Lists are abundantly found in both Latour's and Harman's work, as lists capture the many and varied forms of being, their interconnectedness and their inherent partitions.

> "E.T. is - 8 kilobytes of 6502 opcodes and operands, a moulded plastic cartridge held together by a screw, a product packaged in a box and sold at retail, a system of rules or mechanics that produce a certain experience, a story of an alien botanist stranded on earth, an interactive experience players can partake in, a unit of intellectual property that can be owned, a sign that depicts the circumstances surrounding the videogame crash of 1983" (Ibid, p.18).

To illustrate how this works in practice, let us ask a similar question - what is Alexa?

Alexa is – a cloud-based conversational voice service, a female presenting voice assistant completing various sound-based interactions and actions such as voice and music playback for a user, listens for users making sounds via the seven microphones in the housing unit, listens for its own name "Alexa" to be at the attention of the user, AI operations are located within the backend systems known as the Amazon Web Services (AWS) such as automatic speech recognition (ASR) that converts audio into words…

The practice of creating a flat ontological render of a thing reveals that Alexa, or any *thing*, is simultaneously many different things. There is no elementary unit that comprises Alexa, nor is it it's composite, and to say so would be an Irreduction, according to Latour. Here Bogost offers us a model called "unit operations" to describe the sorts of being that exist simultaneously with, yet independently from one another (Ibid).

4.1 Unit Operations & Constellations

Bogost's analysis of things is that they are made up of units and uses the word 'operation' to describe how units behave and interact. To investigate a unit operations ontology is a practice of speculation, "If we speculate more - about everything - reality will become more malleable" (Dunne & Raby, 2013). How do all the units within and of Alexa behave and

interact? When the flat ontology of being expands something is always something else; a relation in another function or assembly or a part of another whole (Bogost, 2012a, p.26). Things are not merely what they do, but that things or units do in fact do things, tracing the reality of variances between different objects is exposing a unit's operation, the rationale by which objects perceive and engage with their worlds (Ibid, p.29). Bogost believes that a unit's means of making sense to another is not universal and cannot be explained away through natural law, scientific truth, or even its own perspective but through the practice of speculation considering all relations and the perspectives of a thing. Speculative Realism creates an opportunity to make reality more malleable, to use Dunne and Raby's notion, which pertains to Harman's concept that speculation is only a rough sense, a representation - a caricature of new insight.

Bogost emphasises that unit operations fall into the domain of phenomenology. Phenomenology, fundamentally, is "to describe objects just as one experiences them, and to extract philosophy from the process" (Hammond et al,1991, p.2). Bogost's main argument is that as humans, we may be able to describe how objects and assemblages work, but what is it like to be a thing? What is the alien's phenomenology and experience? Can we understand something in its own terms (Bogost,2012a, p.10)?

As aforementioned, the intricacies of AI are a challenge for human understanding. An alternative perspective of things and their impacts can unravel additional ways of interpreting the materialistic characteristics of AI. "Just as the astronomer understands the stars through the radiant energy that surrounds them" says Bogost "the philosopher understands objects by tracing their impacts on the surrounding ether" (Ibid, p.33). The ether of the Internet of Things (IOT) has previously been described using the metaphor *constellation* (Coulton & Lindley, 2019). A metaphor to describe and frame OOO-thinking for designers working in the context of IOT, to illustrate the wild variances in how things can appear depending on the perspective the observer takes. Succinctly described as 'ideas are to objects as constellations are to stars' (Benjamin, 1999). Here we appropriated the metaphor constellation to frame OOO-thinking in the context of AI to address multiple perspectives and thereby consider different forms of unit operations. In summary, by observing an AI constellation from multiple perspectives, designers can speculate, for example, different forms of bias considered beyond simply what may be present in the learning set. The role of OOO through the scope of constellations brings forth multiple perspectives and highlights the interdependent and independent relationships and perspectives within the Alexa assemblage (see figure 1).

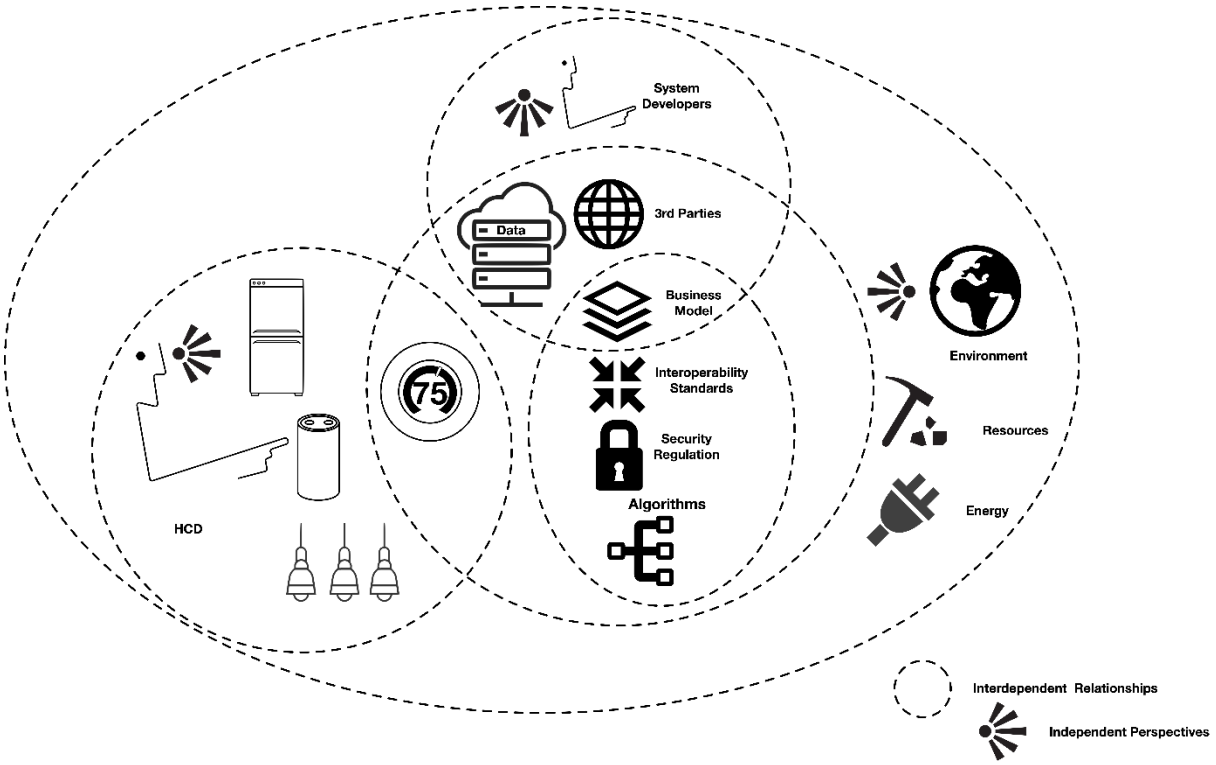

Figure 1 *This is an example of a constellation map of various IOT objects, which includes an Amazon Echo and numerous unit operations. This maps the interdependent relationships and independent perspectives that can be considered, brought about using the metaphor of constellations to frame OOO-thinking for design.*

4.2 Ontography as Practice

Bogost's adoption of ontography is an inscriptive strategy that exposes the abundance of units, their operations and their inter-object relations: it is a catalogue of being.

Ontography is a practice that exposes the couplings and chasms between units, where revelation invites speculation (Bogost,2012a, p.50). Leonardo Da Vinci was famous for his exploded view diagrams of speculative flying contraptions and anatomical drawings, exposing the operation of things, the constellations of units and providing a glimpse into something alien.

Figure 2 illustrates our exploded ontographical research of the Amazon Echo and the backend Alexa service using filed Amazon patents. This is a sample of our research, detailing the exposed unit operations engaged: digital units, mechanical units, data units, programming and processing units, and several AI units operating within the backend units of the Amazon Web Services (AWS). This ontological research enables us as designers to observe and trace a unit's influence and emergent qualities to better understand the things we speak to and place in our homes to record and capture a profusion of data consequently fed into backend AI systems.

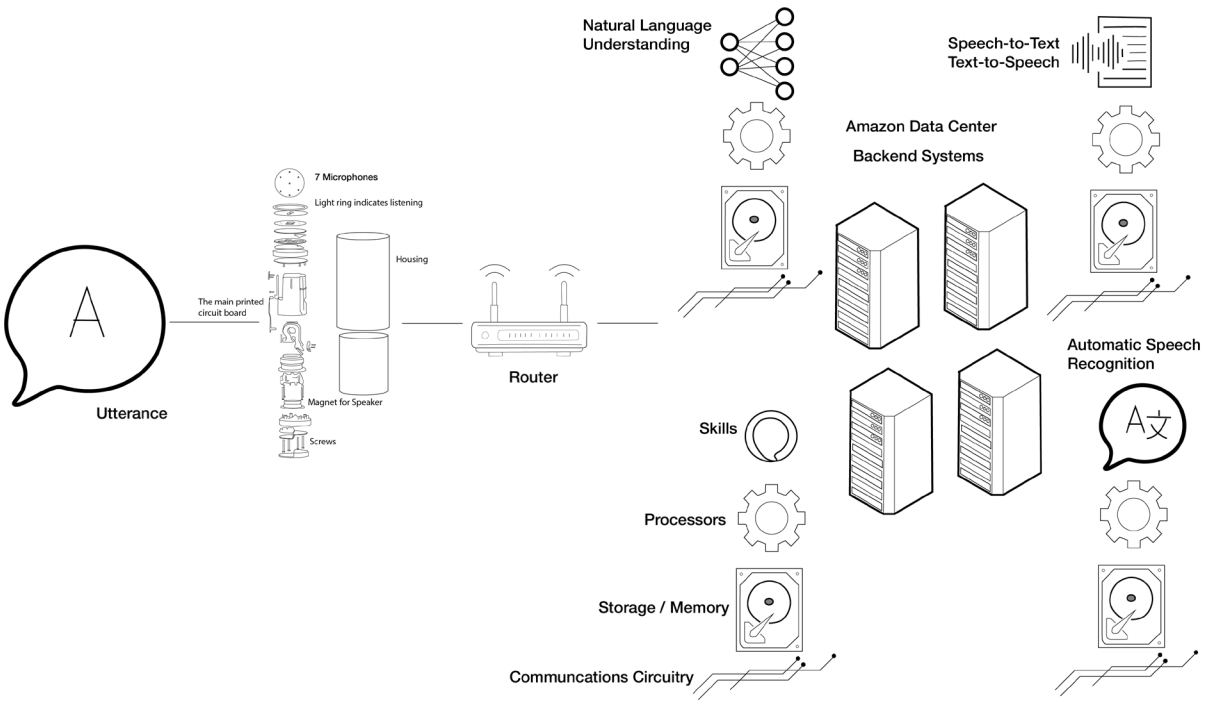

Figure 2 *Our exploded ontological diagram of the Amazon Echo and Alexa service, here you can see a user's spoken 'utterance', and the path through the various units and unit operations towards the Amazon backend services where data is fed into various data and AI systems.*

4.3 Metaphorism

In his famous paper, the philosopher Thomas Nagel attempted to answer the question "What is it like to be a bat?" (Nagel, 1974, p.435-50). We, following Bogost's example, have titled our work in a similar vein, and use Nagel as our starting point to consider Metaphorism.

Nagel's work focuses on the idea that consciousness has a subjective character, which cannot be reduced to its physical components. For Nagel even if the experience of a thing can be explained as a unit operation, it fails to describe the experience of a thing, known as "the subjective character of experience" (Ibid, p.436).

The subjective character of experience – 'what it is like to be a thing' is out of reach or withdrawn. A bat's sonar is a form of perception; however, it is alien to us. We possess no similar senses; thus, there is no reason to subjectively link it to anything we can experience or imagine, according to Nagel (1974). The best thing we could do is try to invoke what it might be like to be a bat, but this is a task we will always fail in. We are as Nagel says, "restricted to the resources of our own mind", imagining what is like to be a bat is not the same as being a bat (Ibid, p.439). Nagel asks for an "objective phenomenology" one that is "not dependent on empathy or the imagination" (Ibid, p.449).

However, as Bogost points out in his analysis of Nagel's work, to understand how something

operates on its surrounding or they on it, is different from understanding how that other thing understands those operations. They are isolated unit operations - the bat's sonar perception exists separately from the bat's grasping of that apparatus (Bogost, 2012a, p.63). To understand the effects of high-frequency vibrations of sonar has nothing to do with understanding what it's like to be a bat (Ibid). For Bogost, Alien Phenomenology accepts that the subjective character of experience cannot be fully known objectively. Therefore, the only way to "perform alien phenomenology is by analogy: the bat, for example, operates like a submarine" (Ibid, p.64).

We create caricatures to understand things though we do this by placing human agency on them to make claims about the reality of things, such as using the anthropomorphic metaphor that a bat's sonar operation is akin to a submarine. The liability of anthropocentrism is unavoidable (Ibid, p.64). Though negotiating with things via metaphors, we can recognise that we are *omitted* from the experience of things, as the sonar of a bat can be understood by the metaphor of another thing. In other words, metaphors assess the perception itself, not the perception of things, which recedes just as any object does—thereby releasing things from the relation of reductionism between objects, creating a flat ontology (Ibid, p.67).

What is the metaphorism for Alexa? An obvious, analogy would be that Alexa speaks and responds like a human, a would-be contestant for the 'Turing's Imitation Game'. Amazon effectively uses the metaphor 'assistant' for commercial advertising and provides an insight into its operational dynamics for the user. However, we should start from an alternative position of inquiry, rather than falling into the trap of anthropomorphising technology. Perhaps a critical analogy is that Alexa is like a listening device, akin to those utilised since the 1950s by the CIA. Similarly, both devices listen and transmit data for a human at the backend to listen to, process and tag information. Here the analogy finishes due to the differences going forward of how the information or data is handled, therefore permitting a further metaphorism at this point. At this juncture, we start contending with the digital units, where data is fed into various backend routes, such as Alexa Voice Service (AVS) where numerous processes, including ML occur. In practice, we would start to ask questions such as; what is it like to be data going through a neural network?

The practice of metametaphorisms opens up a multitude of possible speculations about the "weird relations between objects" (Ibid, p.81).

4.4 Carpentry

Bogost's most potent probe, to illustrate the perspectives of objects, is derived from the ideas surrounding Carpentry; the process of constructing artefacts that conduct philosophy, where the making of things is championed.

Bogost's ideology is – "[I]f a physician is someone who practices medicine, perhaps a metaphysician ought to be someone who practices ontology" (Ibid,p.91). There is primary importance in the act of doing as "craft holds the key to knowledge" (Latour, 1988, p.218),

which forges opportunities for understanding phenomenology (Ihde,1986). Due to the rejection of Correlationism, the act of Carpentry automatically refuses to address only the human actant within the artefact.

The practice of Carpentry has been developed from two sources: primarily the conventional sense of carpentry where one grapples with and creates from materials; secondarily from Harman's reference to Carpentry as the "metaphysical way in which objects are joined or pieced together, as well as the internal composition of their individual parts" (Harman, 2005, p.2). Bogost's analysis of Harman's thesis – "[the] phrase [carpentry of things] to refer to how things fashion one another and the world at large. Blending these two notions, carpentry entails making things that explain how things make their world" (Bogost, 2012a, p.93). As Bogost defines it, the act of carpentry is to create ontological tools to identify the diversity of being, to facilitate the emergence of its own ontology.

An example of Carpentry given by Bogost's is Ben Fry's Deconstructulator, an exploded view of the Nintendo Entertainment System's memory architecture which displays the sprite and palette systems of current gameplay, depicting the internal units of the game and the machine's manipulation of them (Ibid, p.96).

In summary, Carpentry is a hands-on approach to experimentation through the manipulation or the vivisecting of objects, consequently creating artefacts that attempt to reproduce the unit operations of another thing's experience. Admittedly an experience we can never fully understand, but by speculating, we can trace the outline of their effects on the surrounding world (Ibid, p.100). This is the process of metaphorising things for human comprehension.

Our endeavour to further our understanding about the fabric that embodies Alexa continued when we focused on the opportunity of developing a third-party Skill available through Amazon's developer site, complete with a developer console running on the coding language Node.js. A Skill enables users to interact with Amazon's Alexa service via voice interaction. Examples of Skills includes music playback or setting an alarm. Skills consist of two main components: a Skill service located on the cloud, that is coded working with the second component, the Skill interface, that is configured in Amazon's Alexa developer console. The interaction between code and interface creates a Skill.

Through the act of making Amazon's own Skill tutorial exercise *Cake Walk*, we were able to expose and grapple with the units that compose and bring functionality to Skills. Thus, explain how things make their world (see figure 2). For more clarity, the process of coding utterances and intents would expose them firstly as units. Subsequently exposing their operations of being processed through the conversational AI technology, via automatic speech recognition, for conversion to text, and natural language understanding to recognise the intent of the text. Consequently, through the act of Carpentry, we were able to explode a small portion of the ontography of units that form Alexa.

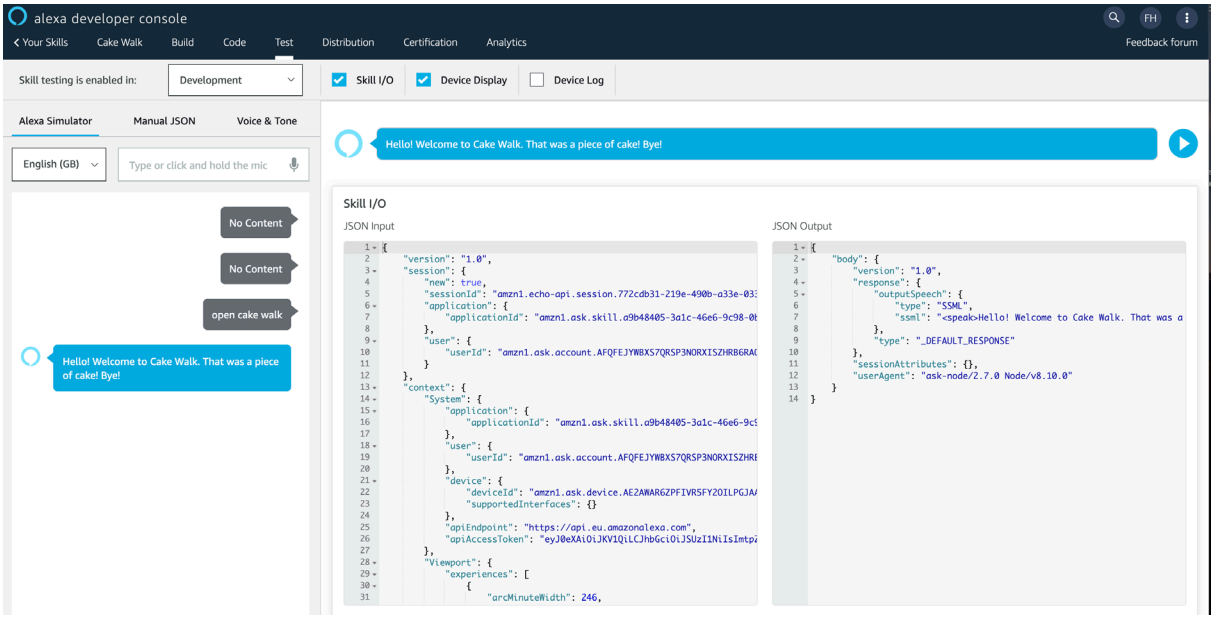

Figure 3 *The Alexa Developer console, where developers can build and test skills through an Alexa simulator. The process of making exposes the code or the units that compose and bring functionality to the Alexa Skill, as well as the AI units that complete the Skill System.*

Here we take the opportunity to interlace all our probes and findings into a single artefact, a VR speculative animated flythrough of Alexa's unit operations (See figure 3). The rationale for creating a VR animation was to compile all philosophical studies into one onto-graphical experience machine, simultaneously presenting an exercise in Carpentry of an exploded flat-ontological constellation of unit operations. The visual dimension of the animation provides context; a fictional skin and narrative further metaphorising the being of Alexa and mapping the morphology of Alexa's assemblage. The VR implementation is a play on the subjective and objective notion of phenomenology.

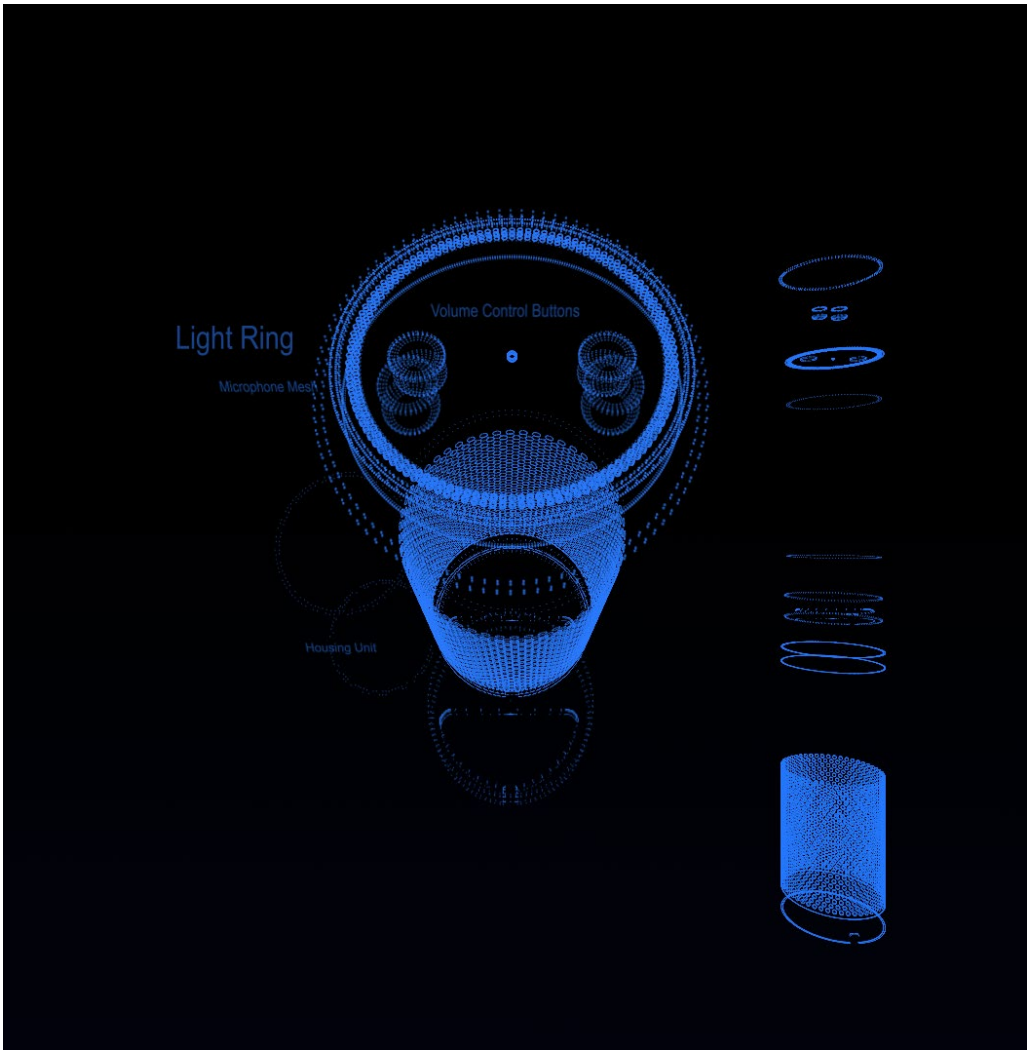

Figure 4 *A screenshot from the VR animation flythrough, which is about to enter the ontologically exploded Amazon Echo, showing the passage through the different units.*

5. Conclusion

Within this paper, we have provided a detailed account of utilising philosophical thinking to create design probes. Where the role of OOO can be used to illuminate the interdependent and independent relationships within AI assemblages.

While anthropomorphising AI might allow these relations to surface, OOO-thinking enables the designer to map the morphology of assemblage, thereby speculate beyond the remit of the observer's perspective of a thing. It is also worth noting that while this paper has clearly defined that the anthropocentrism is unavoidable, there is a formidable need to consider alternative methods, like OOO, of engaging with technology. A necessity, as AI currently stands as unintelligible to humans. The philosophy of Alien phenomenology also prompts the clear separation of the two pillars of AI, and their definitional dualism of strong/general and weak/narrow, by perceiving them as things on a flat ontology. Amongst humans rather than a

conflation through anthropomorphism.

Due to the opaque nature of AI, the speculative and metaphorising prospect of probes provides the opportunity to experimentally engage with theories, offering alternative avenues of thinking about *things* and beyond. We have demonstrated what the practice of Carpentry and ontographical probes has to offer for design, forging approaches to disassemble and resemble new meanings from things. This creates opportunities for unexpected conclusions and theories, leading to greater awareness, and potentially for designing preferable ways of implementing governing technologies.

We have also demonstrated throughout how we have actively engaged with these philosophical probes in practice by vacillating, deconstructing and expanding our perspective of Alexa from the physical to the digital compositions, to the frontend and backend services and displaying the diversity of materialistic units and their operations that compose AI systems.

Our approach to design is a practical process of making and Researching through Design (RtD) to capitalise on alternative ways of seeing. In this case, we use philosophical notions, especially Carpentry, to cultivate new methodologies apt for a critical approach towards subversive things. Our research into AI as a material is not at an end, but a proposition to bring in alternative methodologies and strategies from disparate disciplines to question the nature of technology as a material we can design with.

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Edge of Tomorrow: Designing Sustainable Edge Computing

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Abstract: Vaunted as the next frontier within the scope of the Internet of Things (IoT), Edge Computing (EC) is seen as a means to improve efficiency and privacy across IoT infrastructures. This is because it enables data to be processed where it originates, that is, at the so-called 'edge' of the network, this being within, or close to, individual Internet-connected devices. Consequently, EC is considered more secure than conventional processing methods as data need not travel over networks to and from the centralised 'Cloud'. We argue that EC optimisation might also offer credible benefits for environmental sustainability, particularly regarding decarbonisation by minimising data-distribution. To make this case, we outline the creation of two integrated design fictions which highlight environmental harms resulting from widespread Cloud data management, as well as envisioning potential future sustainability advantages of Edge-based processing. Based upon our process, we put forward an initial model for Sustainable Edge Computing.

Keywords: edge computing; data; decarbonisation; internet of things

1. Introduction

The term *Internet of Things* (IoT) was first coined by Kevin Ashton (2009) in 1999 to describe the idea that any, and potentially every physical artefact, could be connected to the digital infrastructures of the Internet in order for it to be able to collect and share information. From voice activated smart speakers and fitness tracker wearables, to autonomous vehicles and vacuum cleaner robots, the IoT continues to expand at a staggering rate. Whilst global estimates vary regarding the current number of devices which make up the IoT, Statista (2018) contend that there are approximately 27 billion IoT products at present and predict that this number will increase almost threefold to around 76 billion by 2025.

As we progress towards a denser and more complex ecosystem of IoT products, services and systems, it is extremely probable that *datafication* – the generation, processing and storage of both user and automated IoT data – will also increase dramatically in the near future.

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Current estimates maintain that globally 2.5 quintillion bytes of new data are created every day (IBM, 2017). Goodbody (2018) states that this equates to 16 zettabytes of data globally every year with the potential to increase tenfold to 160 zettabytes by 2025. The ensuing growth in datafication will likely be accelerated by increasingly fast networks (for example, 5G) which will facilitate quicker data transfers across IoT infrastructures (Kenworthy, 2019).

Today, the 'Cloud' serves as the primary locus for IoT data management, processing and storage. Some believe however, that the Cloud, in its current form at least, will be unable to efficiently facilitate a more advanced, accelerated and demanding IoT infrastructure (Miller, 2018). It is posited that such issues can be alleviated by the development of improved *decentralised* and *localised* data management methods, specifically, those which occur at the 'edge' of the network, that is, where data is processed and stored closer to where it is first generated – that being either within the IoT's physical devices themselves or, at the very least, in close proximity to such devices (Chakraborty & Datta, 2017). This alternate, nascent method for processing data has been termed *Edge Computing* (EC).

2. Cloud-Fog-Edge

Like *Cloud Computing*, EC is also intrinsically linked to *Fog Computing.* Figure 1 demonstrates the linkages and key differences between these three primary mechanisms through which IoT data is presently processed (PETRAS, 2019). In simple terms, the Cloud enables people to store data beyond the confines of their physical devices' internal storage, often in very large quantities. For example, an *Apple iPhone* user might regularly 'back up' photos they have captured to *Apple's iCloud* platform for safekeeping, while work colleagues situated in different locations might collaborate on shared documents through *Google's Drive* service.

Importantly, although the Cloud is predominately referenced in terms of being a single *centralised* entity, Figure 1 illustrates that it actually manifests as thousands of interdependent *data centres*. Top of FormBottom of FormThe so-called *Big Five* tech firms (Simon, 2011; Sterling, 2014) – *Google, Microsoft, Amazon, Apple and Facebook* – have all developed sophisticated Cloud data centres, both to process and store data generated via their own IoT ecosystems, and to also manage data silos emanating from a host of competitor connected products and services. *Fog Computing's* role in relation to the Cloud and the Edge could be described as acting almost like a 'middleman'. The 'Fog' is essentially the network connections – millions of remote servers – which transfer troves of data between billions of IoT devices located at the edge of the network and thousands of Cloud data centres (CB Insights, 2018).

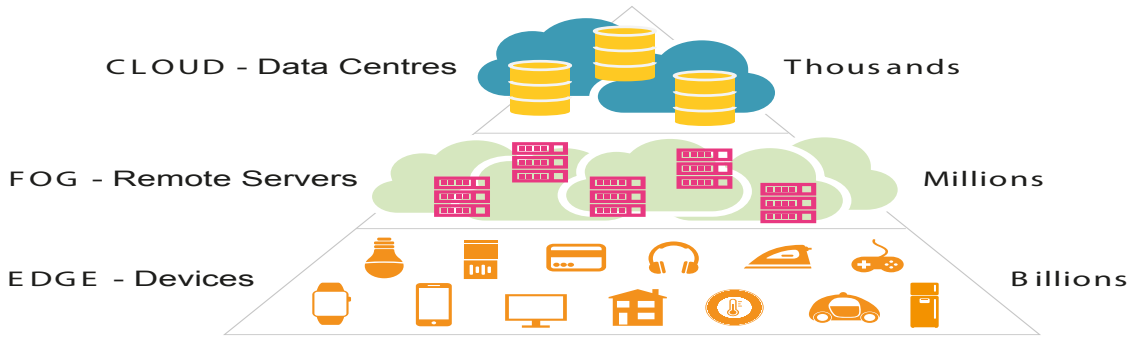


Figure 1 The relationships and contrasts between Cloud, Fog and Edge Computing (PETRAS, 2019).

3. Getting closer to the Edge

As it would still be required for some crucial operations, it is unlikely that EC would replace the Cloud in its entirety. However, the promise of EC is attracting considerable investment (MIT Technology Review, 2019). Two core debates seemingly sit at the heart of current EC research, namely the *efficiency* and *privacy* advantages of processing data at the edge. If devices were to begin to act as 'micro data centres', Kalal et al (2019) envision that the efficiency benefits for the IoT would be threefold – *accelerated processing, decongested networks* and *decreased latency*. EC's *accelerated processing* for example, could be critical to safeguarding passengers and pedestrians lives in a future world where millions of autonomous vehicles are generating troves of data – the processing of which would likely overwhelm existing Cloud infrastructures (CB Insights, 2018; AECC, 2018).

Databox (Figure 2) is an Edge device that has been designed with built-in *privacy-preserving functionality*. Instead of automatically transmitting domestic IoT data to Cloud servers, the home router grants its users' *control* of how their data is processed (Databox Project, 2019; BBC, 2019b). Consequently, *Databox* is a practicable example of a new strategy for IoT design which Mortier et al (2016) term *Human-Data Interaction* (HDI). Gradinar et al (2019) advocate that HDI can help address three key IoT privacy design challenges:

- *Legibility* ensures that IoT data processes are made clearly understandable to users;
- *Agency* ensures that users can easily use and store their data as well as manage third party access to it;
- *Negotiability* ensures that users are able to manage the social interactions that result from data processing and derive value for themselves.

We contend that in addition to *efficiency* and *privacy*, shifting data management away from

the Cloud to IoT devices themselves could also provide tangible benefits for *environmental sustainability*, particularly with regards to reducing Cloud related carbon emissions.



Figure 2 *The Databox home router is an Edge IoT data processing device (www.databoxproject.uk).*

4. The Carbonised Cloud

The IoT is regularly couched in rhetoric which promises a future where our lives are made easier through increased datafication, affording us more time to do other things whilst our devices and services consume less energy and save us money. What is frequently absent from this narrative are discussions regards the tsunami of data which will be generated as billions of additional products and services become networked, and perhaps most importantly against the backdrop of a climate emergency, what the environmental impacts of this surge in datafication will be. As noted earlier, it is often easy to consider the 'Cloud' to be a single *benevolent* and *ephemeral* entity. Efoui-Hess (cited in Stone, 2019, para. 20) agrees, stressing how "the digital mythology is built on words like cloud… something that isn't really real. That's how we picture it." Figures 3 and 4 help to further clarify that the Cloud is in fact an immense, permanent, physical infrastructure characterised by thousands of interdependent data centres – commonly referred to as 'server farms' – which host the Internet and manage its unrelenting dataflows. Similarly, because 'data' is not considered to be *visible* to the naked eye, it is often referred to as 'immaterial' and believed to be relatively harmless and of little impact, certainly in an environmental capacity. However, like the Cloud, we argue that data is in fact *in material* – it is stored within billions of physical IoT devices, within the labyrinth of cables that connect global computer networks, and within the

plethora of aforementioned Cloud data centres. Further, alongside the embedded

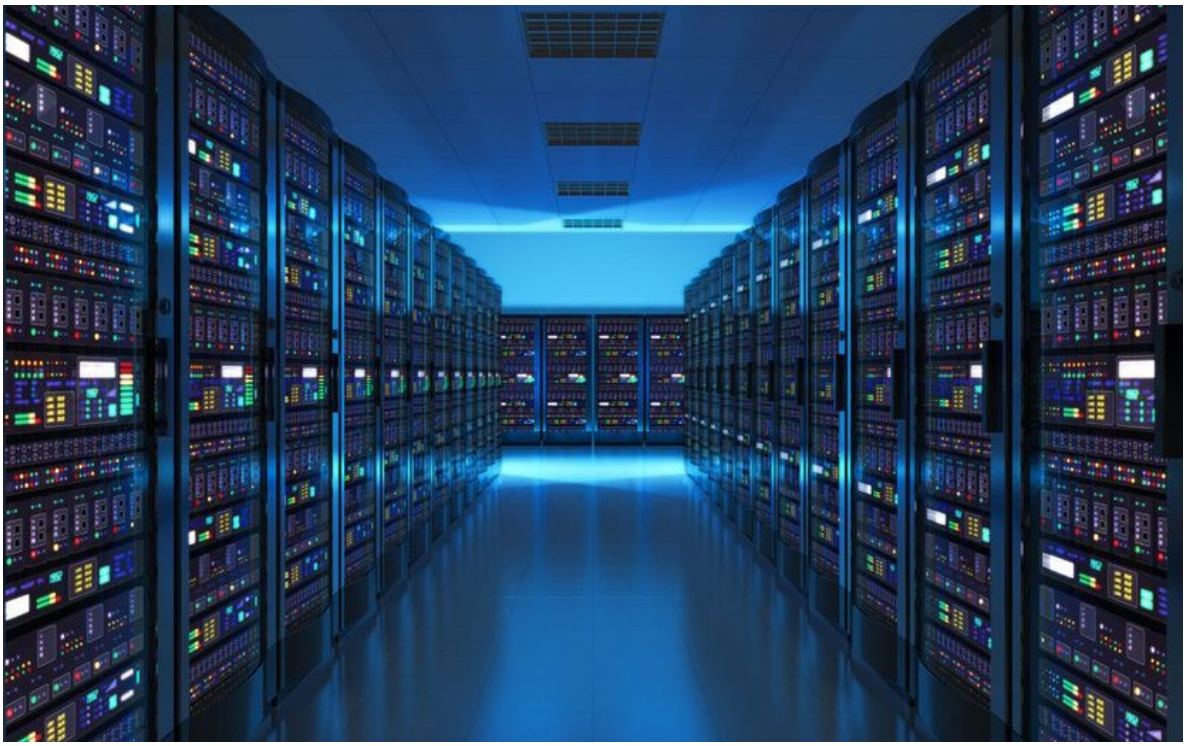


Figure 3 *The interior of a Cloud data centre or so-called 'server farm' (Laboratorio Linux, 2017, https://creativecommons.org/licenses/by-nc-sa/2.0/).*



Figure 4 *The exterior of Google's data centre – 'The Dalles' – in Oregon, USA (Visitor 7, 2011, https://creativecommons.org/licenses/by-sa/3.0/deed.en).*

energy and material resources that are used to manufacture connected devices (Stead et al, 2019a), the vast infrastructure upon which they operate consumes copious amounts of energy, generates large amounts of heat and releases prodigious amounts of carbon emissions – all of which actively contribute to climate change (Crawford & Joler, 2019).

Figure 5 seeks to visualise the relationship that IoT devices have with their data and the wider infrastructures to which they are connected. In short, data transactions are not just one simple transfer from user devices to the proverbial Cloud. Despite their apparent 'immateriality', IoT infrastructures are obscure and complex, and have a tangible and detrimental impact upon resources, energy and the natural environment. Thus, the unsustainable realities of what Strengers (2013) calls the *smart utopia* – the narrative which dominates mainstream technological discourse – are becoming clearer. Globally, Cloud data centres currently consume 200 terawatt hours annually – which is approximately the same amount as South Africa (Tarnoff, 2019). Andrae & Edler (2015) estimate that by 2030, Internet technologies will account for more than a fifth of the world's electricity consumption. Meanwhile, French climate think tank *The Shift Project* (2019) state that widespread digitization is currently responsible for producing 4% of global carbon emissions; a figure which is likely to double by the 2025. Based upon these figures, use of digital technologies will soon eclipse the civil aviation industry in terms of both fossil-fuel derived energy consumption and harmful carbon emissions.

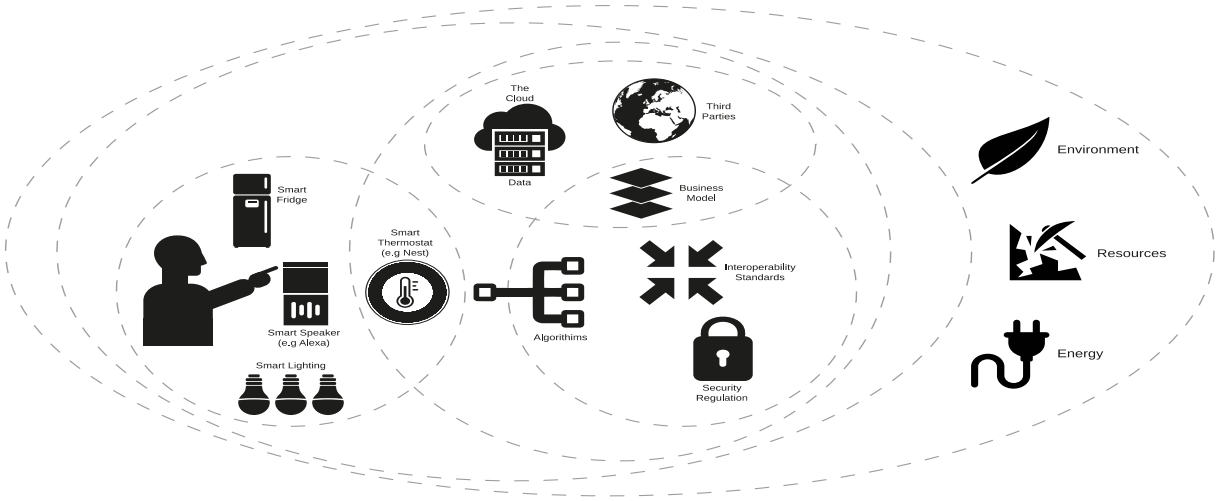


Figure 5 Visible and invisible things in an IoT enabled smart home system (Gradinar et al, 2019).

The United Nations (UN.org, n.d.) uses the term 'data exhaust' to describe how an enormous share of peoples' data is "passively collected [and is derived] from everyday interactions with digital products or services, including mobile phones, credit cards, and social media."

Peoples' limited understanding about unsustainable data production and distribution is in many ways analogous to the lack of societal awareness regards the damaging impacts that characterise the production and distribution of material goods. Berners-Lee (2010) drew attention to this issue by measuring the amount of carbon dioxide equivalent (CO_2e) for a variety of everyday objects and actions. For example, an individual orange will create 90g of CO_2e if transported by boat which increases to 1kg CO_2e if transported by air. Larger commodities such as a new 4x4 car creates 35 tonnes of CO_2e during its manufacture, while a single 5-mile drive in it creates as much as 22kg CO_2e (1 tonne per 45 miles driven). Berners-Lee also calculated average carbon metrics for several digital interactions including sending an email (4g CO_2e, increasing to 50g if an attachment is included), making an Internet search (between 0.7 and 4.5g CO_2e depending on computer's energy efficiency rating) and using a computer for 1 hour (around 63g CO_2e). While these figures appear innocuous in isolation, they quickly come into sharp relief when considered in relation to the growing proliferation of the IoT and its associated datafication. 2018 bore witness to 5 billion Internet searches, 500 million tweets, 294 billion emails, 65 billion *WhatsApp* messages and 4 petabytes of *Facebook* data (Desjardins, 2019).

To temper the growing carbonisation of the Cloud, Stone calls for radical transformation:

> "We'll need to… find cleaner ways to power the web, and reimagine how we interact with the digital world. Ultimately, we need to recognise that our tremendous consumption of online content isn't free of consequences—if we're not paying, the planet is." (Stone, 2019, para. 3).

Unable to ignore climate science any longer, many governments have begun to set ambitious mandates for decarbonisation (European Climate Foundation, 2018). Yet, such mandates do not call for reductions in data-driven emissions. Tarnoff concurs with Stone, arguing that in order for societies and governments to meet mandated decarbonisation targets, they must begin to 'decomputerise'. In his view, combating climate change will "require something more radical than just making data greener… we should reject the assumption that our built environment *must* become one big computer" (Tarnoff, 2019, para. 9). Such perspectives are routinely being undermined by other dominant voices which promote the almost Elysian benefits of adopting widespread 'smartness'. For example, Carmichael on behalf of the UK Government's *Committee on Climate Change*, cites increasing IoT datafication as:

> "An important asset… for enabling consumers to make informed decisions about technology adoption (electric cars and heating)… product information and feedback on purchasing habits (diet)… for redesigning financial incentives for shifts in demand (diet and aviation) and change at the system level (diet)" Carmichael (2019, para. 7).

Despite these analytic advantages, such a narrative is ignorant of the deeply carbonised nature of IoT technologies. Moreover, it allows tech firms like the *Big Five* to press on regardless with their IoT implementation plans. For whilst *Google* has announced that it is committed to only using carbon-free renewable sources of energy to power its Cloud data centres (Google, 2018), the company has also been accused of funding climate change denial campaigns (Hamilton, 2019) – perhaps in order to slow the growing backlash regards its data management's poor environmental credentials**.** In Figure 6, we have sought to illustrate the

carbonised nature of present-day Cloud and IoT related infrastructures. Our visualisation also emphasises the inconsequential role that EC currently plays across these networks in regard to decarbonising IoT data.

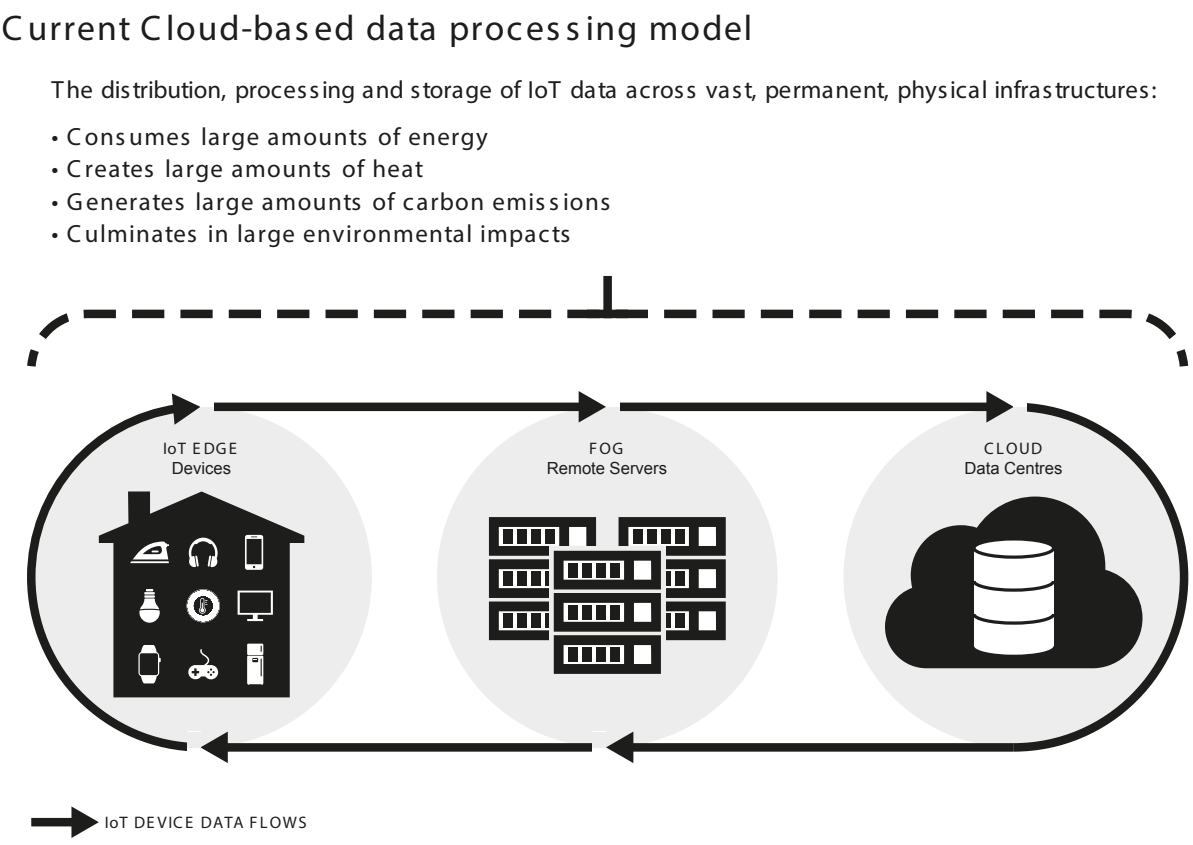


Figure 6 The unsustainable Cloud-based model presently used for processing IoT data (Authors).

5. Designing Sustainability at the Edge

Given the highly carbonised nature of the Cloud, we argue that it is judicious to begin to speculate about the sustainable possibilities of EC. To this end, we will next outline how we applied *Design Fiction as World Building* (DFasWB) methods to explore how EC may support the *decarbonisation* of IoT datafication, as well as highlight the growing unsustainable implications of present-day Cloud data management.

5.1 Design Fiction as World Building

Dunne & Raby (2013) use the term *affirmative design* to describe normative design practice which actively seeks to solve real-world problems through improvements to, and/or commercial production of, products, services and infrastructures. *Design Fiction* (DF) is different to *affirmative design* because rather than solving existing problems, we can use this research method to conduct design practice which aims to create fictional prototypes

which seek to highlight and critique present day cultural, technological, environmental, political and economic concerns. Furthermore, the prototypes help us to facilitate a greater understanding of the future implications inherent to new devices, developing technologies and nascent socio-economic trends (Bleecker, 2009; Hales, 2013; Coulton et al, 2018).

Coulton et al (2017) argue that DFasWB is an emergent form of DF which enables more compelling and constructive prototypes to be produced. This is because instead of creating a singular prototype, DFasWB is characterised by *collections of prototypes*, that when viewed together, *build a fictional world.* Moreover, each of the generated artefacts defines an 'entry point' into the said world. However, in order for the world to appear *plausible*, it is important that the individual artefacts "are mutually consistent and congruent with one another" (Coulton et al, 2017, p.177). We applied the DFasWB method to generate two integrated sustainable EC fictions – a user interface or 'dashboard' titled *InterNET ZERO* and an Internet connected fruit bowl called the *Fruit Sentry.*

5.2 InterNET ZERO dashboard

The *InterNET ZERO* dashboard visualises *decarbonisation metrics* based on the dataflows created by the different IoT devices and related services found inside a near future 'smart home'. Figure 7 depicts a householder interacting with the *InterNET ZERO* platform. The decarbonisation or 'D-CARB' metrics that can be accessed through *InterNET ZERO* are calculated as a result of EC data processing technologies. The domestic connected devices within the fiction are able to operate as individual and/or collective micro data centres. This means that they *locally* manage and store the data that they have generated through autonomously sensing their environment, by sharing information with fellow devices on the local network and via direct interactions with their user(s). Thus, in our fictional world, IoT data would not be passing back and forth from devices, through the Fog and to the Cloud.

We chose to name the fictional interface '*InterNET ZERO*' as an inference to the fact that many recent UK government body and environmental agency reports which call for rapid decarbonisation across modern societies – for example, Carmichael (2019) and Committee on Climate Change (2019) – have set *net zero* carbon emission targets by the year 2050. The *InterNET ZERO* dashboard can therefore be viewed as an attempt by progressive IoT platforms to work toward these decarbonisation directives, as well as a way that helps to make the datafication processes that underpin the Internet and IoT more *legible* to smart home users.



Figure 7 Users can view their device 'D-CARB' statistics on InterNET ZERO (Authors).

In Figure 8 we can see that it is possible to view the metrics which have been calculated for typical IoT products like a smart speaker, smart thermostat, wearables, lighting and an autonomous vehicle. In the fiction, we have also chosen to include a selection of what we deem to be *superfluous* IoT devices. Connected underwear (Skiin.com, 2019); IoT dental floss (SmilePronto.com, 2019); a smart fruit bowl – present day IoT design cultures provide a breeding ground for these kinds of gratuitous connected products. Some commentators such as Rose (2014) use terms like 'enchanted objects' to describe material things, which ostensibly, have no genuine need to be connected to the Internet other than for the novelty factor. We contend that such devices offer little meaningful value for users, other than providing short-term functionality. In addition, their lifespan is complex, obscure and unsustainable. They embody a design culture built on what Morozov (2013) terms *technological solutionism*. Though promoted as solving real-world issues, with perverse effect, these devices 'solve problems that do not really exist.' Developing upon Sterling (2005), we classify such superfluous IoT devices as *gizmos – unsustainable computerised things designed to have short lifespans* (Stead et al, 2019b). Material resources are wasted to manufacture *gizmos*, while their operation creates unnecessary data-driven carbon emissions. As such, the *gizmo* classification is the antithesis to the s*pimes* concept which proposes strategies for designing IoT devices with sustainable attributes *baked-in* throughout their entire lifecycle (Stead et al, 2019b).

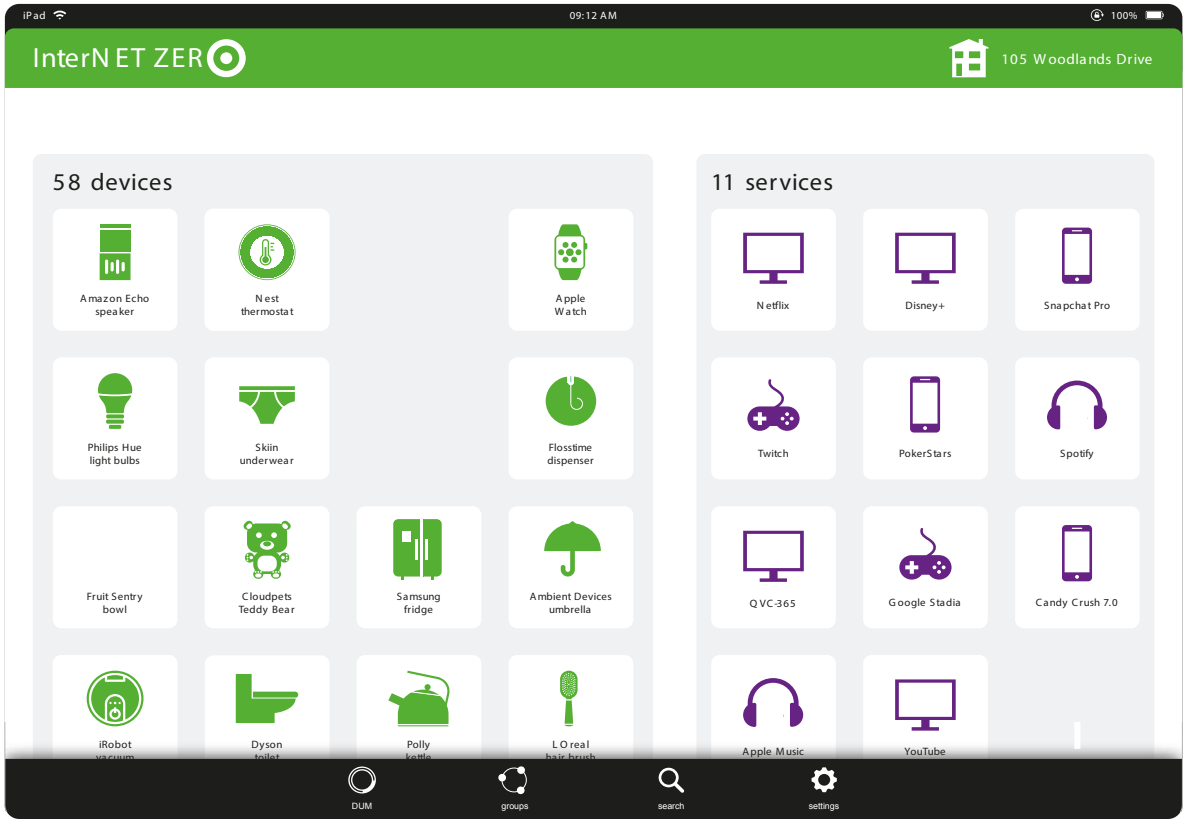


Figure 8 *The dashboard provides 'D-CARB' metrics for most domestic devices and services (Authors).*

In a similar fashion, alongside major, established online platforms like *Netflix*, *Disney+* and *Google Stadia*, we have also included more frivolous streaming services, for example, the fictional *QVC-365* and *CandyCrush 7.0*. Like physical devices, connected services which stream content have also been shown to be the source of large amounts of datafication, and are thus incredibly energy inefficient, resource intensive and heavily *carbonised* (Widdicks et al, 2019). Figure 9 begins to visualise how users have the opportunity to interact with more detailed 'D-CARB' feedback based upon 'grouping' metrics rather than solely data spawned by individual devices, namely by *Consumption* (of more or less data), *Distance* (from the source(s) of data), *Nodes* (the number of devices used to gather data) and *Value* (the perceived value of collected data to external third parties). We contend that, like the *Databox* project, these comparative metrics help us to begin to explore the key attributes of the HDI concept, principally notions of user-data *legibility, agency* and *negotiation* and how these might potentially impact the sustainability of growing IoT-centric datafication.

By choosing to include novelty *gizmo* style devices and services as key actors in the fiction, we intend to draw attention to the usefulness, or to put it in a better way, the *lack of usefulness* of integrating 'smartness' and automation throughout the home environment. To emphasise this point, in addition to the 'D-CARB' metrics, the *InterNET ZERO* dashboard is also able to assign each individual device a 'DUM' classification based upon individual



Figure 9 *InterNET ZERO also visualises more detailed comparative 'D-CARB' metrics by grouping devices and services (Authors).*

device's perceived usefulness when connected to the home network. 'DUM' is an acronym formed from the words *Decarbonisation Utility Metric*. In essence, the 'DUM' classification seeks to emphasise the proliferation of *gizmo* type products within IoT culture and how such devices are markedly contributing to data-driven carbon emissions within the smart home context. 'DUM' is a reference to the notion that with the advent of the IoT, 'non-connected' material objects have often been labelled as 'dumb' and redundant when compared to newer 'smarter', data-driven connected devices. By reclassifying many superfluous networked objects as in fact, not 'smart' but 'DUM', we seek to call into question the perceived utility of 'smartness' which continues to dominate mainstream IoT discourse. This revisionist stance is exemplified in Figure 10 where we have depicted the 'DUM' rating for both a connected thermostat and fork. Whilst, arguably, the thermostat offers some useful functionality when connected to the Cloud by allowing the user to remotely set the temperature in their home, we contend that the HAPIfork is a perfect example of a *gizmo*. Thus, this device has been awarded a considerably lower 'DUM' rating on *InterNET ZERO* as it will generate data-driven carbon emissions when it really does not need to be connected.

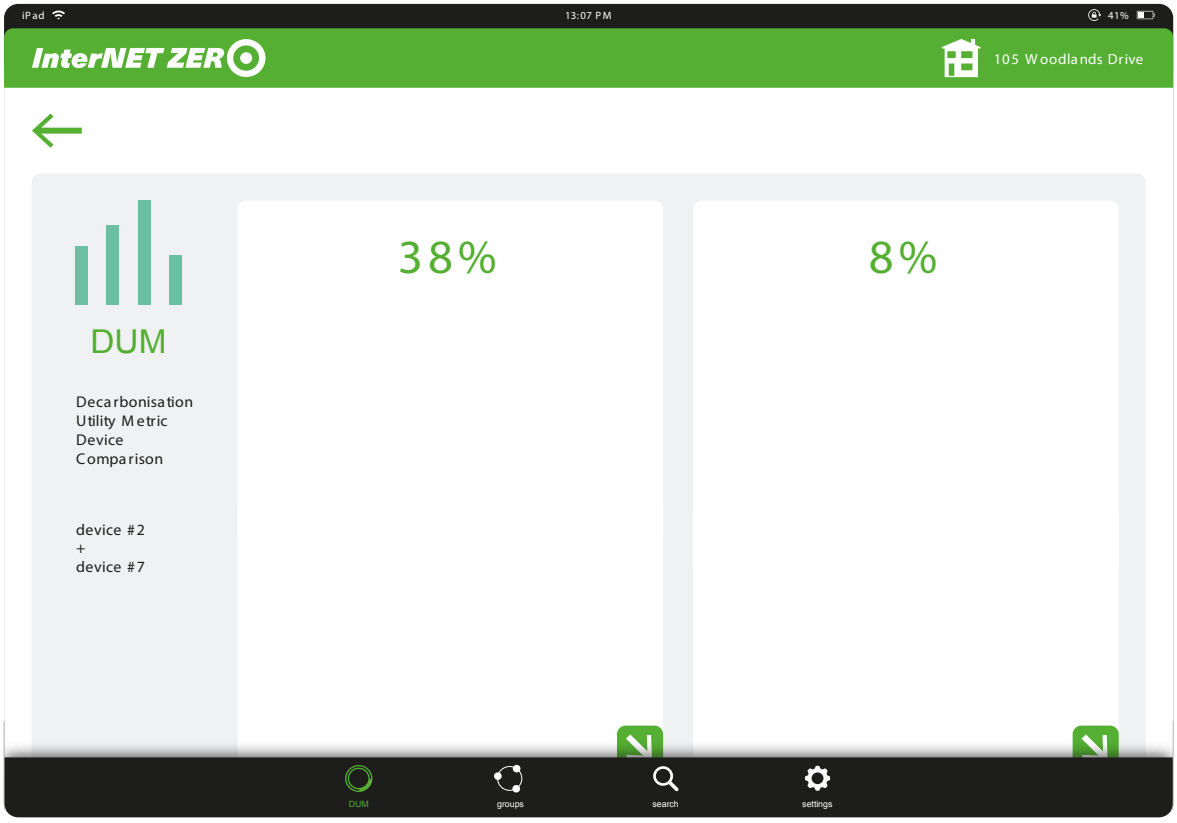


Figure 10 *The contrasting 'DUM' – Decarbonisation Utility Metric – classifications for a connected thermostat and fork. (Authors).*

Our 'DUM' classification is inspired by an episode of the science fiction television series *Black Mirror* called 'Nosedive' (Brooker & Jones, 2016) which closely resembles, and was likely influenced by, early forms of China's impending *Social Credit System*. Nascent forms of the system have been operating in China for some years, for example *Ant Financial's Zhima Credit*. *Ant Financial* is a payment firm spun out of *Alibaba*, China's largest online retail platform and a leader in AI technologies (Kobie, 2019). The *Social Credit System* is believed to be coming into operation in 2020 (BBC, 2019a). Mozur (2018) stresses that it is probable that the system will be a means for China's totalitarian state government to exercise a form of 'algorithmic governance' over its citizens. The system will apparently be governed via the use of approximately 626 million state-owned surveillance cameras installed throughout the country which will use facial recognition and AI technologies to monitor citizen behaviour and assign *credit scores*. 'Nosedive' presents a similar scenario where citizens use technology to share their daily activities and score their social interactions with others via a ratings system. These ratings can have a positive or negative effect on people's socioeconomic status depending on whether they receive high or low scores (Brooker & Jones, 2016). While neither draconian nor 'Orwellian' as these examples, we will explore the wider social implications of assigning peoples' IoT devices 'DUM' classifications in our next fiction.

5.3 Fruit Sentry bowl

As previously outlined, in order for it to be processed, today's IoT devices perpetually transmit data to and from the Cloud. Our second EC fiction begins to examine how the individual physical devices that constitute domestic IoT networks might also become effective mediators for improving the sustainable management of the data that they themselves generate. Figure 11 depicts the fictional device that we designed – an Internet connected fruit bowl called the *Fruit Sentry.* Inspired by real-world IoT products like the *Ambient Umbrella* which alerts its user if it is raining (Rose, 2014), the *Fruit Sentry* bowl sends its users' metrics such as daily *tweets* detailing the expiration data (temperature, humidity, light and air quality) of each of the individual fruits placed inside it, *WhatsApp* messages reminding users' to eat a portion of fruit or vegetables at least 5 times a-day, and monthly emails outlining new recipes for fruit-based meals. Although some users might find this data useful, from a performative point of view, a fruit bowl is normatively an artefact that has no apparent need to be connected to the Internet. With this in mind, we felt that redesigning this banal object as a connected device would be an effective way to emphasise the growing trend for *gizmo* style 'smart' products. Moreover, and perhaps most importantly, the fiction enables us to stress the need to start combatting the increases in data-driven carbon emissions which will result from networking billions of these types of 'solutionist' devices.

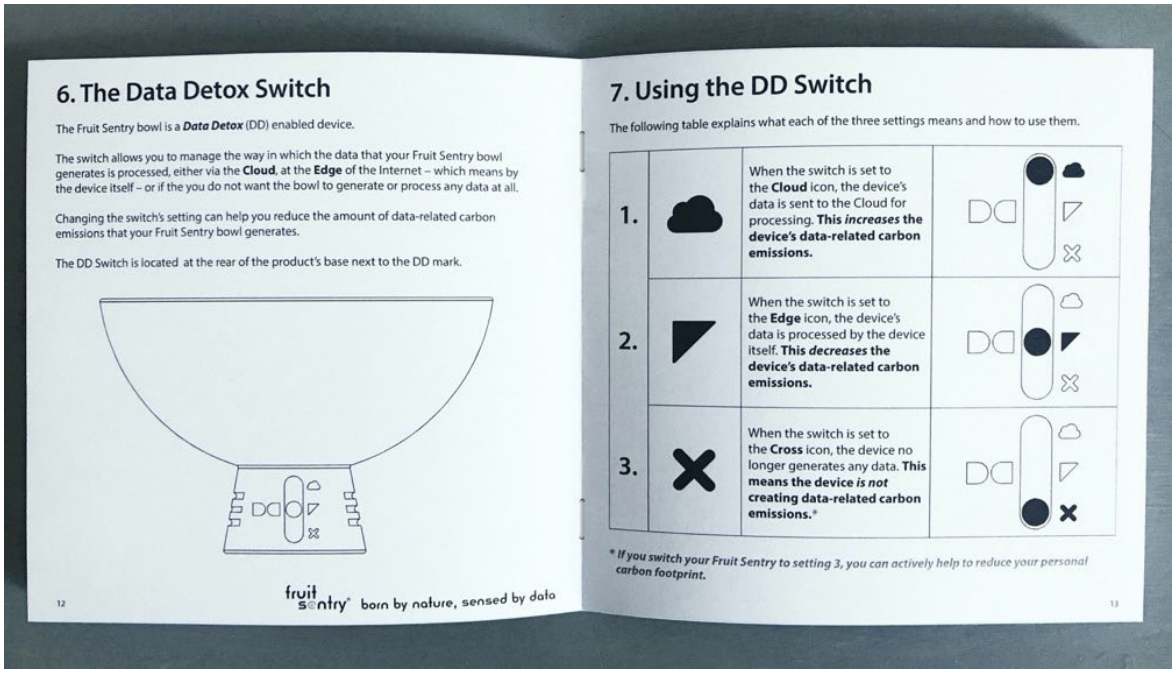
Crucially however, the *Fruit Sentry* is distinct to present day real-world *gizmos* because, within the fiction, it possesses EC capabilities and is therefore able to operate as a micro-data centre. This functionality minimises the distribution of the data it generates as well as the privacy threats that accompany such transactions. Moreover, users can also set the device to send data to the Cloud to be processed *if they so wish*, as well as *not* to collect or process *any data at all*. The latter capability means that the device's connectivity or 'smartness' can be negated entirely. This threefold *negotiation* of the device's level of decarbonisation is enabled via a simple user control switch – the 'DD' switch – which is located on the side of the device (Figures 12 and 13). 'DD' stands for *Data Detox*. Here we are making reference to the growing cultural practice of *digital detoxing*. The term is used to denote when a person makes a conscious decision not to interact with any digital devices and services for a period of time. Digital detoxing is said to improve peoples' mental health, particularly when they limit their engagements with smart phones and social media as these have been shown to be addictive (Friday, 2017). We also wanted to connote the notion of food or beverage related detoxification – the idea that a person will restructure their diet in order to minimise their intake of toxic substances, for example restricting alcohol intake, as a means to cleanse their metabolism. In a similar vein, the *Fruit Sentry's* 'DD' switch grants users a level of agency with regards to detoxing their device of carbonised dataflows.



Figure 11 The Fruit Sentry bowl in situ (Authors).



Figure 12 The Fruit Sentry's 'DD' switch (Authors).



6. The Data Detox Switch

The Fruit Sentry bowl is a ***Data Detox*** (DD) enabled device.

The switch allows you to manage the way in which the data that your Fruit Sentry bowl generates is processed, either via the **Cloud**, at the **Edge** of the Internet – which means by the device itself – or if the you do not want the bowl to generate or process any data at all.

Changing the switch's setting can help you reduce the amount of data-related carbon emissions that your Fruit Sentry bowl generates.

The DD Switch is located at the rear of the product's base next to the DD mark.

fruit sentry® born by nature, sensed by data

7. Using the DD Switch

The following table explains what each of the three settings means and how to use them.

1.	☁	When the switch is set to the **Cloud** icon, the device's data is sent to the Cloud for processing. **This *increases* the device's data-related carbon emissions.**	DD ☁ ◤ ✕
2.	◤	When the switch is set to the **Edge** icon, the device's data is processed by the device itself. **This *decreases* the device's data-related carbon emissions.**	DD ☁ ◤ ✕
3.	✕	When the switch is set to the **Cross** icon, the device no longer generates any data. **This means the device *is not* creating data-related carbon emissions.***	DD ☁ ◤ ✕

** If you switch your Fruit Sentry to setting 3, you can actively help to reduce your personal carbon footprint.*

Figure 13 User instructions for the device's 'DD' switch (Authors).

The physical nature of the switch is also important, in that it transforms the *digital interactions* – user-data *negotiation* and *agency* – into *physical interactions*. This is significant because, as we noted earlier, the environmental harms caused by increasing datafication are not clearly visible or easily understood. As such, the 'DD' switch can be seen as a metaphor for the material characteristics of data. This feature is also comparative to a light switch. We are accustomed to switching off a light source if it is no longer required, as well as in order to save energy and related resources. *Could 'DD' switches on IoT devices become as everyday an interaction as switching off a light? Will people want to switch off the 'smartness' of their devices if they know this will increase data decarbonisation metrics?* The fiction aims to initiate this type of discourse.

The switch functionality also helps us to build the *Fruit Sentry* into the same near future world in which the *InterNET ZERO* platform exists. Like other devices featured on the dashboard, we have given *Fruit Sentry* a 'DUM' classification. Yet, Figure 14 illustrates how the device's 'DUM' rating is acquiescent based upon how its user negotiates its 'D-CARB' levels using the 'DD' switch. If switched to the Cloud setting for data processing, *Fruit Sentry's* 'DUM' rating will be very low. When switched to process its data itself at the Edge, its 'DUM' improves. Finally, when the 'DD' switch is 'off', that is, the device is no longer connected to the smart home network *at all, Fruit Sentry's* 'DUM' is rated highly.

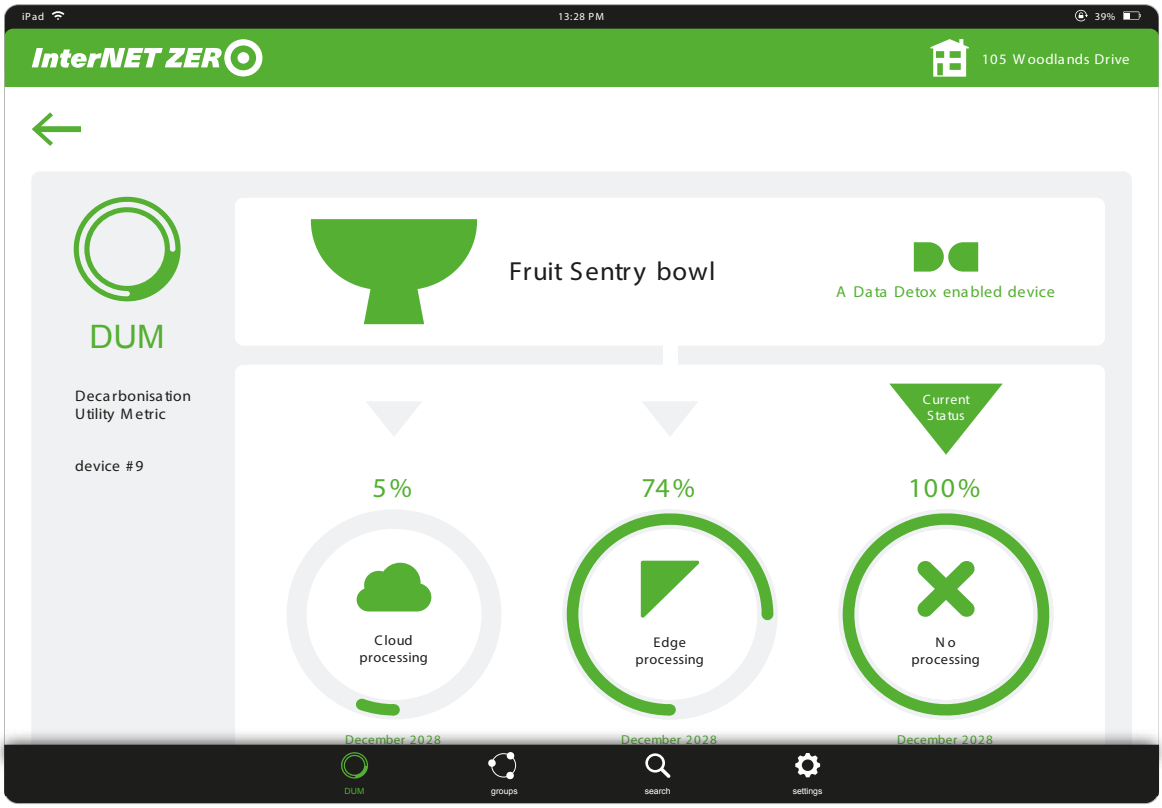


Figure 14 *The 'DUM' classification for the Fruit Sentry device as viewed on InterNET ZERO (Authors).*

Ultimately, we created *Fruit Sentry* to counter the mainstream consensus that increased physical-digital connectivity, data generation and 'smartness' are an unreservedly positive socio-technological development. The fiction serves to emphasise the notion that products that have previously been labelled as 'dumb' because they are non-connected, might actually be smarter *environmentally* because they do not build up data-driven carbon emissions in addition to the established harmful impacts which result from manufacturing said physical products in the first instance. As a means to embody this *environmental smartness* within our fictional world, we again draw upon the *Black Mirror* episode 'Nosedive' and China's *Social Credit System*. Figure 15 and 16 begin to explore the wider socio-economic implications of assigning 'DUM' classifications to peoples' IoT devices. We can see that within the fictional world, citizens who have actively chosen to decarbonise their IoT datafication receive sustainability-related rewards, while others who are not as proactive are penalised, in this case they must pay higher council tax rates.



Figure 15 Data decarbonisation reward coupons which will further offset emissions (Authors).

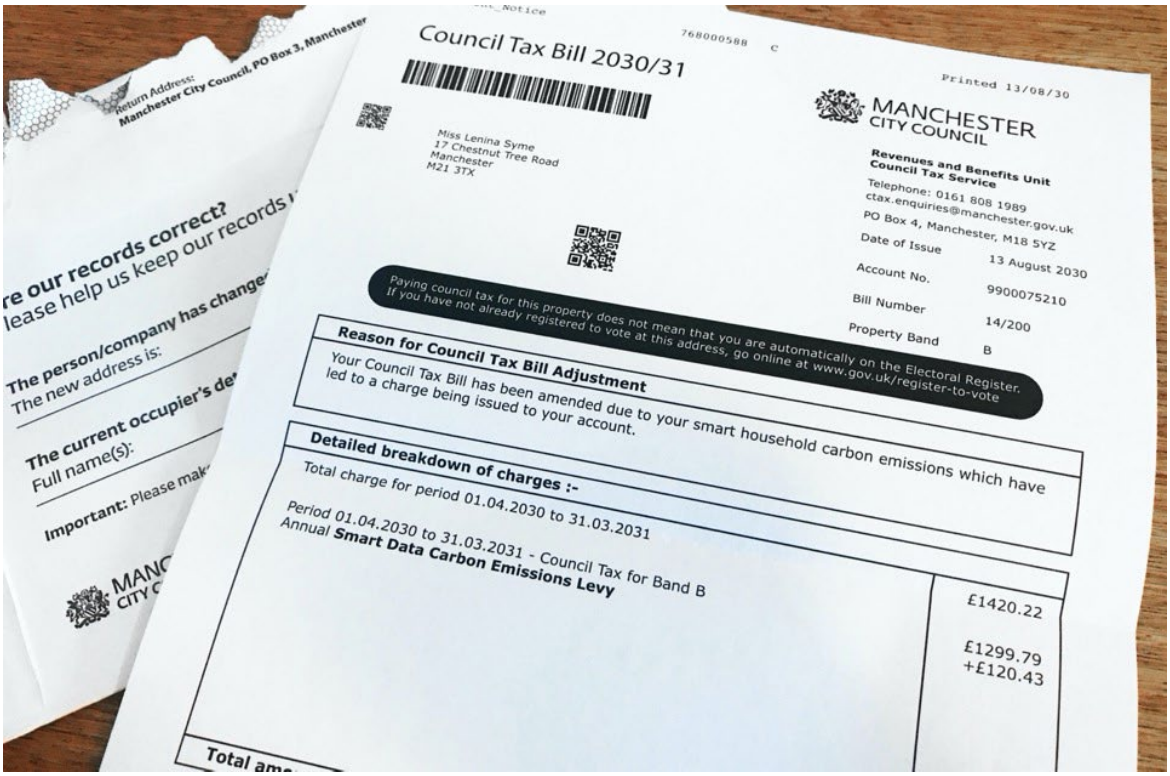


Figure 16 This householder receives a Smart Data Carbon Emissions levy (Authors).

6. Initial Conclusions

As Schulte (2019) makes clear, the development of "technologies takes time, deploying them is complicated and it might take years until their impacts can be observed." We noted in section 5 that Design Fiction is an effective method for gaining a better understanding of the possible future implications of technological adoption and the socio-economic trends and values said technologies may facilitate. Reflecting back upon our own design process, we applied DFasWB techniques as a means to explore a potential world in which the *edge of tomorrow* plausibly exists. We wanted to generate insights regarding the possible sustainable advantages and disadvantages that might arise if EC technologies were to be adopted. We also created the two fictions to emphasise the current unsustainability of IoT datafication, particularly the impacts of rising data related carbon emissions.

We believe that our fictional world also effectively embodies the main design concerns of HDI – *InterNET ZERO* highlights the importance of making the environmental impacts of IoT data emissions more *legible* to users, whilst the *Fruit Sentry* fiction symbolises the need to empower users with the *agency* to personally *negotiate* the extent to which their data can affect the environment. Without disregarding the users of these potential sustainable Edge devices, our principal audience for this research is the design and computing communities, who, through their development and implementation of IoT technologies, presently wield the most power with regards to cultivating future environmentally responsible IoT data practices. As opposed to simply continuing to add more processing and automation capabilities to billions of physical things, these communities need to reconsider what makes devices 'smart' or 'dumb' in relation to the wider environmental issues to which they contribute. Essentially, practitioners must ask themselves – "*just because I can, does this mean that I should?"* As a means to instigate such reflective discourse and provide a counterpoint to Figure 6 (page 8), we have visualised how Edge-based data management might possibly facilitate the decarbonisation of IoT datafication (Figure 17). We have termed this potential approach *Sustainable Edge Computing* (SEC). The diagram is intended to contribute to the outlined debate and our understanding of what EC is *and* can be, namely its prospective relationship to environmental sustainability. As such, it is by no means exhaustive, but rather additive.

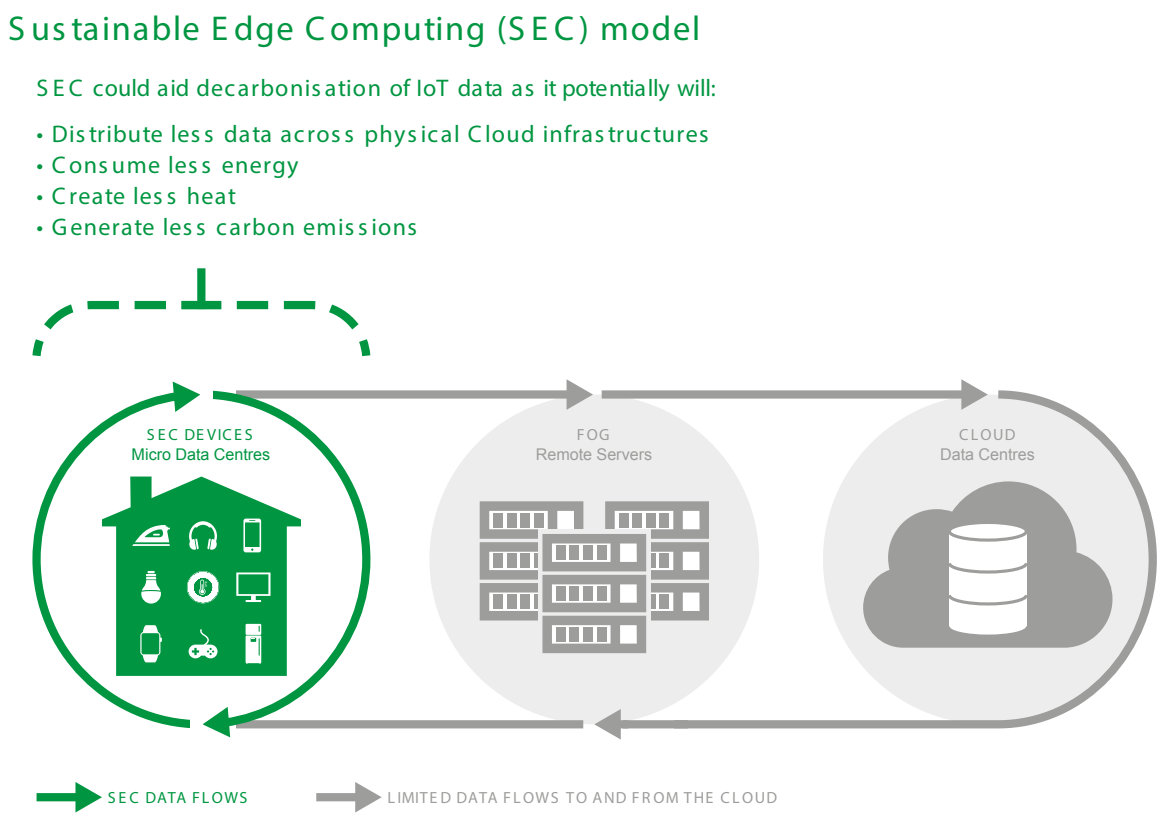


Figure 17 Our initial model for SEC – Sustainable Edge Computing (Authors).

7. Future Work

As Edge technologies are still in their infancy, there is ample opportunity for the authors and others to continue to explore the implications and values that might underpin the adoption of SEC. We foresee immediate follow on research utilising *InterNET ZERO*, *Fruit Sentry* and further SEC fictions, alongside the initial SEC model, as the basis for engagement activities with key stakeholders. These stakeholders will likely be drawn from across industry and academic IoT development communities. This engagement will aim to raise awareness of the growing unsustainability of IoT datafication as well as enable the co-design of new development strategies for SEC. The key question such future work will ask is – *can SEC research help governments reach mandated net-zero decarbonisation targets by 2050?*

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3D Printing Craft: weaving and oozing

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Abstract: This paper explores digital fabrication in the form of 3D ceramics printing. Three iterative case study examples of design work of one of the authors are provided. The case study examples are positioned as research through design, as the designs embody elements of both materials research and development. An underlaying framework of the authors, titled 'user-completion', underpins the discussion and provides a mechanism for developing hybrid design artefacts. Throughout the paper, the notion of craft and risk, which are considered essential aspects of the craft process, are issues also engaged with, and what this means for a digital fabrication process questioned. The intersection of digital fabrication and ceramics facilitates a hybrid design approach, fusing processes and techniques from different disciplinary modes. It is proposed that this provides the opportunity for the discipline to engage in dialogue about the future of disciplinary practice and importantly, its craft.

Keywords: digital fabrication; ceramics; craft; hybrid design

1. Introduction

The resurgence of craft in main-stream design in recent years, exemplified by designers such as Hella Jongerius, and the rise of online open source platforms for sharing and fabricating files "such as Shapeways in 2007, and Sculpteo and Makerbot in 2009", have refocused interest on craft and its ability to inform digital fabrication processes (Chittenden, 2018,p.13). "Computational digital design allows for new explorations of forms and materials, without the constraints of traditional mass manufacturing. Digital fabrication methods such as 3D scanning, printing and digital CNC and robotics have changed the practice of designers, architects and artists. This new palette of tools has opened the door to the possibilities of new forms and differing levels of engagement for the practitioner" (Author & Author, 2018, p.120). It has also led to much debate about how digital fabrication, when used in conjunction with or to replace traditional hand-craft practices, transforms the role of the marker and their craft practice.

This paper presents a series of case studies exploring the capabilities of 3D printing and its

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intersection with craft through two specific forms – basketry and ceramics. The paper is written from within the lens of the product design discipline. The first of the case studies - *Hybrid Material Vessels #1*- took its cues from traditional basketry weaving. In this case study, the hand of the maker and user remains visible and necessary for the finishing of the work. In the second case study, *Hybrid Materials Vessels #2,* 3D printing is explored in conjunction with ceramics and the clay body. In *Hybrid Materials Vessels #3,* the hand of the maker is removed from the equation altogether (aside from a decorative brass component). This removal of the hand of the maker also reduces the element of risk from the process. Each of the iterations presents an example of 'hybrid design,' which is "a strategy that incorporates elements and processes from diverse fields that are in today's design practice not always perceived as compatible. This is a method to generate new design visions" (Hybrid Space Lab, 2019).

As part of the case study discussion, the role of co-creation in 3D printing and its relationship with craft is unpicked. In particular, co-creation is described in relation to the authors' own design framework called 'user-completion'. The authors have previously discussed this framework and tested it through design prototypes. The user-completion framework requires the user's involvement to be conceived of as part of the design process. This is a co-design model in which a non-expert designer has the ability to make design decisions. In previous versions of this idea, the model focused on a specific moment in the design process - assembly and completion. The 3D printed designs presented as case studies here, shifts the user-completion and participatory element to proceed the point of fabrication, made possible because of 3D printing and digital workflows. Folded into the discussion of applying the user-completion model is the notion of risk-taking and its relationship with craft practice. In this way, the discussion seeks to avoid establishing a binary between digital and analogue craft-based processes, but instead frame 3D printing and its associated digital fabrication workflow as an opportunity to test new models of co-creation, connecting not only designers and non-experts but generating connections across digital and traditional environments.

2. A comment on craft and 3D printing

The often-cited definition of craftmanship from David Pye (2002, p.20) links the craft process to notions of risk using the catch-phrase, the "workmanship of risk." In digital fabrication, Zoran and Buechley (2013, p.6) note that there is "by definition" no risk – it is entirely removed from the equation. They note that in a digital fabrication process, "a digital design file specifies exactly what a machine should produce; the result is pre-determined by the file" (Zoran & Buechley, 2013, p.6). While this may be the case for much digital fabrication, this paper will challenge such a proposition through the discussion of 3D printing and ceramics, where much risk remains inherent in the process.

From a product design perspective, it would likely be argued otherwise that risk-taking is entirely absent from a digital fabrication process. A product designer is aware that many risks of various types exist in a digital fabrication process. These risks may not reside at the point

of fabrication due to their removal in the controlled nature of the tectonics of the material, but rather risk may instead exist in the complex work flows that involves integrating a digital and physical environment. In 3D printing ceramics, there is much risk at the material level and its performance.

Returning to Pye's definition, McCullough (1996, chapter 7) suggests that this definition provides a "fundamental challenge from tradition to the proposition of electronic craft". McCullough (1996, chapter 7) observes in a merger of craft and digital "increased notational density supports quasi-continuous operations formerly only available from physical materials." This ability to manipulate - to iterate - is an important feature present in a designer's process when operating at the intersection between digital fabrication and craft. According to McCullough (1996, chapter 7), "Increased notational density distinguishes computing from earlier allographic media based on manual notations such as text or musical scores, which however rich were neither possible to manipulate in real time nor able to provide a continuum of potential states." 3D printing and ceramics provides a different type of opportunity for real time manipulation and engagement across the iterative design and material processes.

Ceramic 3D printing especially in the technologies developing years, cannot reproduce the somewhat flawless outputs as its traditional 3D printing ancestors. The nature of clay, and the knowledge of this material, requires a craft practitioners experience - wedge the clay too thick/hard and it will come out puffy, wedge the clay too soft and it may not keep its shape and come out too fast, don't wedge enough and trapped air bubbles will cause 'explosions' and deformations in the print. Without a full, tactic appreciation of the material and how to craft it, the design will fail - sides will droop, horizontal surfaces not hold etc. So, in a sense the hand of the maker is very much part of the digital fabrication.

3. The academic designer and design research

The case studies presented in this paper are the design work of one of the authors who is described as an academic designer, meaning "a designer who has moved from practice to academia, yet still undertakes practice or design; as the framework for their research" (Author & Author, 2015, p.55). Elsewhere, the authors have attempted to grapple with the question of the role of the academic designer suggesting:

> "The academic designer must work within and answer to the framework of the university, and their creative practice must conform to measurable research expectations. The practice of the academic designer is multilayered and may include undertaking activities such as: grant application, investigation and discovery through designing, written reflection of the practice-research, exhibition, integration of new knowledge into studio teaching, and academic peer-review" (Author & Author, 2015: 56).

To further contextualise design research, we refer to Frayling's (1993/4) tripartite model of design research – research *into* design, research *through* design, and research *for* design. Frayling broadly (and fairly briefly) describes research *into* design as historical or precedent

research, research *through* design as including materials research, development work and action research, and research *for* design in which,

> "the end product is an artefact – where the thinking is, so to speak, embodied in the artefact, where the goal is not primarily communicable knowledge in the sense of verbal communication, but in the sense of visual or iconic or imagistic communication."

The research *for* design category is colourfully and rightly described by Frayling (1993/4, p.5) as the "thorny one." Frayling's definitions provide a useful mechanism to broadly categorise the variety of research types carried out by academic designers, and situate this within a broad framework. However, the three categories are acknowledged as being somewhat "ambiguous" (Jonas, 2007, p.190). Confusion related to these categories has also arisen due to the variety of coordinating conjunctions used, for instance: into/about and through/by, which may cause the emphasis to shift. Jonas (2007, p.190) comments that "Friedman increases confusion still further: Frayling did not speak of 'research by design', but rather of 'research through art and design'". As such, a variety of conjunctions appear in the literature and there is slippage in the application of the categories.

We propose that the case study examples presented here are best framed as research *through* design, as the work embodies elements of both materials research and form and functional development. The design process provides the structure of the methods of research *through* design, the conceptual development, materiality and prototyping, all informing exploration and design decisions that are made. Research *through* design, can be captured throughout the design processes. In these case studies, the methods of design research as defined by Bardzell (et al., 2016) are, "Design documents can vary in forms, which includes workbooks, journals, engineering diagrams, sketches … and rough prototype models". One of the benefits of prototyping is that it may open up new creative possibilities through experimentation with materials and physical forms (Eekhout & Swieten, 2015, p.3). However, traditional formulations of prototyping and its role are called into question by 3D printing processes. Industrial designer Thorsten Franck has observed that, when 3D printed: ""They are not prototypes because the 'prototype' does not exist anymore [in this context]," said Franck …"When you print the stool, you are manufacturing it" (InDesign Live, 2017). In this sense, the prototype when 3D printed is high fidelity and removes the element of risk described earlier. Yet, when integrating the printed materials with other materials, or working with clay which has a life of its own, a residual material uncertainty remains – risky in that it requires a developed tacit understanding - developed through testing and prototyping to determine the possibility for success. The product design prototype in this way, is arguably an element of craft. To return to Pye's (2002, p.20) definition mentioned earlier:

> "craftsmanship…as a first approximation…means simply workmanship using any kind of technique or apparatus, which the quality of the result is not predetermined, but depends on the judgment, dexterity and care which the marker exercises as he works. The essential idea is that the quality of the result is continually at risk during the process of making…"

> In the case study examples that will be described here, the material selection reintroduces risk into the equation. In addition, the application of the user-completion framework also embeds unknown risk, although it would not be fair to align this risk-type with craft as it involves engagement with non-designers, as will be described.

4. User-completion framework

The user-completion framework was first posed by the authors of this paper in 2012. It is distinct from mass customisation yet similarly allows users to peronsalise their product. Mass customisation expert Piller (2008, p.631), has described how manufacturers should provide toolkits to enable end-users the ability for "defining, configuring, or modifying their individual solution within the given set of choice options." The user-completion framework is seen as distinct and separate from traditional mass customisation approaches in which "configurators" or "knowledge-based software tools that support a potential customer in specifying a product solution within a company's product space and guide the customer through the elicitation process" (Piller & Wang, 2018, p.18). While we propose a "configuration toolkit" of sorts, it is deployed in a different manner to that used in mass customisation and importantly requires user investment to complete the design (Piller & Wang, 2018, p.19).

The user-completion framework has been tested in a number of designs, including in a workshop run with users to gauge its level of success (see Author & Author, 2015). The user-completion approach requires the designer to conceive of the product as a kit-of-parts that can be assembled and personalised by the user.

> "The user-completion approach relies on the specialised skills of the designers to provide the components and understand the manufacturing options, whilst leaving some details of the finished product to the end-user to decide upon. It should be noted that the skill of the designer is in no way diminished by embracing the involvement of the end-user – instead, the designer is required to understand the product in new ways and forecast its potentialities" (Author & Author, 2018, p.126)

Importantly, the various skill levels of the user need to be taken into consideration when designing the kit-of-parts. Mugge, Schoormans and Schifferstein (2009, p.473) in a discussion of personalisation, has noted that if a user is not sufficiently skilled to personalise the product, it may be ruined and its value diminished. This is an element of risk that needs mediating by the designer during the design development process.

In response to this possible issue, in the user-completion framework the kit-of-parts is complimented by a pattern 'sheet'. The patterns provide users with possible completion options or may act as inspiration for their own pathway in completing and personalising the product. In a mass customisation model, Piller and Wang (2018, p.21) propose "combining a recommendation system with a co-design toolkit" to help with the decision-making process. The pattern sheet provides recommendations in the form of precedent-style examples in this way. The authors understand that for the particular case studies we provide, the end-user would need to have sufficient digital design skill to undertake the printing of the project to

produce an aesthetically pleasing object. Currently these skills are not widely practiced by the general public but home digital fabrication is on the rise.

5. Hybrid Material Vessels #1



Figure 1 *Variations of Hybrid Material Vessels as exhibited in Digital Crafts as part of Sydney Design Week 2018.*

This series of Hybrid Material Vessels (Figure 1) were exhibited as a solo show: *Digital Crafts* as part of Sydney Design Week 2017. The series sought to test the user-completion model in a 3D printing digital fabrication process.

In this first iteration of vessels, the potentiality of basketry and its incorporation with 3D printing was seen as an opportunity. “Basketry and weaving are ancient crafts and have a lot of plasticity– allowing for varying levels of engagement” (Author & Author, 2018, p.126). A similar observation was made by Zoran (2013, p.326) noting that “These qualities of basketry (adaptability, changeability, and usage of a variety of technologies and raw materials) make it a perfect domain for experimentation.”

The initial design developed following an analogue process of hand drawing. To test assumptions, a series of clay models were then made. Importantly, physical prototypes focusing on the “transition points of the vessels – where the rattan meets the digital print – were experimented with both digitally and through the clay models. The early designs mimicked traditional woven forms, with the idea that the rattan or flexible element would appear to ‘grow’ from the digital vessel. These initial forms were abandoned, and after more form development a more industrial language was adopted for the 3D component of the vessel” (Author & Author, 2018, p.127).

The tool used for printing the vessel was an extrusion-based printer [Up Printer 2] whose process involves “a thin plastic filament…fed into an extruder, which melts the filament and lays down a thin trail of plastic onto the build plate” (Chittenden, 2018, p.13).

The material selection was two-fold. One was the selection of material for the 3D-printed form and the other the woven material element (Figure 2). For the 3D-printed form, ABS

material was selected because of its being economic and readily available. For the woven element, "Traditional rattan was chosen for the woven element – as it holds a strong traditional visual language and was available in many sizes" (Author & Author, 2018, p.127).



Figure 2 *Details of the Hybrid Material Vessels, variations in printed components and rattan weaving.*

In developing the forms of the vessels, they "were not, and could not, be entirely pre-conceived. The act of 'crafting', through the basket weaving, was dependent on many unknown quantities – the materials available and their constraints, the 'mood' of the maker, the time involved in fabrication. This is what links it back to the essence of craft" and Pye's notion of risk-taking as inherent in the process (Author & Author, 2018, p.127). However, it is important to acknowledge that the element of risk remains firmly situated in the hand-crafted component of the vessels. From a fashion design perspective, Kate Fletcher and Lynda Grose (2012, p.146-47) emphasise the tacit material knowledge associated with craft practice:

> "hands-on, resource based and practical. It has a visceral connection with materials and the way they are shaped into forms for display or use. It involves the actual doing of something rather than merely the experience of being done to – that is, the practice".

The user-completion framework underpinned the conceptual development of the vessels. In a digital fabrication process facilitated by 3D printing, it was envisaged that if the final vessels were developed for the marketplace, the user would receive the file for the vessel as an STL file. They would then have the option to customise the vessel in a material of their choice with resulting implications for colour, texture and weight. Scale changes could also be made. The user could then either print at home or through an online agency. This level of customisation is made possible by receiving the file itself not simply the end product. Of course, this presupposes that the user has access to a suitable CAD platform. "Users could have weaving diagrams [patterns] available (through a web source) to mimic, or they could weave their own design. The design of the vessels allows for different flexible materials to be slotted into the 'tubes' of the vessel wall. This means the user could use organic and/or synthetic filaments or other materials, such as metal, to vary colour, texture and visual language" (Author & Author, 2018, p.127). The notion of risk described by Pye remains ever present for the user and the variety of decisions they might make and the implications these

decisions will have on the finished vessel. Without a practiced craft-hand, a user will be unlikely to be able to assess and manage the risk.

6. Hybrid Material Vessels #2



Figure 3 *Woven rattan and 3D printed ceramic vessels exhibited as part of the Woven Dialogues exhibition at UNSW Galleries, Sydney 2018.*

This series comprised 3D-printed earthenware and terracotta with interwoven rattan (Figure 3). Exhibited as part of *Woven Dialogues*, at UNSW galleries in 2018.

As with Hybrid Material Vessels #1, the objects are produced through digital design and fabrication and then completed through hand-craftwork. The digitally designed and fabricated components are themselves an exploration of both traditional and emerging new manufacturing methods. This case study of design practice, reflected on the process of designing for both craft and digital fabrication, from the experience gained with the earlier traditional 3d printed vessels.

In this iteration, 3D printed ceramics was selected as the material of choice, with the aim to recreate the vessels using ceramic to give them a perceived high material value, and weight. This was the authors first experimentation into ceramic 3D printing, and while in many senses the process of digital design was similar to 3D printing, the nature of clay changed the fabrication process and results drastically. “Clay is wet, messy and respond to gravity under its own weight. It is possible for nozzles to over-ooze, to get clogged, for printed layers to sag if printed too quickly or to fall apart if layer are too dry” (Chittenden, 2018, p.15. The resulting vessels capture the imperfections of the making process in their haphazard irregularity and visual gravitational indicators. They are much more aligned with craft practice and the improvising nature of making.

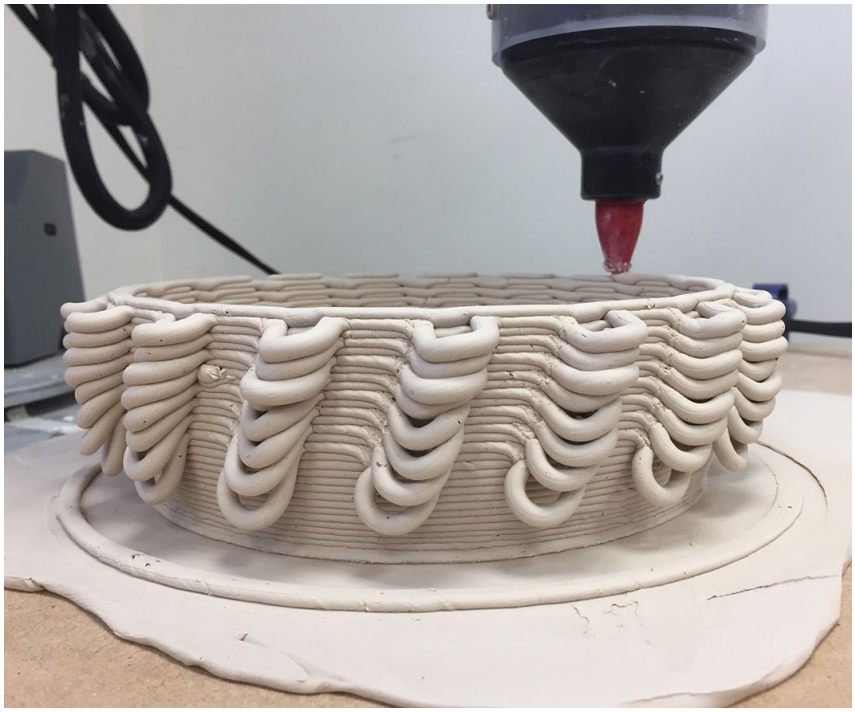

Figure 4 *Ceramic 3D printing of the Hybrid material vessels #2, clay loops can be seen "drooping" as it is pushed out of the Potterbox printer, due the loops being unsupported and the forces of gravity.*

As the designer/author had no prior experience working with clay, she undertook a 4-week ceramic course to learn the basics of wedging, hand building, clay recycling and the firing processes. It became evident early on in the concept stage, that the designs from Hybrid Material Vessels #1, could not simply be reproduced in ceramics; the digital drawing was vastly diverse, the 'drawing' did not give any clear indication of what the resulting fabrication would perform like, or look like. The digital interface between the user and the ceramic printer - the Potterbox, is very primitive, with pixelated icons representing the designs. The line drawing, does not take into consideration the nozzle size used on the printer, nor the spread of the clay as it prints and impacts on each layer - so measurements were vague, and radii unknown. Air bubbles were explosions that deformed or destroyed the print entirely. Bases needed to be hand rolled as the printed base was not strong enough, and once the vessel was leather dry, the bases needed to be trimmed before bisque firing. Through this experience, it can be said that the process of digital 3D ceramic printing is a combination of ceramic hand building and finishing, alongside digital fabrication.

> "Yet clay is still unpredictable enough to make its voice heard in dialogue with the requirements of the printer – certainly in the coil extrusion approach…The ways in which the material can distort the intended print, rather than being seen as a frustration of failure, has suggested ways for some practitioners to reintroduce the humanness in printed forms and led them to deliberately program random noise into some of their prints" (Chittenden, 2018, p.21).

Due to the imperfections and irregularities of the print, especially with the 'loops' (Figure 4),

and the shrinkage in both the bisque and final firing, tolerances were difficult to calculate, which effected the rattan weaving component of the designs. In Hybrid Material Vessels #2, the weaving is far more simplified than in the first series of vessels, but as the design is so decorative due to the clay printing, the designer decided to leave off weaving in some of the vessels.

Questions of 3D printing and craft (in cases where the final artefact is considered to be aligned with craft and therefore bespoke, not in the situation of 3D printed mass-produced multiples), reveals the need to ask broader, potentially disciplinary re-shaping questions. Chittenden (2018, p.36) proposes a number of thought-provoking questions, particularly in relation to the ownership and exhibition of 3D-printed craft objects, asking;

> "Can individuals print their own Edmund de Waal from file? Do galleries maintain control of print-on-demand runs? Would we see counterfeit 3D scans produced in numbers? Would a museum print a version of a ceramic work for exhibition, meaning that the file is transported rather than a fragile object? What does 3D printing mean for insurance claims if a broken original can be reprinted from file?"

Some of these questions stem from the underpinning concern for the authenticity of the original and how this may be eroded by the 3D printing process. At the root of these questions is something akin to the Ship of Theseus paradox – what does identity and originality mean when components or whole artefacts can be replaced? Is there a point of loss where the craft-'ness' vanishes? This presents an intriguing disciplinary risk of a different nature.

Reflecting on these thoughts from Chittenden, the framework of user-completion has the potential to open out the actors interacting with the designs – to expand beyond the domestic users, as the framework is largely currently conceived, to include galleries and professional design organisations. In this way, the user-completion framework could be made more robust through the more detailed consideration of 'users' and who these might entail and what their needs might be. The user-completion framework in this iteration was employed in a similar manner to the earlier iteration but in the vessels that did not include this component, the user does not have the same degree of involvement or investment in completing the design.

7. Hybrid Material Vessels #3



Figure 5 *Hybrid Material Vessels #3 exhibited as part of the Femufacture exhibition at the Japan Foundation, Sydney 2019.*

This series comprised 3D-printed tinted stoneware ceramic vessels with brass sheet collars exhibited as part of the *Femufacture* exhibition in 2019 (Figure 5).

The author set the brief to merge traditional decorative and craft forms and qualities, with those of digital fabrication. Using domestic Australian ceramic decoration of the 60s and 70s as a reference point and reinterpreting these through digital design software and 3D ceramic printing fabrication, the vessels were completed with handmade brass components. The design and production process examined the contradictions and similarities of traditional domestic decoration and forms, and the new visual and formal language of 3D ceramic digital fabrication.

The vessels in this iteration take on a much more mechanical feel, more aligned with traditional 3D printing. In part, this is the outcome of design intent, but also as a result of the designer/author having a greater understanding of the 3D ceramic printing process and the nature of the clay after working on Hybrid Material Vessels #2. In this way, the designer built tacit craft knowledge through lived experience of the process. The vessels were designed with this understanding and also to capture the decorative patterning qualities of the layering process.



Figure 6 *Each component of the vases is layered over a central brass vase, allowing the user to achieve different configurations and a sense of personalisation.*

In keeping with the authors' "user completion framework", the vessels were designed with a playful user interaction component. Each vessel had a hand-fabricated brass inner vase, and a series of brass collars. Each ceramic component was printed separately using different colour tinted clay, and different pattern configurations - like bangles that could be slipped over the metal inner vase in multiple configurations (Figure 6). The design intent being that the end user is able to design the final vase using the ceramic bangles and brass collars in whatever arrangement they preferred. As a result, the user involvement is more controlled and reduces the level of risk when engaging with the object.

8. Conclusions

Through Vessels #2 and #3, the designer/author's experience of digital fabrication was challenged due to the material choice of clay. Chittenden (2018, p.15) acknowledges that "the relationship between 3D printers and typical ceramic ware has been a strained one." This is perhaps unsurprising because as McCullough (1996, chapter 7) has said, historically "any dominance by or widespread commercial use of a powerful new technique tended to taint its acceptance in the artistic academy". However, the foundation of distrust between 3D printing and ceramic practice emerged from early difficulties of printing at a satisfactory scale, difficulties of printing food-grade and heat safe materials, and challenges of working with clay in a printed. It is still a medium that one cannot receive satisfactory results, without

experience – or craftmanship of clay and ceramic practice. In a sense, the process has really been a 'crafting of digital fabrication.' While ceramic 3D printing can produce 'identical' artefacts, the process more often than not produces artefacts that all have individuality due to the nature of the wet clay, and like handmade ceramics, they all slightly vary and warp through the drying and firing process. The authors also felt that the layering method of fabrication also has many more limitations than traditional 3D printing. In traditional digital fabrication, support walls are often printed, that can then be removed once the print is complete. However, this is not possible in ceramic printing, therefore any overhangs or horizontal surfaces cannot be supported and collapse or droop. In addition, forms in general need to be more 'vertical', and radii and curves need to be very gentle so that the layers of wet clay support themselves without toppling.

The authors' user- completion method applied to a digital fabrication process encouraged hybrid design to occur. The intention here was to involve the user in the finishing and assembly processes, which encourages a craft-like approach. The author chose a basketry crafting process to facilitate the user involvement, but it is acknowledged that many types of craft practices are open to user involvement. The user-completion method seemed to offer a good approach for developing hybrid artefacts, allowing the machine and the craftsperson to work together. This type of approach has the potential to avoid "a false dichotomy between digital and physical processes," and instead encourage a process where "designers might operate in a post-digital environment, where the boundary between screen and workbench has dissolved completely" (Chittenden, 2018, p.36). It also facilitated a hybrid design approach, fusing processes and techniques from different disciplinary modes, in this case, digital fabrication and craft. The potential of this approach is "a method to generate new design visions" that also allow the disciplines to engage in dialogue about new techniques and their implications for the future of the disciplinary practice and its craft (Hybrid Space Lab, 2019).

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“Where is your other half?”: A Wedding shaped by the Profile, Politics and Potential of the Indo-China Border

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Abstract: We, two design researchers, citizens from India and China, had planned our wedding as a performative design act on the Indo China border. As we neared our performance site from either side, a border dispute broke out and there was a military stand-off between our armies keeping us separated by over a hundred kilometres. From this field-based project, we present three different design outputs: our designed wedding rings, then our wedding video shot at the border and a speculative architectural design program for wedding venues on political borders. In reflection we present the process of arriving at the decisions of these three different design artefacts and articulate three forces, namely profile, politics and potential of the border as shaping these design outputs. We attribute these characteristics of the Indo-China border as forces of design agency. With this we also present designing personal events as a discursive genre for Research-through-Design.

Keywords: rtd genre; field based design practice; constructive design research; border studies

1. Introduction

Research-through-design (RtD), as a knowledge making endeavour has considerably evolved in the past decade, both within the design discourse and also within the domain of Human Computer Interaction. Design objects and artefacts, their making, deployment and their documentation processes have been argued to be generators and communicators of various forms of knowledge(Bardzell, Bardzell, Dalsgaard, Gross, & Halskov, 2016; Gaver, 2012; Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2012; Ozenc et al., 2007; Zimmerman, 2009). The RtD community is still growing, contributing to multiple academic domains, with streams within academic conferences and also having its own biannual conference(“RtD,” 2019). But a further need for its development is evident with multiple

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calls from various practitioners. These calls have been for a diversity in approaches, need of new genres of RtD's discourse to support its practice, and to be undertaken with more openness and articulation(Bardzell et al., 2016; Boess, 2016; Gaver, 2012). Heeding to such a need for furthering approaches of RtD, we wish to articulate a project we undertook, present its design outputs, and present 'designing of personal relation making events', as a genre for RtD. Our aim in presenting the project as a 'genre' is not for creating another academic subdivision within the still nascent field. Instead it is to indicate to the RtD community about the potential, scope and opportunities present in personal relation making events when undertaken as RtD.

To facilitate this discussion, we wish to position our argument within a specific sub-theme from this conference call, that of 'situation'. Within RtD, while context of the design act and objects have received emphasis (Koskinen et al., 2012; Mäkelä & Latva-Somppi, 2011; Zimmerman & Forlizzi, 2014), there are not particularly many discussions that highlight and emphasize how forces of a specific context and situation act as a design agent, shaping and forming, objects through the acts of design practitioners. For such a scope it is necessary here to clarify how we approach the terms 'context' and 'situation'. Within the purview of this discussion, we see a relation between these two terms, where a situation is context with a particular evolving character in time, i.e. a situation is an aspect of a context but with evolving characteristic. By presenting our project in such a frame we wish to discuss and highlight to the RtD community how a situation within a particular context can transform as design agency. We present these two contributions, that of a genre for RtD, and the design agency emerging from a situation, by describing a personal field-based project which we undertook as our wedding in the format of a design performance, within an evolving context of the Indo-China border.

The presentation of this discussion is organized with the following flow. We begin by describing our reason for undertaking such a project, that of cross-cultural relation making, and the institutional support that we garnered for the project. Then we present the context of the project, the Indo-China border and its dynamic situation because of evolving geo-political forces, which influenced our decisions and actions. We position and provide evidence from this situation as having design agency. Within this section we present and describe three design artefacts with varied characteristics but closely related with the personal relation making project as design outputs. Based on the three artefacts we will present a reflective discussion highlighting, firstly how the three artefacts are an output that were shaped by the context and the evolving situation at the Indo China political border and secondly of personal relation making events as a genre for RtD.

2. Designing Rituals for Cross Cultural Personal Relation Making

The walls of our home had heard many discussions of visas, permits and such bureaucratic procedures that had become part of our daily lives. As citizens from India and China we are political neighbours, while we cohabit as a couple in a third country (First in Finland,

when we undertook this project and now in Denmark). The distance from our countries of birth and its subsequent citizenry made us ponder on the political boundary between our neighbouring nations. While between India and China, our rituals, practices, food habits and languages vary, the two nations share a long political border that also separates along the Himalayas. This boundary as a political border is many places, practices and procedures. As field-based design practitioners, we conceptualized a performative project, with the aim to highlight the experience of this border for two cross-border citizens wishing to establish a personal relationship. For this we began by imagining to utilize the political and bureaucratic processes from both sides for weaving a wedding event at a border pass between India and China known as Nathula. The pass an offshoot of the old silk route had closed after a war in 1962 between the two nations and had reopened for trade in 2006. The procedures employed by the Chinese and Indian state, to reach the border check posts, for entry, document checks, stamping and the overseeing of these by the border control personnel along the border control were framed to be an integral part of our wedding ritual at Nathula on the Indo-China border.

By considering the political and bureaucratic border control processes as wedding rituals at the border for a symbolic union of two individuals, we aimed to inquire into new possibilities for the Indo-China border as a political boundary. While we acknowledged the procedures of structural division on the border site, we reframed them for a ritual of a personal alliance. On the one hand, the project wished to highlight the political processes and protocols necessary for individuals from India and China to reach the boundary to form a relation, on the other, we wished to subvert the procedures of structural division into new meanings of a personal alliance. With this we agreed that our wedding rituals would be both supported and constrained by a political border context. So, we began attributing agency to this context from the inception of the project. By staining a personal wedding of two cross-border citizens as an event of union event along a political border that divides and separates, the project through a personal relation-based design practice wished to seed a subversive coupling onto the Indo-China border.

With this background we made a proposal to the Kone art foundation call for projects in September 2016. As deliverables, we stated that the project's outcome would be a performative project with an output of a short documentary film, academic articles and a photo series to exhibit. In the proposal, we chose the wedding date to be the 6th of July, as this was to be the 11th anniversary of the reopening of Nathula Pass in 2017. With these elements, the proposal thus had a conceptual idea for a cross-border wedding as a performance, a location, the reasoning for a date of the performance, a set of deliverables and a broad plan. We were fortunate enough to receive the project grant for 2017, after which we started planning for performing the event at the Indo-China border. We began by trying to get in touch with relevant Indian and Chinese state authorities for permissions, contacted border research academics and also inquired with our personal contacts who might have had experiences working at or travelling to the Indo-China border. Having had varied responses from the authorities from both India and China we proceeded on reaching

the Indo-China border from either side of the two nations. We began our journey from our respective homes in India and China at the end of June 2017 and coordinated our journey to Nathula. We traced this journey towards Nathula extensively through notes, sketches, photographs, audio and video.

3. Context of the Wedding: Nathula Pass and a Military Standoff

India and China as neighbouring nations are largely separated by the Himalayas. They also share their borders with two mountain kingdom nations, wedged as buffering states, that of Nepal and Bhutan. A majority of the nearly 3488 km long Indo-China border remains disputed and contentious and the military from either side approaches the border through what is known as Line of Actual Control (LAC). There are three mountain passes along the Indo-China border Shipkila, Lipulekh and Nathula. Only licensed local traders from either side are permitted to cross these three passes, while along Lipulekh and Nathula, Hindu religious tourists from India are also permitted to reach to visit Mount Kailash and Lake Mansarovar in the Tibet Autonomous Region. For non-licensed Chinese citizens, Nathula is the only accessible pass for visiting, therefore we chose this as our wedding project venue. Having never visited the Indo-China border as Chinese and Indian citizens, our understanding of it as a possible place for our wedding started to form in patches. Old readings, from online sources of texts, images, videos and maps helped us gradually build up a repository of places through desk research.

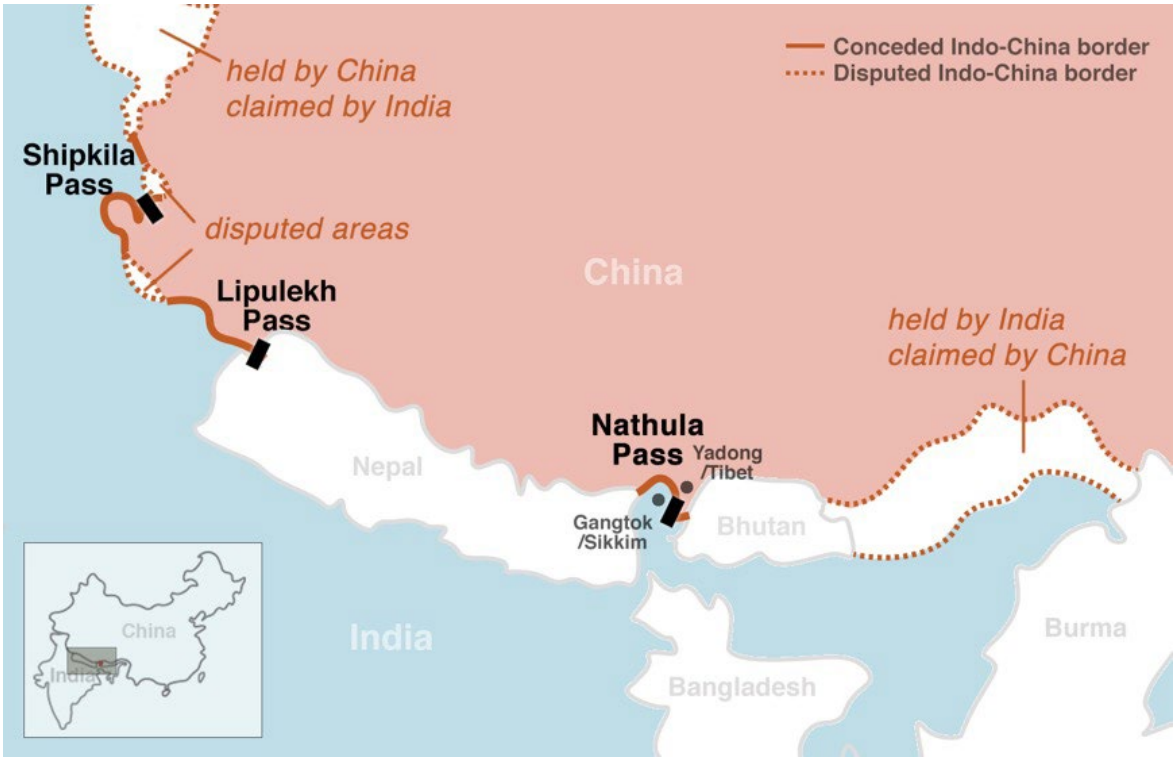

Figure 1 The Indo-China political border with location of the Nathula Pass

Nathula pass is 4,310 meters above the mean sea level and is an offshoot of the ancient Silk Road trade route that connects Tibet and the plains of Bengal in India. This is the southern most of the three mountain passes. It can be seen as a military site, as a trade route for local businesses and then also as a transit point for Indian religious tourists(Panda, 2015). The closest large city from the Indian side to Nathula is Gangtok, the capital of the state of Sikkim, and from the Chinese side the closest administrative county is Yadong. Only Indian citizens are allowed to visit Gangtok without special permits and only Chinese citizens can visit Yadong. To reach the border check post at Nathula, special permits are required for the respective citizens on either side. Nathula was a legal point of entry for Indian citizens to enter the Tibetan Chinese side and the section along this pass was stable and a resolved border between India and China when compared to the two other passes. Of the three passes, the simplest one to reach from the Chinese side is also Nathula. These aspects made us also choose Nathula as a venue for our wedding as a design performance.

Historically, Nathula can be seen as a place of constantly evolving characteristics. Starting as a trade route, then as a military pass, then as a conduit for Tibetan refugees to move into India, next as a sealed border after the Indo-China war in 1962, in 2006 reopening as a trade pass again and finally becoming a point on a pilgrim route in 2015. The pass thus has been constantly transforming, gaining commercial, political, military and religious touristic characteristics. With our proposal for holding our wedding ceremony at Nathula, we wished to push the evolutionary characteristic of Nathula further, and induce a personal poetic signification of union onto the border by two ordinary citizens across the border.

3.1 The Doklam standoff

In order to perform an event as a wedding in Nathula, we contacted our respective state authorities to get permits to visit Nathula. This was part of the conception of wedding as a performance. With this the bureaucratic practices of citizenship document check, printing permission paper, stamping, control to enter and exit were framed as symbolic acts of providing permission and recognition to the couple to perform a wedding.



Figure 2 The permits issued by border authorities from India and China enroute to Nathula Pass

And the certificates issued by the states got considered as symbolic artefacts of union as part of the wedding ritual (Figure 2). After gaining these permits we planned to hold a small ceremony that mixed Chinese and Indian rituals and exchange rings at the border to perform what we framed as a wedding ceremony at the border.

As we set out on the final stretch to meet and perform our wedding in the summer of 2017, there occurred the largest military build-up since 1962 across the Indo China border. This is a well-covered event by the Chinese, Indian and international media is known as the Doklam standoff(Shiseng, 2017; Taylor, 2017). What occurred then was on the 16th of June 2017, Chinese troops began building a road in Doklam, a plateaued region claimed by both Bhutan and China. This region is approximately 35 km away from Nathula. Right below Doklam is India's narrowest corridor of 17 km, which joins the North Eastern Indian states to the rest of India. Thus, India views any military access around this region with concern. India with its agreement and support to the Bhutanese military opposed this road building activity by the Chinese military troops and this caused a large military standoff between India and China. This lasted from mid-June 2017 till 27th August 2017. This conflict changed the normative border regulations. While in usual situations, Indian and Chinese citizens could visit Nathula from either side, during this period when we had already set on our journey to the venue of our wedding, a number of restrictions arose. By June end, the restrictions from the Chinese side resulted in a no entry to Nathula for all non-local Chinese citizens. On the 4th of July 2017, just one day before the bride reached Yadong, the Chinese administration also closed the access to border county of Yadong. This cross-border political event changed much of our wedding project plan at Nathula, and from then on, this particular border issue as a situation began shaping our project rather than our wedding changing the meaning of the border

context.

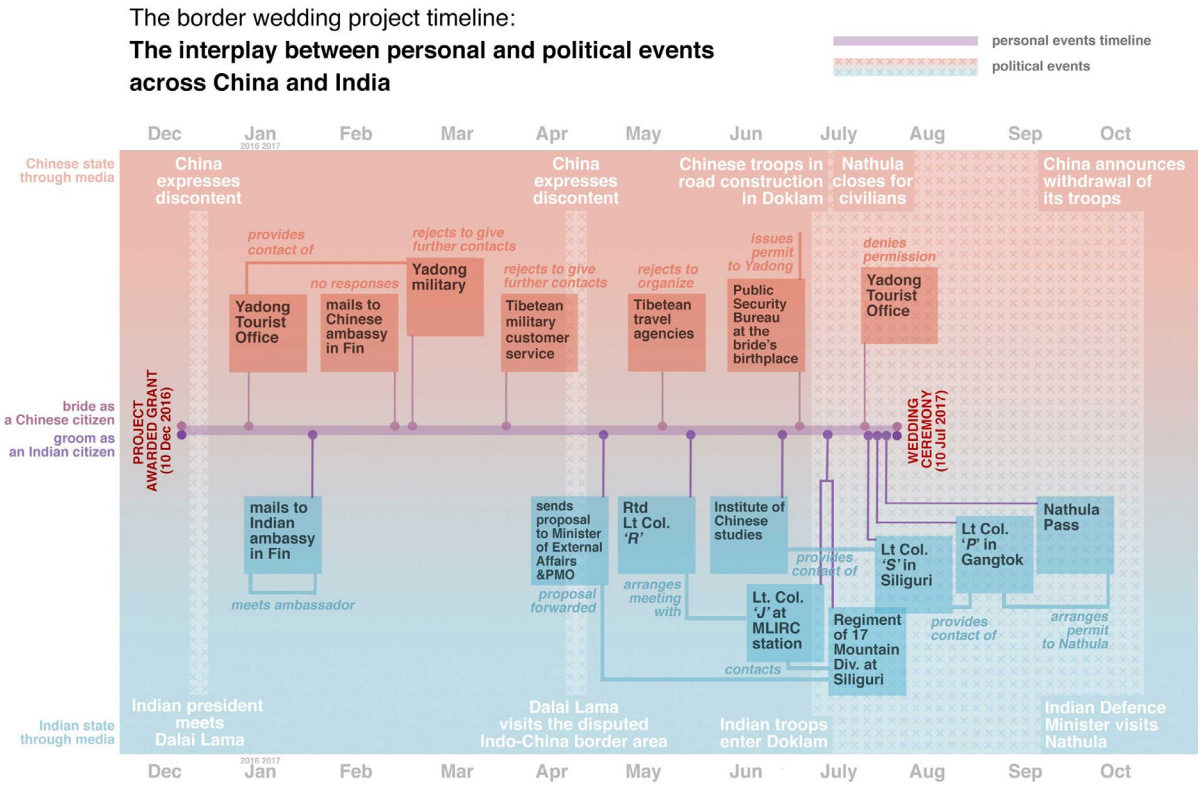

Figure 3 The full timeline of the project, tracing personal and political events

4. The Indo-China border Situation as a Design Agent

As citizens of two neighbouring nations, our relationship is cross-cultural. Considering we have different nuptial rituals, we had taken the liberty of framing and designing our own wedding rituals such that it allowed us to inquire and integrate an element that separated us as citizens from two nations, the political border between India and China. As field-based design researchers, this aspect was at the root of our decision, to integrate a design project with a personal rite of passage event, transforming our wedding into performative field based design. This integration by design of the political border for an event of personal union while can be seen as a subversive design act, it was also to question and inquire into the nature of a political border as a context. It is this aspect, of integrating inquiry through the design of a personal event is what we present to the design research community for a consideration as a discursive genre for RtD.

With that above as our first contribution through this paper, in this section, we will present the second contribution, three design outputs from our performative project at the Indo-China border. These outputs are presented as design objects and acts, also under

the purview and interest of RtD. The three outputs are, a relation making design object, secondly the video documentation of a field-based performance design act, and thirdly a speculative(Dunne & Raby, 2014) architectural program. It is also important to consider the second output, the video of a performative design act, as a being a result of encountering a military standoff, and thus should be seen as design act that emerges as a result of the situation at the border. Therefore, parts of this section reflect the larger political force of the border, and because of it reveals a situated response from us as design practitioners to the Doklam standoff in designing and performing our wedding at the border. This indicates how we addressed opportunities to challenge the constraints offered by the situation at border. It is this which makes the situation at the political border to be seen by us as having design agency. With this background we present three design artefacts shaped by the Indo-China political border.

The first refers to the design of personal jewellery relating to the nuptial ritual, the wedding rings. The second design outcome is a short film that documented the wedding 'in the absence of the other' in two places separated by the conflict at the border. Thirdly, based on our reflections and learning from the field-based design project, we introduce and propose an architectural program for politically contentious borders calling for places of varied architectural scales to accommodate cross-border weddings. Considering a RtD framing and interest we have consciously chosen these three artefacts for the discussion here. As design objects the three outputs are of varied characteristics and mediums. The first is a relational jewellery, the second is a film of a performance and the third is an architectural concept. The common thread though is that all three of these as design outputs can be considered to be shaped through us as designers because of our encountering the context/situation of the political divide of the Indo-China border. Furthermore, the forces of the political border that have shaped these three design objects also vary in character. We identify the characteristics of design agential forces of the border that shape the three artefacts as Profile, Politics and Potential respectively. With this we present this context/situation of the political border as a design agent provisioning agency within this project. Next in the coming sub-sections, we describe these three design outputs in order.

4.1 Wedding Rings: Profile shaped as the Indo-China border

Rings have evolved to become an integral element of a conjugal relation-making process in many different cultures. It is almost a universal indication that a person wearing a ring on a particular finger is in a relationship. The ring wearing practice indicates a symmetrical relationship, which is, if a person wears a ring, on a particular finger, then it is plausible that one's partner is wearing one or has at least also received one. We wanted our wedding rings to relate and be part of our performative project at the Indo-China border.



Figure 4 The Wedding rings shaped by the profile of Indo-China border along Nathula Pass

The many hours spent looking at Nathula and the line that pronounced the border on the online maps led us to shape our wedding rings along a scaled geographical boundary line that separates India and China at Nathula. We sketched and modelled a number of possibilities to arrive at a design where the edge profile of two rings showed a scaled down geographical line of the Indo China border at Nathula. Thus, when the rings are not worn, they can be combined together, showing the border between India and China at Nathula. This also means that one ring's profile represents the Indian side and the other ring, represents the Chinese side. We decided that as a couple, we wear rings that represent not our own country but the other's. Therefore, the Chinese person's ring holds a landform of the Indian side and the Indian has of Chinese landform on the ring. This decision, allows a symbolizing of a material exchange of Indo-China border landforms through the bride and groom's rings of a wedding at the Indo China border. With this, we also decided to invest a special meaning of the border into our relationship announcing wedding rings. The rings were made to order in gold to an Indian jeweller. These were partly handmade and partly done using a CNC dye making machine, to get the exact profile of a jagged geography of Nathula Pass. They were crafted by the jeweller who transferred a digital drawing given by us, onto a metal dye profile and later onto a gold plate to get the accurate profile of the Indian and the Chinese side. Both the rings were carried by the groom by wearing them throughout the journey to the border. These border profiled rings as design objects played an important role during the project, that of communicating the project's intent during the journey to the border. The design concept that integrated the border within its profile and form, its physical manifestation, and them being wedding rings indicated a weighted intent of the project. When the groom encountered an administrative doorkeeper, such as a government official or military personnel then the project intent would be communicated by showing the rings and clarifying the concept. This helped in opening up a lot of bureaucratic and administrative doors thus helping in reaching the border from the Indian side. This aspect of a design concept, of using the border profile and its manifestation as wedding rings, not only facilitated in communicating about the project but also helped in reaching the

Indo China border. Such a personal intent and a clear design concept manifested as a well-crafted object, thus, became be a reasonable tool to open doors to the border even through a situation of a military build-up at the border. Thus, this aspect of the border's 'profile' is the most rudimentary way with which we attribute design agency to the political border, through its scaled manifestation on wedding rings as relation making objects.

4.2 A Border Wedding: Politics puts Performing Rituals within a Screen

Our original plan was to gather all the necessary bureaucratic permits to reach Nathula from either sides of the border and then hold a small ceremony together. For this particular event we had gathered and interpreted Hindu and Chinese wedding traditions and rituals. We were prepared with particular ritual practices from both sides that symbolized the rites of union, supposed to be performed by the groom and bride together. These were an equal mix from both Indian and Chinese traditions choreographed as mixed rituals that could be performed as a cross cultural relation making event. This event was where we were supposed to meet and exchange rings. The political situation between the two nations resulting in military stand-off did not allow us to meet. This dramatic evolution in character of the border as an overtly political context reinforced by the military complex and its ability to shape our decisions became most evident at this point. To overcome this complex political context, we chose the route of cinematography. With this tactic, we performed the same set of rituals that we were prepared with in the absence of the other and in two separate places. We recorded the performances on video, and merged them on the screen through video editing. In this manner the ceremony was performed in two places on the 10th of July 2017, the Indian part at the Takshe residential school run by a Buddhist community in Gangtok by the groom and two of his friends, while the Chinese part was carried out on a mountain behind Tashi Lhunpo Monastery in Rikaze by the bride and three of her friends. We performed a coordinated set of same interpretive ritualistic practices in the absence of the other: we enacted exchanging a flower bouquet and garland; crossed lines, performed libation, the act of pouring and receiving ritualistic liquids, received and wore rings but

through a red thread, bowed, and walked, all in the absence of the other half. We coordinated and documented these acts as a performance using video in both places. In this process, it was the camera that replaced the position of the other half. Then later after we got back together, we collaborated, designed and edited, merging the video footages from both sides, realizing sequences of rituals of union on the screen, as our wedding event. We took this route only because of the political situation between our two countries prevented us from meeting each other and performing our conception of wedding at the border.



Figure 5 Stills of the merging of wedding rituals on the screen from the wedding video

4.3 Wedding Venues on Borders: Potential for an Architectural Program

The final outcome as a design act is a speculative design proposal for an architectural program for politically contentious borders. As field-based design researchers from neighbouring countries, who inquired into a border through our performative wedding, our call is for political boundaries to house and facilitate a union of cross-border citizens and cultures than separate. Towards this we propose the potential of wedding venues of varying architectural scales on political borders where these places allow cross culture and border citizens to gather and form familial relations. Being located on separating political borders these wedding venues could still follow the necessary protocols of border control and passage, but in between they are made and designed for rites, rituals and practices of a union. As a potential architectural program, these venues could be small pavilions, to a wedding hall, to the size of a hotel or even at the scale of a neighbourhood or larger, but all located on political borders. One can imagine such edifices on currently politically contentious borders, for instance, a pavilion at the Nathula Pass on the Indo-China border, a wedding hall on the North and South Korea demilitarized zone, a Trump wedding hotel on the US-Mexico wall or a large wedding complex along the banks of the Shatt al-Arab on the Iraq-Iran border. Such a type of an edifice for familial cross border and cultural unions could house the gathering of two different cultures, with the potential of bringing together and mixing food habits, clothing, religion, languages and even architectural elements while indicating for a resolution of political differences across borders. With this proposal, we suggest that such an architectural place within it holds potential to symbolically evolve embodying the ritual of a union itself.

5. Discussion

We performed our wedding in the absence of the other, at the Indo-China border during the Doklam standoff which had the biggest military build-up along the border since 1962. The consequences and characteristics of our wedding as a field-based design project was influenced, conditioned and shaped by the context/situation of the Indo-China border. We have provided evidence of this shaping through three different design outputs from the project that are closely related to the design performance. Through these objects we have also identified and articulated the nature of forces that have shaped these objects, and term them as profile, politics and potential. With these characteristics we attribute agency to the context/situation of the political border. To further iterate, as we reached closer to the border the experience of our political identities became more pronounced, but we let our design practitioner identities be influenced and shaped by the context/situation of the political border and perform our wedding in the absence of the other half. We see this aspect of our wedding performed in the absence of the other as being a reflection not of our personal relationship, but a reflection of our respective political identities. So, the performance of our wedding at the border, as a micro event undertaken by a Chinese and an Indian citizen, indicated the nature of the relationship that was prevalent then between the political states of India and China. This is also what we wish to indicate with our performance as a design act.

Then by framing our wedding as a personal relation making project, our aim is to contribute to the RtD community to highlight field-based performance as a genre of RtD. This approach considered the relationship between us, two design practitioners, who as cross border citizens performed an event symbolizing our wedding as an inquiry along a political border. With this, we deliberated our design practice and our wedding as a personal relationship making event, to fuse. There ceased to be a separation between a personal event and the use of design for performing a personal political commentary as respective citizens. This particular fused characteristic of our performance, when undertaken at the context of the border, integrated inquiry through the design of a personal event. This is what we present to the design research community for a consideration as a discursive genre for RtD.

Such an approach of fusing design practice and personal events and allowing this fusion to not only make a political comment but also as a personal relationship-based inquiry provisions design practice to engage into larger political events. But this also has its consequences. Unexpected turn of events, the risk of being suspected by state authorities and even fellow citizens, loss of control over planning, general uncertainty and many unexpected turns were situations that we faced when carrying out this project. These aspects indeed have implications at a personal and professional level. Yet such a fusion also allowed us to push our boundaries at a personal, professional and also at political identity levels. Thus, our RtD practice by facilitating the conception of such a fusion provisioned a change at personal, professional and political levels.

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Grappling with Diversity in Research Through Design

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Abstract: Since its introduction, Research through Design (RtD) has taken on a wide variety of forms. Currently, there is a lack of clarity about what connects and separates different RtD approaches. Several attempts have been made to clarify these matters, often in the form of a top-down categorization. Here we start on a different path, one that is open for different points of view and grounded in the ongoing concerns and needs of RtD practitioners. Over two months, we engaged a local research community in weekly discussions about RtD in their work. Thoughts and questions were posted on a dedicated wall-space, maintained, and clustered over the weeks. As a result, we identified 11 themes that indicate concerns among participants about RtD. We suggest the themes can help in articulating different RtD 'styles' and 'genres', and believe this should be a collaborative and bottom-up effort that crosses disciplinary and institutional boundaries.

Keywords: research through design; practice-based research; constructive design research; design-led research

1. Introduction

Research through Design (RtD) refers to a way of doing research in which design activities play an essential role in the generation of knowledge. Introduced by Frayling (1993), RtD is commonly distinguished from research for design – i.e. research that aims to inform design practice – and research on (or about) design – i.e. research that aims to understand design practice (Forlizzi et al., 2009). Since its introduction, different design schools and disciplines increasingly have adopted RtD. Over the years, research communities have emerged that disseminate their RtD work in conferences, such as Design Research Society (DRS), Human Factors in Computing Systems (CHI), Designing Interactive Systems (DIS), and, very specifically, the Research Through Design conference (RTD). As a result, there are seemingly disparate ways of understanding and practicing RtD.

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The RTD2019 conference, which was hosted in Delft, the Netherlands, explicitly sought to bring together these divergent understandings of RtD. The conference, in the words of the organizers, aimed to "explore frictions and affinities among different RtD traditions" and to "open up to new audiences" (Research Through Design Conference website, n.d.). In line with this aim, the selection of papers and artefacts presented during the conference revealed a wide variety of approaches to RtD. Among several participants, a conversation emerged in which a lack of clarity was sensed about what connected and separated these different approaches. The authors of this paper, some of whom were part of this conversation, have come to frame this struggle as one of 'grappling with diversity' in RtD.

Over the last decade or so, several scholars attempted to get a grip on diversity in RtD, resulting in various categorizations and overviews. For example, Chow (2010) aims to clarify different versions of RtD by comparing 'practice-led research', 'project-grounded research', and 'research through design'. Koskinen et al. (2011) describe three RtD approaches – 'lab', 'field' and 'showroom' – each based on different historical foundations. Dow et al. (2013) suggest that RtD approaches differ along three dimensions: how far in the future designs are projected; where and how artefacts are used to generate knowledge; and the design researcher's philosophical stance. Lenzholzer et al. (2013) propose a categorization of RtD approaches in landscape architecture, based on Creswell's distinction of positivism, constructivism, advocacy/participatory, and pragmatism. Godin & Zahedi (2014) aim to 'federate' different views on RtD, comparing them according to ontological aspects, epistemological aspects, expected contributions, methodological aspects, and limits. Krogh et al. (2015) distinguish five methods of experimentation in RtD based on how knowledge is built up. Stappers & Giaccardi (2017) provide a comprehensive account of RtD, reporting on the various ongoing discussions in the literature. Finally, discussions in human-computer interaction have focused on distinguishing 'pragmatic' from 'critical' RtD approaches (Forlizzi et al., 2018; Bardzell, 2019), as well as on the 'how', 'with whom' and 'why' of RtD (Anderson et al., 2019). Common to these categorizations and overviews is a retrospective top-down categorization of published work.

The literature mentioned above contains valuable contributions to the discourse regarding RtD and its future. Many of these authors have made attempts to 'grapple with diversity', trying to clarify and articulate RtD from a particular point of view. Yet, as pointed out by Stappers and Giaccardi (2017), "the involved communities are still struggling to find the right words, models, and practices". Similarly, attendees of the RTD2019 conference voiced struggles in understanding the similarities and differences between different RtD approaches. For this reason, instead of developing and proposing yet another top-down categorization of RtD, we start on a different path – one that is open for different points of view and grounded in the ongoing concerns, needs and practices of RtD practitioners1. In what follows, we take an initial step in this direction, where our goal is to understand the thoughts and questions that RtD practitioners are struggling with in relation to RtD. We share a synthesis of these

1 With 'RtD practitioners' we refer to researchers who are, or have been, actively engaged in research projects where design activities play an important role in the generation of knowledge.

thoughts and questions and discuss how this illuminates a way forward to differentiate between various RtD approaches in a bottom-up, collaborative, and cross-disciplinary way.

2. Approach

To understand the thoughts and questions that RtD practitioners are struggling with, we hosted a series of 'RtD LabTalks'. These sessions offered an open platform to a local design research community for sharing, discussing, and reflecting on their RtD work (see Figure 1). The community was based in a university of technology, and the majority of participants have engaged in RtD projects. The RtD LabTalks consisted of eight weekly sessions spread over two months – seven sessions that aimed at collecting and mapping thoughts and questions, and a final session that was dedicated to an overall reflection on the outcomes of the earlier seven sessions (Figure 2).



Figure 1 *Impression of an RtD LabTalk with participants writing post-it notes and placing them on the dedicated wall-space.*

The RtD LabTalks 1-7 included three types of participants: moderators, speakers, and audience-as-discussants. All the participants were design researchers with diverse backgrounds (e.g. anthropology, architecture, computer science, industrial design, management, psychology, and sociology). Three authors of this paper were the moderators of the RtD LabTalks2. Three other authors took part as speakers3. In total, 19 speakers presented work related to RtD. The speakers included three full professors, two associate professors, eight assistant professors, one post-doc, and six PhD candidates. Half of the speakers were Dutch, while the other half contained a mix of nationalities (i.e. Australian, Canadian, Danish, French, German, Iranian, Italian, and Polish). Overall, the speakers could be divided into two slightly overlapping categories. Some were design researchers that applied RtD in their projects (e.g. Baha et al., 2018; D'Olivo et al. 2017; Bendor et al. 2017). Other design researchers have contributed to the theoretical development of RtD (e.g., Boess, 2009; Stappers & Giaccardi, 2017; Sleeswijk Visser, 2018; Vermeeren et al. 2016). Some speakers presented general topics, such as a pragmatist perspective on RtD and

2 Abhigyan Singh, Boudewijn Boon, and Marco C. Rozendaal.

3 Ehsan Baha, Frithjof E. Wegener, and Pieter Jan Stappers.

similarities of RtD to other fields of research. In contrast, others presented particular RtD cases, on topics such as 'museum experience' and 'city-making'. Each of the RtD LabTalks engaged an audience of 20-30 discussants.

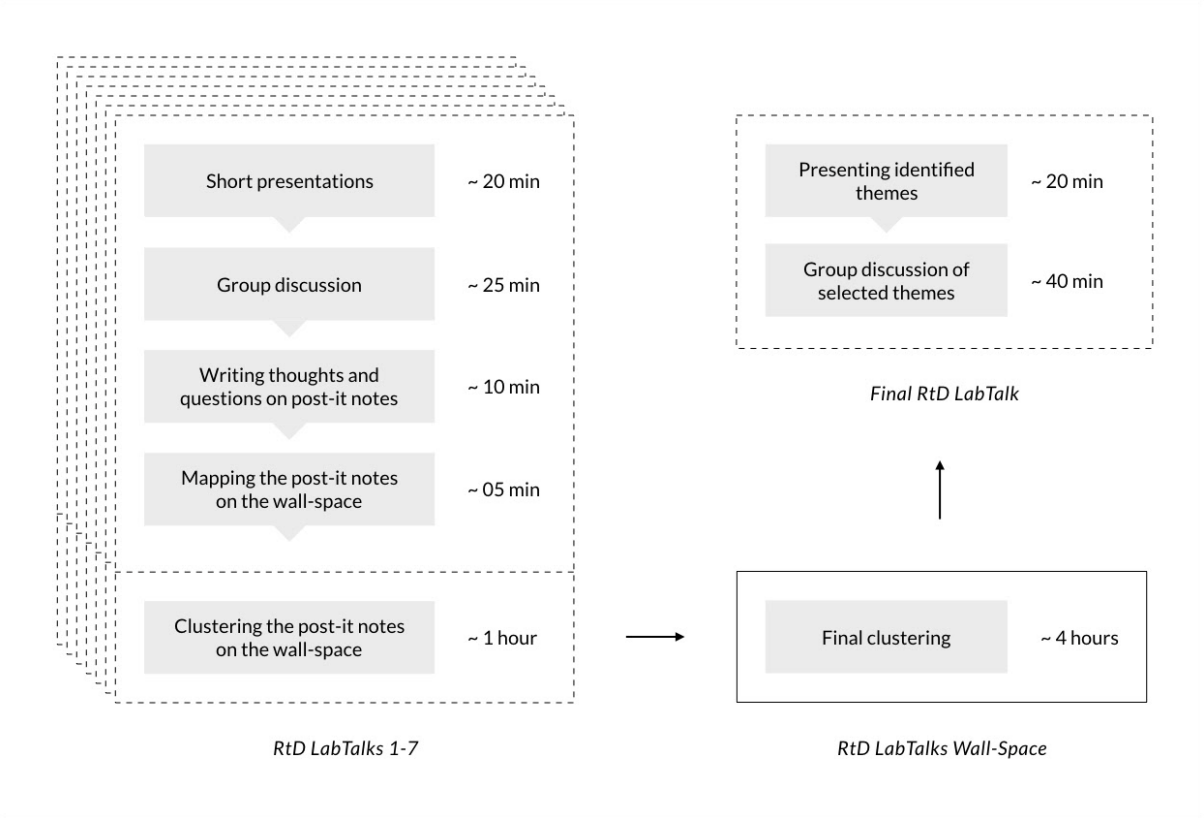

Figure 2 Schematic overview of the RtD LabTalk sessions

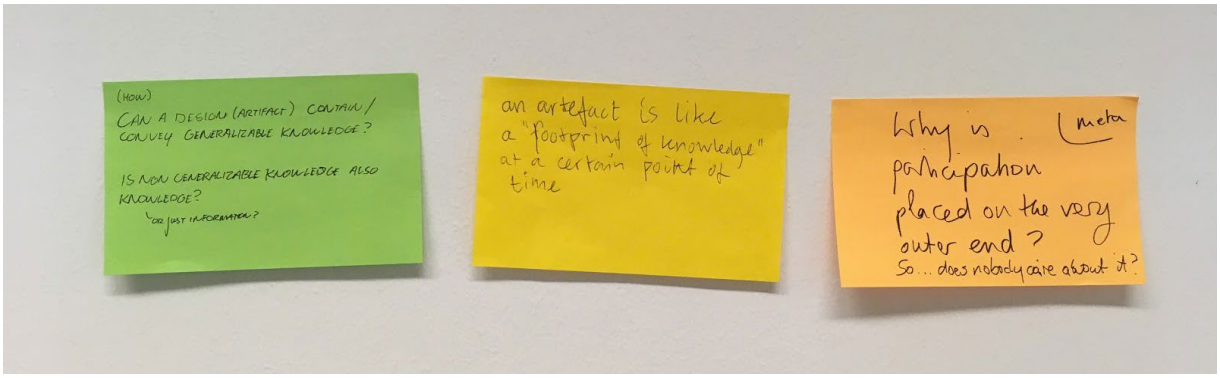

Figure 3 Different types of participant contributions: questions (left), statements (center), and meta-reflections (right).

The final RtD LabTalk involved a meta-reflection on the outcomes of the RtD LabTalks 1-7. To prepare for the final LabTalk, the moderators did a final clustering by thoroughly going through all the clusters and content generated in the LabTalks 1-7. Some post-it notes were excluded from the clustering as their content was either unclear or contained reflections on

the format of the RtD LabTalks itself (see 'Excluded content' in Figure 4)4. The final LabTalk started with the moderators presenting an overview of all the 11 themes to the audience (20 minutes). Following the presentation of the overview, four themes (Knowledge, Process, Quality, and Philosophy) were proposed by moderators for discussion. Each of the themes was discussed for 10 minutes. The idea behind discussing these themes was for everyone to better grasp and understand the nature of the themes and to explore their value. The final LabTalk ended with a discussion regarding the overall lessons learned from the RtD LabTalks.

3. Findings

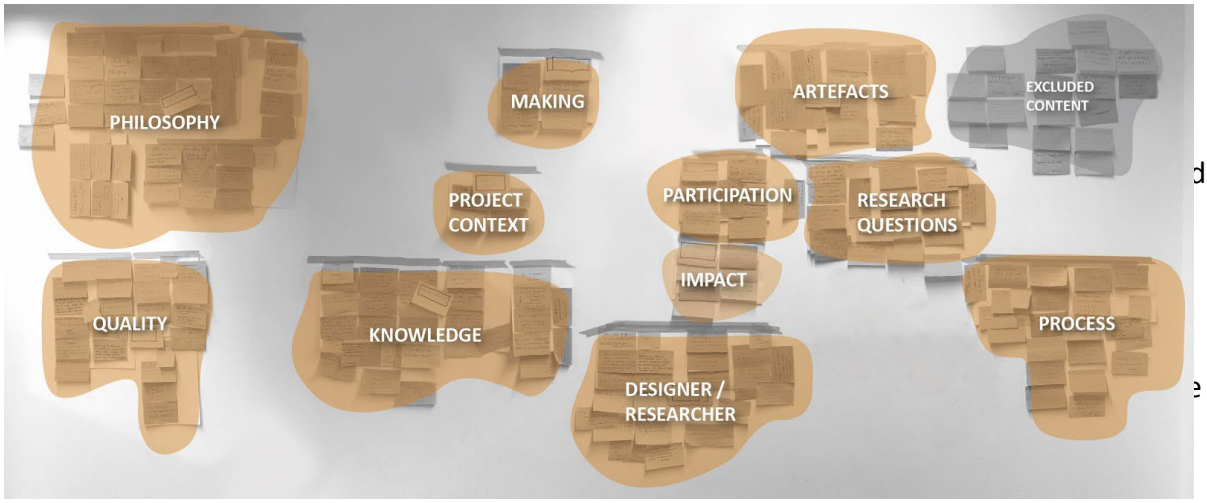

Figure 4 *The RtD LabTalks resulted in 11 themes based on participants' thoughts and questions about RtD.*

1. **Philosophy** – discussion regarding beliefs and definitions of RtD. Associated questions: What is RtD? Is it a paradigm, method, methodology or research approach? How should we consider epistemology, ontology, and worldview in relation to RtD? Is RtD a form of inquiry in itself or a blend of research methods from engineering, the social sciences, humanities, and the arts? When does RtD stop being RtD? Is RtD necessarily academic? What are the limits of RtD?
2. **Knowledge** – discussion regarding knowledge used and produced in RtD. Associated questions: How is knowledge used and generated in RtD? What forms does knowledge take (e.g. guidelines, critique, propositions)? What is the generated knowledge about? How specific is this knowledge and how to make it transferable to other contexts and disciplines?
3. **Designer/researcher** – discussion regarding ideals, mindset, roles, and skills of designers/researchers in RtD.

4 During the writing of this paper, we made a final adjustment to the clusters and their respective titles.

Associated questions: How do the ideals, mindset, and skills of designers/researchers play a role in a RtD process? To what extent do these characteristics affect the outcomes of RtD? What roles do designers/researchers take in RtD projects (e.g. analyst, maker, mediator, critic)?

4. **Process** – discussion regarding how design and research activities are related and structured in RtD.
   Associated questions: How do design and research activities relate to each other in an RtD process (e.g. are these sequential or parallel)? How are these activities structured and temporally arranged in RtD practice? What are effective tools and methods to structure and document RtD activities?
5. **Quality** – discussion regarding understanding and assessing quality in RtD.
   Associated questions: How do we deal with quality in RtD? What design and research criteria can we use to determine the quality of an RtD project? How do questions of quality in RtD compare to other disciplines or research approaches?
6. **Artefacts** – discussion regarding roles, nature, and positioning of artefacts in RtD.
   Associated questions: What roles do artefacts play in RtD (e.g. as demonstrators, physical hypotheses, future proposals, or boundary objects)? What kind of artefacts are used in RtD (e.g. dynamic – static; tangible – intangible; finished – unfinished; high/low fidelity)?
7. **Research questions** – discussion regarding role, type, timing, and purpose of research questions in RtD.
   Associated questions: What is the role of research questions in RtD? How do research questions relate to design briefs and goals? When and how are research questions articulated (e.g. at the outset of an RtD project, or do they emerge/evolve during an RtD project)? What types of research questions are asked in RtD? (e.g. 'how to', 'what if', 'what might be', or 'what ought to be')?
8. **Participation** – discussion regarding various types and reasons for participation of people in RtD.
   Associated questions: How are people other than the designers/researchers (e.g. users, stakeholders, problem owners, citizens) engaged in RtD? What different roles can people take in RtD (e.g., research subjects, collaborators, end-users, beneficiaries of research outcomes)?
9. **Impact** – discussion regarding impact of RtD on design, research, and society.
   Associated questions: How does RtD contribute to the design discipline? How can RtD contribute to other disciplines of research and practice? How can RtD uniquely impact society? Who is affected by RtD? How are outcomes of RtD disseminated?
10. **Making** – discussion regarding the role, contribution, and documentation of making in RtD.
    Associated questions: What constitutes making in RtD (e.g. preparing stimuli, as a knowledge-generating process in itself, a process to reflect upon, proposing novelty)? How does making contribute to generating knowledge? How to

document making processes and outcomes?

11. **Project context** – discussion regarding domains and contexts in which RtD takes place.
    Associated questions: How do different domains (e.g. healthcare, sustainability, or mobility) and contexts (e.g. hospital, home environment, airport) require different approaches to RtD? What are the differences between RtD projects in academia or in industry?

3.2 The final RtD LabTalk: reflecting on the themes

The purpose of the final RtD LabTalk was to have a meta-reflection on the 11 identified themes. In this section, we provide a summary of the discussion that emerged in the final RtD LabTalk. LabTalks 1-7 were characterized by the externalization of thoughts and questions, which resulted in the 11 RtD-related themes. In the final RtD Labtalk, we noticed how these themes served as a structure for participants to discuss their thoughts and questions more deeply – it allowed them to communicate more easily and to align with, or differentiate from, one another. In this way, similarities and differences between participants' way of working became more explicit. For example, during the discussion about 'Quality' one professor pointed out the difficulties of evaluating PhD theses that applied RtD, due to a lack of agreed upon quality criteria. Participants agreed there was a need for such criteria, while suggestions for such criteria were very diverse. Examples were proper documentation, novelty, applicability or usefulness of the generated insights, and the extent to which the work clarifies and evaluates particular characteristics of design examples.

During the final LabTalk we also noticed that when discussing one theme, it often connected to other themes. The discussion on 'Quality', for example, also related to the themes of Philosophy and Process. Themes could thus not be easily discussed separately from one another, and the discussion was of a more holistic nature. Another thing that stood out during the final LabTalk was the consensus among participants to remain open to a variety of RtD approaches, sharing a sense of embracing diversity in RtD. Towards the end of the discussion, the notions of 'styles' and 'genres' were put forth as a way to articulate different RtD approaches. These notions raised enthusiasm and sparked imagination among the participants.

4. Discussion and conclusion

We started this paper with the goal to capture the thoughts and questions that RtD practitioners struggle within their work. We organized these thoughts and questions in an overview of 11 RtD-related themes. Our intention for this overview was not to inform 'our take' on RtD, but rather to start on a different path – one that is open for different points of view on RtD, and one that is grounded in the ongoing concerns and needs of RtD practitioners. We consider the overview of themes as an initial step in such a direction. We are aware that our overview of themes is based on discussions in a particular local academic

environment, and we do not claim these themes to be representative of all RtD practitioners, nor this overview to be exhaustive. Our community is based in a university of technology, and it consists of a diverse group of RtD practitioners of different cultural and disciplinary backgrounds. Still, other themes would likely have emerged from, for example, discussions in arts- or humanities-based communities. We return to this issue below, where we describe opportunities for future work. We believe that overviews like the one developed in this paper bring value to the RtD discourse in two ways. First, the identified themes can help in making distinctions between different RtD approaches. Second, the overview points at aspects of RtD that are currently little discussed in the literature. We discuss these contributions in the subsections below and conclude the paper with opportunities for future work.

4.1 Using the themes to distinguish different RtD approaches

A way to grapple with diversity in RtD is to differentiate between different approaches to RtD. We suggest that the 11 RtD-related themes can be helpful in this respect. On a general level, the themes focus our attention to particular areas of similarities and differences. More specifically we suggest seeing the themes as dimensions along which RtD approaches differ. Take, for example, the theme of 'Artefacts'. Artefacts can play a variety of roles in RtD (e.g. see Stappers, 2014), and these roles could potentially be useful to characterize particular RtD approaches – artefacts in a 'showroom' serve a different purpose than in the 'field' or 'lab' (Koskinen et al., 2011). Similarly, approaches are likely to differ in terms of their 'Process', ranging from more structured approaches (e.g. Keyson & Bruns Alonso, 2009) to approaches that are described as continuously adjusting or 'drifting' (e.g. see Krogh et al., 2015).

The above themes can be valuable for RtD practitioners in making sense of diversity in RtD in two ways. First, individual RtD practitioners may find the overview of themes useful in trying to develop or make sense of their particular way of doing design as part of doing research. For example, the themes can serve as general considerations that they otherwise may overlook. Beyond their utility for individuals, we suggest the themes can serve a particularly valuable role in facilitating group discussions about similarities and differences between RtD approaches. Such discussions may eventually inform new categorizations or other developments within RtD. In existing categorizations, the dimensions used for making distinctions have not always been specified. We suggest that the step of explicitly defining such dimensions is a crucial requisite before categorization.

4.2 Contribution of the themes to the RtD discourse

A wide variety of topics have been covered in the RtD discourse, and we see that most of the 11 themes identified in this paper are addressed to a large extent. For example, 'Philosophy' is discussed in terms of what RtD is (e.g. Jonas, 2006; Zimmerman et al., 2010) and what could act as epistemological foundations for RtD (e.g. Dixon, 2019; Isley & Rider, 2018). 'Knowledge' is discussed in the discourse on 'intermediate-level knowledge' (e.g. Höök & Löwgren, 2012; Gaver & Bowers, 2012) and in terms of how RtD generates knowledge (e.g. Markussen et al., 2017; Redström, 2017). Also 'Artefacts' (e.g. Zimmerman & Forlizzi, 2008;

Odom et al., 2016), 'Process' (e.g. Basballe & Haskov, 2012; Stappers et al., 2017), 'Quality' (e.g. Biggs & Büchler, 2007; Fallman & Stolterman, 2010), 'Impact' (e.g. Durrant et al., 2015; Koskinen & Krogh, 2015), and 'Making' (e.g. Mäkelä, 2007; Löwgren, 2016) are addressed in the literature. This coverage could be seen as a reassuring sign, telling us that the thoughts and questions that practitioners have been considered in the literature to a large extent. However, our discussion so far has mainly focused on the generic themes that we identified. Whether the particular questions that make up the themes have sufficiently been addressed in the literature is uncertain. It is beyond the scope of this paper to make a statement in this regard. Instead, we encourage authors that address one or more of the 11 themes to consider using the particular questions summarized in Section 3.1 to inform their work.

Four of the themes of our overview are, to the best of our knowledge, still underemphasized in RtD literature. The first is 'Participation' – while many participatory design projects can be considered as a form of RtD, such work is not often discussed in RtD-related papers. We see signs that this theme is of interest and relevance, as several authors adopt the term 'research through co-design' (e.g. Ricci & Scataglini, 2020), positioning participation at the center of their RtD approach. Furthermore, the themes of 'Designer/researcher', 'Research questions' and 'Project context' are very little discussed in the RtD literature, although with exceptions. For 'Designer/researcher' see Sleeswijk Visser (2018) on the different roles that designers/ researchers take in RtD. For 'Research questions', see Findeli (2010), Brandt & Binder (2007), and Bang et al. (2012). Finally, for 'Project context', see Boess (2009) on the situatedness of RtD. We believe these four aforementioned themes require more attention in the RtD discourse.

4.3 Future work: Towards 'styles' and 'genres' of RtD

At the outset of this paper we stated that, rather than proposing yet another categorization of RtD from our particular perspective, we start on a different path – 'one that is open for different points of view and grounded in the ongoing concerns, needs and practices of RtD practitioners'. Our contribution can be considered as an initial step in this direction. We see two main opportunities for future work.

A first opportunity is to continue discussions according to the approach taken in this paper, and to engage a broader range of RtD practitioners in sharing thoughts and questions about RtD. Such discussions can enhance the overview of themes developed in this paper. Moreover, we suggest the process of sharing thoughts and questions is valuable in its own right. It allows RtD practitioners from different backgrounds to learn from one another and to get a grip on the variety of approaches that RtD practitioners are taking in their work. We suggest conferences such as the RTD, DRS, CHI and DIS conferences, are an ideal venue for such purposes, as they typically bring together such a diverse community.

A second opportunity concerns the distinguishing of different RtD approaches. During the final RtD LabTalk (see Section 3.2), the notions of 'styles' and 'genres' were proposed to serve this purpose. We share the enthusiasm that participants had for these notions, and see them

as a promising way forward to grapple with diversity. We envision 'genres' of RtD as more general categories that come with certain agreed-upon conventions – much of the related work discussed in the introduction addresses diversity on this level (e.g. Koskinen et al., 2011; Forlizzi et al., 2018). 'Styles' refer more to the particular ways of working of individual RtD practitioners or research groups – we feel that there can be more discussion on this level. Here is where similarities and differences can be articulated in a more granular way, close to RtD practitioners' everyday practice, and close to their needs and preferences. We propose that the notions of 'styles' and 'genres' can form the basis for a shared language for the RtD community – a consistent language that is currently missing (Stappers & Giaccardi, 2017). A consistent language requires conceptualizing the two notions further, building on theory and a strong engagement with RtD practice. Developing such a shared language will require discussions that cross-disciplinary and institutional boundaries. We hope to organize and participate in such discussions in the future to collaboratively understand and embrace the diversity that marks the RtD discourse.

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Building a Sense of Identity Belonging and Culture Through Place-Making and Creative Co-Design: Practices within New Zealand's Educational Context

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Abstract: The key role and the importance of arts and culture in shaping today's creative economy and bringing vibrant range of creative and cultural activities to the public has been steadily growing in the past few years. This paper investigates the question of how design research contributes to belonging and wellbeing, specifically in the context of Aotearoa, New Zealand. Through a proposed three-folded structure: a) Toi Whītiki in Action, b) Aotearoa – New Zealand and Education Context, and c) Student Case Studies, this paper delves deeper into student creative projects and city co-design practices to enhance a city's status of wellbeing and engagement with diverse culture.

Keywords: aotearoa; arts and culture; design research; collaborative practices; placemaking; wellbeing

1. Introduction

The creative industry sector is gaining more and more momentum, and perhaps it will hit 'pick creativity' in the next years to come. The arts are contributing as well towards the creative entrepreneurship, as the CreativeNZ surveys shows: "New Zealanders believe the arts make their communities better places to live and agree they should be a part of everyone's education" ("New Zealanders and the arts summary report", 2017, p.5). Furthermore: "Eight out of ten New Zealanders have participated in the arts or attended an arts event, or both, in the last 12 months resulting in a record high for arts engagement (80%)" ("New Zealanders and the arts summary report", 2017, p.6). The benefits of the arts, as stated in the survey, are plentiful: boost of confidence, creativity, a sense of belonging; all the signifying badges of well-being and effective impact. "'New Zealanders recognise the positive contribution the arts make to supporting strong, thriving communities and the development of happy, confident young New Zealanders,' said Creative New Zealand Chief Executive Stephen Wainwright" ("New Zealanders and the arts summary report", 2017, p.1).

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'Art for the many, not for the few', as the New Zealand Prime Minister and Minister for Arts, Culture and Heritage voiced in an opinion piece (Ardern, 2018). Taking the framework of the Auckland Council document Toi Whītiki: Auckland's Arts and Culture Strategic Action Plan (2015), this paper looks into the question of how design research contributes to belonging and wellbeing, specifically in New Zealand. Through a proposed two-folded structure: a) Toi Whītiki in Action, b) Aotearoa – New Zealand and Education Context, and c) Student Case, this paper delves deeper into student creative projects and city co-design practices to enhance a city's status of wellbeing and engagement with diverse culture.

2. How Tāmaki Makaurau - Auckland Plans to be the Most Liveable and Culturally Diverse City

In the period between 2015 and 2025, Tāmaki Makaurau - Auckland, will face the need to respond to continued growth, changing demographics, and increasing international competitiveness in the creative sector. In order to address those areas in need of support and make the most of opportunities, Auckland Council and its subsidies having been planning the future of the creative sector to make Auckland the most liveable city. There are several strategic initiatives which contributes to this government goal such as the Toi Whītiki Arts and Culture Strategic Action Plan ("Toi Whitiki Strategic Action Plan", 2015). This strategic plan has set goals and key objectives for the duration of ten years to develop and grow arts and culture in Auckland. Currently the Auckland, Tourism, Events and Economic Development (ATEED) are calling out to the Auckland community to have a say on how the city can grow the potential of the creative sector through a "Creative Industries Strategy" towards 2030 ("Creative Auckland 2030"). The Auckland Co-Design Lab is another example of an Auckland Council supported organisation that is calling for community engagement. This initiative aims to work with central government and community partners to apply co-design principles and a perspective view to complex social issues. This paper situates Toi Whitiki in relation to the New Zealand government goals for the creative sector, looking into what is the new data and target goals in the field, and how enhancing wellbeing through creative means, will further expand the impact of arts, culture and a sense of belonging.

The key role and the importance of arts and culture in shaping today's creative economy and bringing vibrant range of creative and cultural activities to the public has been steadily growing in the past few years. Case example is Tāmaki Makaurau - Auckland, which through the Auckland's Arts and Culture Strategic Action Plan (Toi Whītiki) strives to achieve the vision of becoming the "world's most liveable city". As it is stated in Toi Whītiki:

> Arts and culture play a key role in the cultural, social and economic life of Auckland, making it a more dynamic and attractive place to live, work and visit. It connects and strengthens our communities, gives us a sense of identity and pride, improves individual and community health and well-being, and contributes to a strong economy. (2015, p.4)

Toi Whītiki aims to deliver on the vision and outcomes of the Auckland Plan (the key strategic document for Auckland Council), which includes the integration of arts and culture into

everyday lives, and to address the challenges and opportunities in the ever-growing and increasingly diverse city. Following on from the strategic directions in the Auckland plan, Toi Whītiki is a core strategy recognising the importance of people's engagement with arts and culture and boosting participation in shaping stronger communal bonds, wellbeing, and sense of partaking an active role in shaping Auckland to be truly a liveable and multi-cultural city. The action plan has a 10-year timeframe in order to allow time to measure the impacts and outcomes and has been developed by Auckland Council in collaboration with the arts and culture sector. Commented upon by councillor Alf Filipaina: "Public engagement on Toi Whītiki, led by Auckland Council, clearly showed that Aucklanders understand that arts and culture are fundamental to a healthy society and a good quality of life" ("Toi Whitiki Strategic Action Plan", 2015, p.3). To support this statement, the Action Plan gives the figures that 88% of Aucklanders believe that the arts are good for you, 86% agree the arts help to improve society, and 90% agree that they learn about different cultures through the arts ("Toi Whitiki Strategic Action Plan", 2015, p.4). In 2014, over 90% of Aucklanders attended or participate in at least one arts event. The number of people participating in arts and cultural activities is growing exponentially each year, which is evident from the numbers and figures provided by Creative New Zealand (Figure 1). The action plan recognises the importance that the creative sector plays in bringing wider economic, cultural, and social benefits, and supports opportunities to maximise the sector's contribution to the vision of greater Auckland.

In relation to the Toi Whītiki plan, Auckland Council is looking at South Auckland as becoming "the first New Zealand Maker City, known to for intergenerational creativity, entrepreneurship and innovation" ("Toi Whitiki Strategic Action Plan", 2015, p.5). Through the official strategy *South Auckland: City of Makers Strategy* (2018*)*, the Auckland Council puts in focus how "in the next five years, we will be focusing on strengthening the maker movement and growing the ecosystem of spaces, people, knowledge and infrastructure" ("South Auckland: City of Makers Strategy" 2018, p.6). This plan operates in the broader scope of The Southern Initiative (TSI), which was launched in 2012, with the goal to "plan and deliver a long-term programme of co-ordinated investment and actions to bring about transformational social, economic and physical change in this area" ("South Auckland: City of Makers Strategy", 2018, p.6). Tamaki Makaurau - Auckland, is already a city that exhibits qualities of a strong leader in the creative economy, following the statistics that "with nearly 18, 000 people working in concentrated clusters, supported by some of the world's best talent - 49% of the country's creative jobs are based here, contributing $1.8 billion in gross domestic product (GDP) annually or 2.3% of Auckland's GDP" ("Toi Whitiki Strategic Action Plan", 2015, p.54). Overall, working within the framework of the South Auckland Maker City plan, Auckland Council puts forward few points that will focus on: "Celebrating South Auckland successes locally and nationally"; "creating market opportunities by jumpstarting key initiatives"; and to "work with communities, government and private sector to promote south Auckland as a hub for learning and innovation" ("South Auckland: City of Makers Strategy", 2018, p.54).

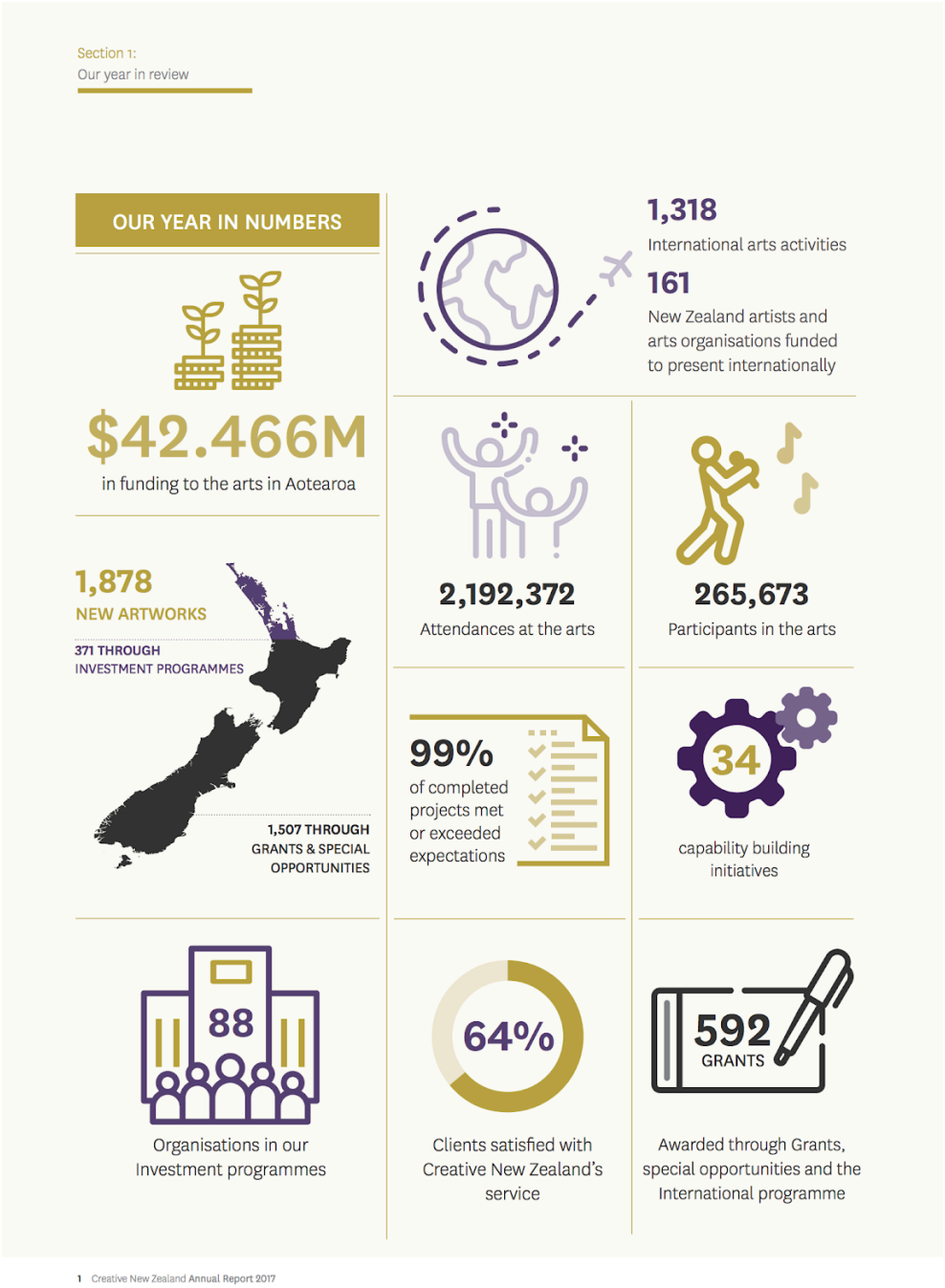

Figure 1 Creative New Zealand Annual Report 2017

The vision for arts and culture in Toi Whītiki is focused on six key categories: Participation; Investment; Infrastructure; Place-making; Identity; and Creative Economy. In order to get a better grasp of why and how these key points are included in the action plan and what role they play; they will be discussed further below. Starting from the very first one - Participation.

Participation is the rudimentary founding block of the Action Plan. What participation means for the vision of the Auckland Plan is that "all Aucklanders can access and participate in

arts and culture" ("Toi Whitiki Strategic Action Plan", 2015, p.18). The participation aspect consists of three Action Plan points: a) increase opportunities for Aucklanders to experience and participate in arts and culture; b) better communicate what's on offer; c) remove barriers to access and participation ("Toi Whitiki Strategic Action Plan", 2015, p.20). The vital role that participation has is to ensure that indeed all Aucklanders, despite age, cultural background, and mobility, can partake in engaging with the arts and culture activities: "research shows that while Aucklanders value arts and culture in all their forms, many do not engage with them, and access and participation are not equitable across the region" ("Toi Whitiki Strategic Action Plan", 2015, p.24). In order to address these barriers, the three sub-points need to be put in action to ensure that participation is accessible to all Aucklanders.

Another important aspect that needs to be taken deeper look into is 'place-making' (point four of the Action Plan) and the role of arts and culture as intrinsic elements to Auckland's place-making agenda. Auckland plays a vital role as a creative incubator for place-making, and strives to enhance further the engagement and liveability of the city:

> We've heard that Aucklanders want to improve the liveability, beauty, vitality and sustainability of the region and its people through creativity and innovation. While 76% of them agree that the arts help define who we are, we know we need to do better in communicating the key role that arts and culture, and specifically public art, have in making a great city. Making it easier to create art in public places will go some way towards encouraging more people to be part of the transformation. (Toi Whītiki, 2015, p.43)

Following from this statement, in order for the city to indeed do better in communicating the key role that arts and culture, including public art, have in making a significant impact, there are two major points Action Plan points put down for consideration: a) the narrative - tell people's stories by encouraging unique and distinctive public art that reflects and responds to place-making; and b) make it easier to plan, create and deliver innovative art and design in public places ("Toi Whitiki Strategic Action Plan", 2015, p.44). This links as well to the next point of the six major Action Plan categories, which is 'Identity' (point five). Auckland celebrates a unique cultural identity and the status of the city as a melting pot of different cultures and the standout feature which is the vibrant *Māori culture* ("Toi Whitiki Strategic Action Plan", 2015, p.48). To be able to stand out on the global stage, Auckland Council is firmly supporting and putting in action the vision of strong local identities, which gives the unique flavour of the arts and culture produced here:

> Combined with our strong European heritage, robust Pacific cultures and growing Asian identities and their festivals, Aucklanders are increasingly enjoying cultural experiences. An exciting blend of artistic styles, techniques and performance arts is emerging and can be supported by helping these groups to network. Auckland's indigenous culture and strong contemporary art practice are already growth areas in its visitor economy, and this can be built on. ("Toi Whitiki Strategic Action Plan", 2015, p.48)

An example of growing Asian identities and for other cultures to embrace the Asian community through fostering enjoyable cultural experiences is the Chinese Lantern Festival in Auckland. In 2019 the festival celebrated its 20th anniversary, providing for its visitors the

experience of "hundreds of handmade Chinese lanterns, music and dance performances, martial arts demonstrations, traditional Chinese art and craft – there's a range of activities for all ages" ("Lantern Festival" [APA], n.d). Another big major festival, celebrating robust Pacific cultures, is the Pasifika Festival. Running since 1993, is the "largest Pacific Island cultural festival of its kind in the world" ("Lantern Festival" [APA], n.d) festival of its type in the world and attracts over 200,000 visitors annually. The festival consists of "...11 distinctly different villages, each with a performance stage and market, to show the diversity of the Pacific cultures represented. The villages represent the Cook Islands, Fiji, Niue, Aotearoa, Hawaii, Samoa, Tahiti, Tuvalu, Tonga, Tokelau and Solomon Islands" ("Lantern Festival" [APA], n.d).

New Zealand is evolving through place-making, creative co-design and inclusiveness values - it is hoped there will be a "synergy", "the coming together of people" and substantial social impact. Opening opportunities for the community to shape 'their' city is a real strategic approach. The Auckland Council strategic plans support the significance of community participation shaping stronger communal bonds, wellbeing, and sense of partaking through people's engagement with each other via the arts and culture as well as advocate Auckland to truly be a liveable, harmonious and multi-cultural city.

3. Aotearoa - New Zealand and Education Context

Historically, biculturalism has been central to New Zealand's self-conception. This has evolved with the Treaty of Waitangi which, in 1840 promoted "We are one people now" (Sinclair, 1971) and then 150 years later became "Two peoples, one nation" (Bathurst, 2011). However, New Zealand's growing polyethnic diversity, is proving that both biculturalism and multiculturalism play a role in New Zealand's evolving identity and are necessary for strong and healthy ethnic relations in New Zealand (Ward, & Liu 2012). For example, the recent mosque terrorist shooting in Christchurch this year, radically defined New Zealand's national identity in solidarity and unity against racism.

In the 2016 Social Report, the Ministry of Social Development ("MSD", 2016) stated that under the section of Cultural Identity, a desired outcome was to value the cultural diversity in New Zealand. (Ministry of Social Development, n.d.) Thus, this raised the question: How do we promote the preservation of a multicultural national identity?

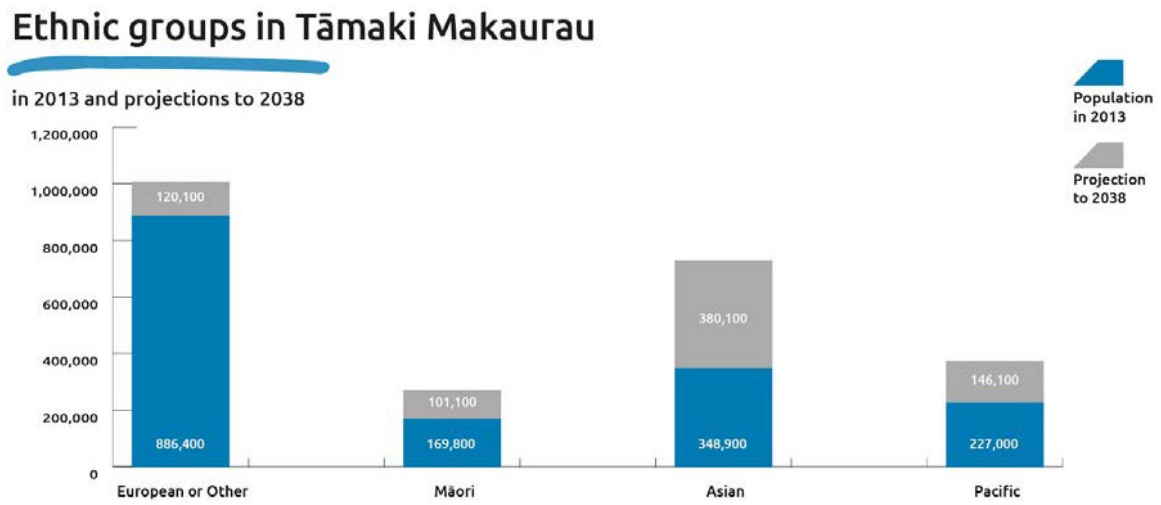

Figure.2 Source: Stats NZ, subnational ethnic population projections.

Auckland University of Technology (AUT) is the second largest and one of the leading universities of New Zealand, in the field of innovation and technology. As a young millennial university who will be celebrating its 20th anniversary in 2020, it is one of the world's best modern universities – Times Higher Education has ranked AUT as the top millennial university in Australasia and in the top 1% of universities in the world. The university's mission is simply "Great Graduates" [AUT, n.d] with a vision to respond to its place in the world through exceptional learning experiences and to contribute wellbeing and prosperity through discovery and application of knowledge. Fundamental to its vision to be a place where people love to work and learn are its values: "Tāwhaitia te ara o te tika, te pono me te aroha, kia piki ki te taumata tiketike - The path of integrity, respect, and compassion; scale the heights of achievement" [AUT, n.d]. As a university in Aotearoa - New Zealand, AUT is committed to the rights and obligations articulated in New Zealand's founding document The Treaty of Waitangi. The university advocates Māori presence and participation in all aspects of university life including the AUT Values framework and AUT authentically integrating Mātauranga Māori within research, teaching and learning. Furthermore, the emphasis put on The Treaty of Waitangi in relation to teaching and learning practices can be summed up in the following way: "The Treaty of Waitangi principle puts students at the centre of teaching and learning, asserting that they should experience a curriculum that engages and challenges them, is forward-looking and inclusive, and affirms New Zealand's unique identity" [AUT, n.d].

Students who study in *Aotearoa* - New Zealand will be submerged into a curriculum where the Treaty of Waitangi principles places students at the centre of teaching and learning, supporting that they should experience a curriculum that engages and challenges them, is forward-looking and inclusive, and affirms New Zealand's unique identity. An amalgamation of the Treaty of Waitangi and Mātauranga Māori has shaped AUT to be committed to building a safe, positive, and inclusive higher learning environment characterised by the free exchange of diverse ideas, skills and cultural perspectives. This

is evident through a range of student's projects that explore identity, culture, sense of belonging and wellbeing.

4. Case Studies

AUT programmes such as the Creative Technologies attracts diverse students who aspire to be entrepreneurial by hacking singular approaches to disciplines, technologies, methodologies and collaboratively innovate through transdisciplinary. The programme sits within the Faculty of Design and Creative Technologies and is recognized as a highly visible place for the development of critical and creative skills, amongst the creative industry and students. This highly visible place, which can be better framed as "creative place-making" (Markusen 2014), is an "inherently restless, unfinished process", that seeks and supports the continuous flow of creativity, and preparing the students for "pursuing the chimera of creative entrepreneurship" (Schlesinger, 2016, p.6). As an example of establishing strong co-design practices and a sense of collaborative place-making, the faculty paper Mahitani (Collaborative Practices) serves as an initiative across the DCT Schools, in order to better understand each other's background and culture and to provide the space and tools to connect with the community through an interdisciplinary community or industry project. All DCT students must take the paper as a prerequisite, which includes ethics and guiding principles of tikanga and mātauranga Māori, in order to instil the sense that they can co-create and co-design as a community and not simply as individual learners and makers. The paper description of Mahitani states:

Introduces concepts of collaborative work, in a wider context of students' work futures, that are underpinned by the guiding principles of tikanga (customary lore, practices and traditions) and mātauranga Māori (Māori-knowledge of the Māori world). Examines a relevant conceptual or thematic issue affecting Aotearoa/New Zealand through the design and completion of a small-scale collaborative project across disciplines. Explores how these concepts of collaboration relate to emerging workplaces and evolving digital work futures. (AUT Documentation)

It is important as well to highlight the learning goals and outcomes of the paper and how they relate to the above-mentioned principles of tikanga and mātauranga Māori. This is achieved through the students working together to identify and select effective collaboration strategies that include decision making and risk taking; an interdisciplinary approach to exploring data and analysing problems; reflect on the collaboration performance using a tikanga and mātauranga Māori framework; reflect on how the practice relates to the future of work across disciplines and digital environments. The project brief is dependent on a real-life client from either a community organization or a company, which provides the students with an external real-life practical learning experience.

Another one of the programme papers in the Creative Technologies - 'Integrative Practice', states as its aim to: "Explore concepts, issues and problems from more than a single disciplinary perspective. Introduces methodologies for integrating knowledge and practices

from different disciplines and allows students to both comprehend and directly address complex issues". Emphasis is put on interdisciplinary approaches and collaboration, to foster comprehension and skills "from more than one disciplinary perspective". This approach is reflected through the student practices and their creative works. Two student cases will be discussed here: Continuum (2018) and Tāngatai Tāngata (2019).

4.1 Continuum (2018)

The project 'Continuum' aims to prompt self-awareness on the performativity of heritage through facilitating conversation between two participants. This is done through an interactive and performative kinetic table. This work arose from the creator's personal desire to understand her own heritage, and to explore and understand the performativity of heritage and remembering. The work's original purpose aimed to embody the creator's journey of self-discovery of her heritage. Also, to prompt others to reconsider and 'remember' their own intangible heritage. However, it was soon realised that these were two separate projects. Thus, the purpose was refined to prompt self-awareness that their relationship with the heritage and past, influences the performance of their identity. The key message being heritage is performative.



Figure.3 'Continuum', Talia Pua (2018)



Figure.4 'Continuum', Talia Pua (2018)

Design Process

When heritage and memory are understood through the frame of active remembering, they are performative. As Harrison (2012) argues, "heritage is primarily not about the past, but instead about our relationship with the present and the future." (p. 4) In this way, heritage and remembering has the power and stimulate to inspire us inspire and influence our actions. From this perspective, like performativity, focus is shifted off the objects of heritage and memory, and onto the process, experience and produced effects of remembering. For the aesthetics, the layout of the table drew inspiration from family tree diagrams. The arcs of the family tree diagram were adapted to represent the continuums. The table design took inspiration from antique Chinese tables so that the participants would feel a sense of heritage before interacting with the work. Furthermore, by reinterpreting a tangible heritage artefact into a kinetic table, participants are symbolically transforming the way they relate with heritage through physically manipulating the composition of the table surface. Regarding performativity, the work drew inspiration from existing performer driven displays and performative surfaces. These included, Reuben Margolin's kinetic sculpture, 'Connected' (Margolin, 2011), MIT's kinetic tabletop, 'Transform' (Ishii, Leithinger, Follmer, Zoran & Schoessler, 2014), and Andreas Vang's 'Tectonic Clock' (Vang, 2015).

The work was developed through extensive prototyping and playtesting of all aspects of the design so to prove the design's fulfilment of the project's intention. The interaction design came from an early role-playing workshop that play-tested different performance approaches to exploring the concepts. From this, the continuum exercise was then further refined through playtesting multiple paper prototypes and cardboard mock-ups that focussed

on different elements of the exercise. For example, the wording and order of the questions, the instructions, the layout and group vs. individual context.

The physical mechanisms and design of the table were all prototyped on low-risk scales first. For example, using cardboard mock-ups, using CAD software for 3D modelling, and paper concepting. This then progressed onto a medium-risk scale where the design of the mechanisms was tested and finalised on a small scale using the chosen materials and methods e.g. plywood and laser-cutting. This progression from low-risk to high-risk scale prototyping was done to minimise costs, i.e. time, money and resources, and maximise the success-rate of the final design by proving that it works beforehand.

All feedback received and decisions made were critically assessed alongside design pillars. These pillars outlined the three key concepts the work needed to engage with, and the three-key aesthetics of play for the desired experience. The play aesthetics were informed by Hunicke, Leblanc and Zubek's (2004) MDA framework for game design. The design pillars were then adapted into a methodology flowchart which assisted in the decision-making process. This evolved an exploration of how to encourage self-expression and reflection, using theories of performativity, Tactile User Interfaces (TUI), and social play.

Implementation of Continuum

Talia Pua was contacted by an AUT initiative called "Wiser" - an "intimate space designed for conversation, connection, and reflection on the ups and downs of being human", consisting of a "programme of talks, workshops, rituals, and social events to explore how we can develop better self-knowledge and a greater sense of purpose and meaning in our lives", to work with them on implementing Continuum as part of Wiser's programme of workshops and events at AUT in 2020. The curatorial team are currently looking at designing a workshop around 'Continuum' that will focus on heritage and identity. As the artistic director of Wiser stated:

> Continuum has a lot of value for people. I have done work with a lot of individuals who have expressed that they feel disconnected to parts of who they are and their cultural heritage. And I think that Continuum gives them an opportunity to work through some of that. The tactile nature of Continuum, the ability to touch and feel, as well as have a conversation is a really great way to open people up and help them express what they want to say. (Pua, 2018)

As a recognition of the success of the project, it won the Designers Institute of New Zealand Best Design Award, in the category of Student Public Good. This is what the Best Awards Judges stated:

> This thoughtful, tactile experience stood out against a deluge of digitally based entries. We loved the way that the design returns users to a slower, more personal and connected interaction, and we imagine, a deeper conversation about heritage and identity. Wifi-free gamification meets culture in a compelling and beautiful package. (Designers Institute of New Zealand Best Design Awards, 2019)

4.2 Tāngatai Tāngata (Person in People)

Serving as an example is the collaborative duo-project 'Tāngatai Tāngata' (Hobman & Pua, 2019) sought to address New Zealand's multicultural national identity by asking: "what does it mean to be a New Zealander?" Through the development of this project, it became important to find how to conceptualise identity within a New Zealand-specific lens. This led onto drawing on Māori *tikanga*, way of doing, such as *Pepeha* and the *Au to Whakawhanaungatanga* framework. To make these frameworks accessible to the public, 'Tāngatai Tāngata' drew on other disciplines including tangible user interface design, play and interaction, participatory art and data physicalization. "By creating and contributing their own personal 'pepeha tile', participants are encouraged to self-reflect on their own identity within a New Zealand-specific framework, and reflect on how they connect to the wider collective" (Hobman & Pua, 2019).

Relevant theories

Initially Pua and Hobson considered theories on social sustainability as being equity between generations (McKenzie, 2004). Specifically, they considered this within a cultural and collective context: how can we sustainably build and maintain collective and cultural identities across generations? Other theories on nationality, identity and social sustainability were also considered within the design and development.

While national identity has been defined as being united in assimilation (Bobro, 2018), 'Tāngatai Tāngata' intends to contribute that national identity is built upon the preservation of its diverse collectives. Identity markers are "a characteristic associated with an individual that they might choose to present to others to support a national identity claim" (Kiely, Bechhofer, Stewart, & McCrone, 2001). For this process to develop, there is a need for more fluid national identity rules to assess identity markers.

Project Inception

The design and development were initially inspired by the research question - "How do we preserve a multicultural national identity?" The phrase "This is how New Zealand introduces itself - *Koinei tā Aotearoa whakamihi*" (pepeha.nz) was the main catalyst in the 'Tāngatai Tāngata' project that prompted to consider: "What would New Zealand's pepeha be?"



Figure.5 Au to Whakawhānaungatanga framework diagram (TKI & Ministry of Education, n.d.)

Through practice as research, it was discovered that contrary to rigid notions about national identity and nationality, "New Zealand-ness" manifests in numerous ways (see images below). Moreover, from discussing with a cultural advisor Pua and Hobson were challenged with how to create a National Pepeha that would represent and relate to everyone. Thus, it was endeavoured to discover how to create a system in which theoretically the populace could collectively create their own national pepeha. In doing so, how principles could be applied from collaborative and participatory art practices were explored. The Au to Whakawhānaungatanga framework, which was applied to the format to highlight the connection between self and the collective.

An iterative user-centred design approach was applied and throughout the process of creating tangible user interface (TUI), playtesting and interviews were conducted to progress and improve the theory. Each playtest included a follow-up interview using retrospective cognitive probes about the physical aspects, user experience, the choices made and the fundamental theory for the project. Subsequent design and development iterations of the project were through feedback and reflections.



Figure.6 'Tāngatai Tāngata', 2019 Talia Pua and Olivia Hobson



Figure.7 'Tāngatai Tāngata', 2019 Talia Pua and Olivia Hobson

5. Conclusion

Auckland Council have planned a continual growth for the next 15 years, considering the changing demographics, and increasing international competitiveness in the creative sector.

In order to support and leverage opportunities, Auckland Council and its subsidies having been planning the future of the creative sector to make Auckland the most liveable city. This paper has provided an overview of these strategic initiatives which contributes to this government goals to develop and grow arts and culture in Auckland. As New Zealand is increasingly becoming a multi-cultural and diverse city, Toi Whītiki aims to deliver on the vision and outcomes of the Auckland Plan, which includes the integration of arts and culture into everyday lives. For further development and helping to carry the mission of 'most liveable city', initiatives such as Placemaking in Practice (2018), can play a crucial role in positioning creative placemaking as the binding agent of overarching approach to improve neighbourhoods, communities, cities or towns; aiming to make arts and culture truly for all, and not just for the few. It is believed that these actions will address the challenges and opportunities in the ever-growing and increasingly diverse city. The outcomes from such initiatives will positively enhance understanding of different cultures to encourage wellbeing and a sense of belonging.

As concluding notes, it is suggested that tertiary education providers can enhance and build-up the framework for acting as testing spaces/co-designing spaces, and provide place-making approaches for council initiatives. This has been already observed on the level of the student case studies, with reference to the recognition, feedback, a part of an exhibition, and the Wiser initiative—all indications of the public engaging with the arts and culture. Embedding Mātauranga Māori within education and design research provides an open and safe place to experience and explore culture inclusiveness, our place in the world and how we engage with each other. Mātauranga Māori assists in the balance of the tension between design research, new experience design coupled with social inclusiveness. The case studies discussed illustrates how interactive activations can be a tool to unite people and culture yet also allow the participants to remember and reconnect with their heritage and for others to gain understanding and build connectedness. Allowing "the heart of people" to set the direction of the creative sector is a meaningful approach to fulfilling positive social impact, diversity, cultural acceptance, and wellbeing. As further suggestions for future research work, this paper can provide an interesting discussion and comparison with other critical design educational programs, such as that of OCAD (Ontario College of Art and Design) in Canada and draw links with placemaking projects in other cities, such as the case example of placemaking in Michigan, by the Michigan Municipal League (MML/League). In addition, AUT has recently signed a partnership with two South American Universities. The partnership includes research projects that support South American institutions to reconnect with the indigenous people through integrating cultural values and practices with learning and teaching.

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Design Meets Death: Emergent Issues in a Research Study on Reimagining 'Legacy' in the Context of Paediatric Palliative Care

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Abstract: 'Legacy' is a death-centred adult-oriented concept, conventionally defined and narrowly imagined. Legacy making activities in palliative care are proven to enhance sense-making and offer therapeutic benefits. However, research around legacy and legacy making is limited in definition, outcome, and ambition. This paper reports on an exploratory, interdisciplinary, design-led study aiming to reimagine 'legacy', in the sensitive and heavily under-studied context of paediatric palliative care. An inclusive design approach is adopted and children and young people are focused upon as the 'lead design partners' with potentially distinct and largely overlooked voices and viewpoints in palliative care. Both chronological and thematic perspectives are used to outline and discuss the issues and barriers emerged throughout the study. Three overarching themes i.e. Conceptual; Ethical; and Operational are identified as key challenges. Critical reflections are summarised under three insights on Legacy, Difficult conversations, and Life design. Future opportunities for research are outlined under four recommendations.

Keywords: inclusive design; palliative care; legacy; paediatric

1. Introduction

"*I don't see the point of measuring life in terms of time any more. I would rather measure it in terms of what I actually achieve. I'd rather measure it in terms of making a difference*."

(17-year-old boy shortly before he died of cancer, 2017)

1.1 Palliative and end-of-life care

Arguments within the healthcare world around patient-centred care (Kane et al., 2015), patient-reported outcomes (Aslakson et al., 2017) and personalised medicine (Lloyd-

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Williams et al., 2008) resonate strongly with the wider recognition of the need to reclaim and reimagine end-of-life as a 'human', rather than a mere 'medical' domain (Davies, 2018), raising questions around power, control, and singular expertise in end-of-life (Author, 2019). This is further aligned with the rapidly growing evidence base in the design world, on recognition of the individuals' right and desire to reclaim, reimagine, and design their own palliative and end-of-life experience in meaningful & desirable ways (End Well Symposium, 2019; Reimagine End of Life, 2018; HELIX, 2015; Open IDEO, 2014).

In the context of paediatric palliative care however, less is known amongst healthcare professionals about how children and young people make sense of their end-of-life experiences (Langton-Gilks, 2017; Warner et al., 2016). Approaches typically used for conducting end-of-life conversations in the adult setting have proven to be ineffective in paediatrics (Pease & McMillin, 2018) due to complexities including consent and legal authority (Thieleman et al., 2016). On the other hand, research leading to an awareness among the public and healthcare professionals of how Children and Young People (CYP) perceive their end of life experience is severely underdeveloped, and much needed (Jones & Weisenfluh, 2003). Consequently, there is, to date, no coherent framework for different disciplines in the biological, social and human sciences to work together to improve end-of-life care for CYP (Langton-Gilks, 2017; Behrman & Field, 2003).

Young adults with life limiting and life-threatening conditions have emphasised the importance of having discussions about death and dying supported by professionals and carers. Interestingly, they also note, efforts should be made to get to know them and their values prior to broaching difficult matters, further highlighting the need for engagements oriented around life, rather than death (Together for Short Lives, 2015). A need for practitioners to work more openly, proactively, and collaboratively with families has also been highlighted (Coad et al., 2014).

1.2 Legacy

A key construct in how individuals envisage their 'end of life' is that of 'legacy.' The concept of 'legacy' is conventionally understood in adult terms and commonly and narrowly defined as something handed down to a predecessor; the remains of a person, material and/or imagined, that lives on, once they have passed on. Hence, in its current limited definition, framed through an 'after-death' perspective, immediately relevant to every dying rather than living person. Such death-oriented understanding, has also been shown to permeate how adults perceive and conceive of the term when referring to children and young people's legacy. Legacy-making activities offer a range of therapeutic benefits and have been identified as a significant enterprise with end-of-life design potentials for adults, enhancing sense-making, familial communication and positive emotional experiences (Allen, 2009).

An evidence base is beginning to emerge, which explores the meaning and impact of legacy and legacy-making in the experiences of children and young people with life-limiting and

life-threatening conditions, and their Significant Others[1] (SO) (Ackard et al., 2013). However, more often this has been gauged through the perspectives of health professionals (Foster et al., 2012) or bereaved parents (Foster, 2009). We still know little about how children and young people make sense of their own legacy, how they define and understand the term, as well as their preferences for talking about it in accessible and meaningful ways (Foster et al., 2012).

Moreover, significant differences could be anticipated in how life legacy is perceived, defined, and envisioned by CYP, compared to adults. This could be due to variances in awareness of, and adherence to socio-cultural norms and structures; imaginative and creative thinking; theories of self and personal meaning; length of life experience.

In reimagining legacy, the focus on children and young people would not only ensure their voices and visions are central to paediatric palliative care, but also add a novel and potentially significant take on the whole concept of 'legacy'. Hence, potentially enhancing, challenging and revitalising its current limited perception and potential.

1.3 Design

Beyond a process of opportunity framing and problem solving (Lawson 2007; Cross, 2006), design is an act of meaning creating (Krippendorff, K. 2006). The creative, generative, futuristic, and empathic mindset and practices of design (Johansson-Sköldberg et al., 2013) has a lot to offer to palliative and end-of-life care (Nickpour, 2019) and could inform the process of reimagining legacy. In particular, a human centred (Giacomin, 2015) and inclusive design (Clarkson et al., 2003) approach would ensure that the voices and multi-faceted experiences of users are central to every stage of the design process. Putting the extreme voices and experiences of children at the centre of reimagining legacy can be particularly helpful in challenging and innovating upon the concept for all.

An inclusive design approach implies identifying, empathising, and ultimately designing with those often ignored or excluded user groups at the peripheries, whose experiences pose the most extreme and diverse design challenges and constraints. Such focus on moving beyond the mainstream and bringing the extreme to the centre, could in turn offer rich insights, alternative novel perspectives, and lead to better-informed design challenges, re-framed opportunities, and innovative solutions that benefit all.

2. Research aims and questions

2.1 Scope and Aim

A range of gaps, limitations, and opportunities were identified within the current knowledge

1 By 'significant others,' we refer to those individuals who are both biologically related to, and also provide tangible as well as intangible support for, the child or young person in care. Thus, this category includes parents, siblings, grandparents, aunts, uncles and cousins.

and applications of legacy in the context of palliative care. These included the narrow, death-focused, and adult-oriented existing definitions and dimensions; limited creative and generative outputs; lack of child-centred exploratory research on the topic; multiple confirmed benefits of legacy-making activities; and potential unexplored impacts of reimagined legacy-making activities on life trajectory and health outcomes.

Hence, an interdisciplinary design-led study was planned, aiming to reimagine legacy in the context of paediatric palliative care. The research study was co-defined and co-led by an interdisciplinary team of senior clinicians from a children's hospital and academics, coming from three distinct fields i.e. Paediatric palliative care, Design, and Management.

2.2 Research questions

Accordingly, four research questions were outlined;

- How might CYP receiving palliative care, reimagine their 'legacy'?
- How might CYP's SO, reimagine notions of 'legacy'?
- Based on the data from (RQ1) and (RQ2), how might CYP and their SO co-define, co-capture and co-curate 'legacy' in ways that are cognitively, emotionally, spiritually and psychologically satisfying to all concerned?
- How might legacy-making activities impact life trajectory and health outcomes in CYP and their SO?

The notion of 'legacy is for all' underpinned the exploratory research, aiming for a mentality shift in focusing on legacy as a life-centred, ongoing, dynamic, imaginative, and inclusive concept – for all those living, rather than only for those dying. CYP were seen as one progressive, distinctive and uncontaminated voice to help reimagine legacy. Furthermore, by adopting the concept of legacy as a hook, and through use of generative and creative processes and methods, the study aimed to open up spaces of dialogue around a meaningful life, what CYP wanted to achieve alongside, and how they wanted others to know about or remember them. Figure 1 captures the different approach to 'legacy' in the context of this study.

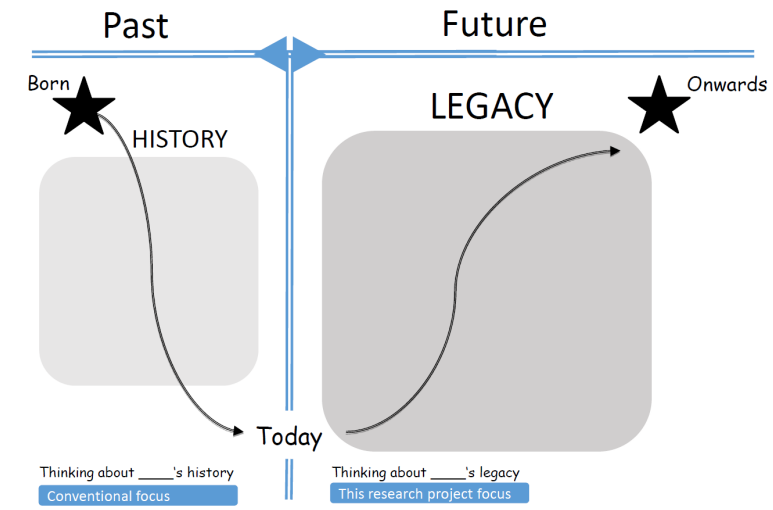

Figure 1 *Legacy, a different take; LEGACY reimagined as an ongoing unending concept versus 'HISTORY' as a past concept*

3. Study design and Development

Table 1 outlines the study plan comprising multiple stages, running across a 12-month period.

Table 1 *Legacy Study plan running across 12 months*

Stage & Activity	**Length (month)**
Review literature on the overarching areas of legacy, CYP, and design	3
Design Initial Legacy-making 'Creative Session', structured around RQs 1, 2 and 3, and informed by the literature review	1
Review initial session design by Steering Committee	0.5
Apply for research ethical approval	2
Recruit participants by approaching guardians for initial interest, if positive, followed by provision of information sheet, followed by a meeting with clinical team conducting the session, who will explain the study in detail and seek consent if the guardian and CYP is agreeable	2
Pilot three Legacy-making 'Creative Sessions' conducted with three eligible CYP and their SO	1
Review and finalise the 'Creative Session' by study Steering Committee	0.5
Conduct eight Legacy-making 'Creative Sessions' with CYP and their SO	8
Design 'Reflection Session' including semi-structured qualitative interviews with CYP, their SO, and facilitating staff	1
Review 'Reflection Session' by Steering Committee	0.5
Conduct 'Reflection Session' with participants involved in Creative Session	8
Data analysis	9

3.1 Ethics and Governance

A substantial ethical approval application was planned for approval by Integrated Research Application System (IRAS) which is the notional body for health, social and community care research permissions and approvals in the UK.

3.2 Sample and Recruitment

The concept of "legacy is for everyone" underpinned the recruitment strategy. Hence, all Children and Young People (CYP) diagnosed with a life limiting condition and their Significant Others (SO) who were referred to the participating hospital's Specialist Palliative Care team, were considered eligible to participate in the research. Additionally, a clear inclusion and exclusion criteria was outlined to be carefully considered by Specialist Palliative Care team on a case by case basis. Table 2 outlines the study inclusion and exclusion criteria.

Table 2 Inclusion/Exclusion Criteria for participation in the Legacy Study

Inclusion Criteria	**Exclusion Criteria**
CYP with life limiting conditions referred to the Specialist Palliative Care team at the children's hospital	Deemed too unwell/too advanced/ not suitable by Paediatric Palliative Care Multidisciplinary team
SO of CYP referred to the Specialist Palliative Care team	Parent or guardian not providing informed consent
CYP Aged 4-18	CYP aged below 4 or above 18
	CYP not providing assent

3.3 Stakeholders Mapping & Steering Committee

Due to the exploratory, complex, and sensitive nature of the research, an interdisciplinary group of stakeholders, who work with the target population in different capacities, were mapped. These stakeholders were also invited to join the study as the Steering Committee. They met regularly as a team, and were consulted separately where needed to review, advise, and steer the study. Figure 2 represents the Steering Committee's spread of expertise and perspectives.

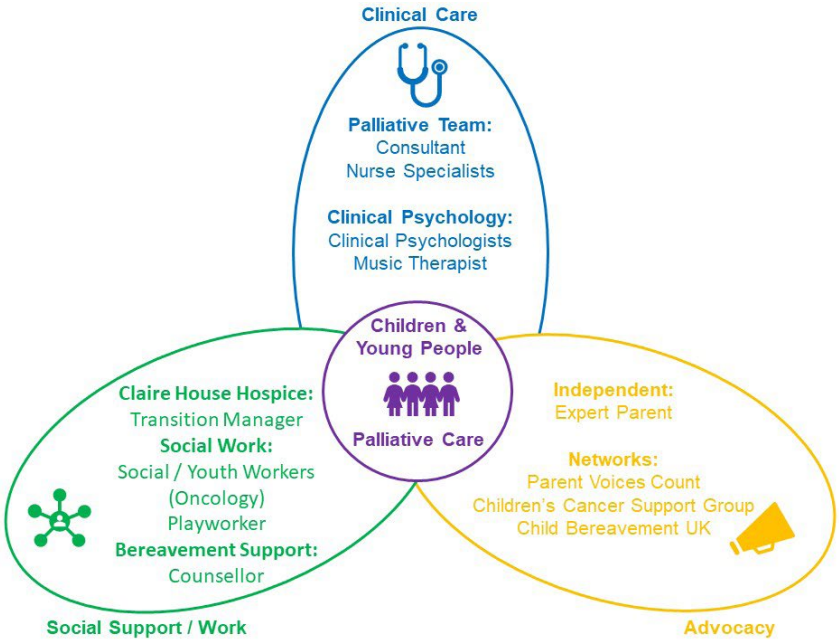

Figure 2 *Legacy Study stakeholder mapping and Steering committee members*

The initial study design was reviewed by committee members including two bereaved parents, a music therapist, a clinical psychologist, a patient and parent participation facilitator, and a bereavement counsellor.

4. Issues and Barriers

The study progressed into pilot phase but did not reach the Legacy-making Creative Session stage, due to a number of issues and barriers. Both chronological and thematic perspectives are used to outline these emergent issues. Firstly, an account of specific issues faced at different stages of the study is provided. Secondly, all barriers are categorised under three over-arching, inter-linking themes.

4.1 Chronological issues

CYP PROFILE

The inclusion criteria at the onset of study, included CYP aged 4-18, with normal global development and verbal communication, enrolled on a palliative pathway. This however, needed to be reviewed, in order to ensure CYP were fully involved and their distinct individual voices were captured. It was commonly understood that adolescence was the age, when children began to form their own distinct identity and voice (Briggs, 2002). However, in the context of paediatric palliative care, the confounding factors were the often multiple complex health and social difficulties that accompanied these young people, affecting their development and their ability to verbally communicate.

Accordingly, the participation age was revised as 11-18. Furthermore, a narrow band of specialties i.e. Cardiac, Duchenne Muscular Dystrophy, and Oncology was focused upon,

where CYP were more likely to have typical developmental and communication abilities, to participate with personal agency, see Figure 3. Despite the inclusive "Legacy is for Everyone" remit of the study, the time and budget limitations did not allow specialist support to facilitate participation of CYP with developmental and communication gaps. This excluded certain voices and reduced the already small number of potential participants.

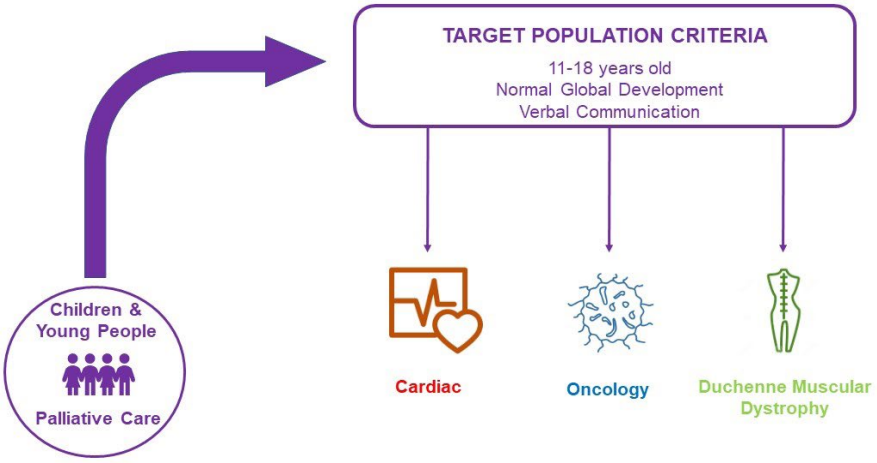

Figure 3 *Re-focused CYP participant profile*

Public and participant framing

The intention was to help reimagine legacy for everyone through an inclusive design approach. However, a necessary ethical and practical consideration in recruitment strategy, was to redress the real possibilities for misunderstanding the concept of legacy, and the overall study, in participant-facing communication.

It was acknowledged that framing the initiative through the lens of legacy, could cause negative emotions, depending on previous conversations regarding the CYP's condition, and the meaning attached to their prognosis.

From a clinical psychology perspective, the introduction of the study to a potential CYP and their family, could irrevocably challenge the understanding of the family, and the knowledge and understanding the CYP might have of their condition. Such a situation could only be mitigated through communication with the network of healthcare professionals and others involved in care of the CYP, in order to establish where a given family were in their journey, prior to approaching them for participation.

As a rejoinder to this issue, it was decided to explicitly use the term 'legacy' in communications and public framing, to maintain the project's integrity, and to keep intact transparency regarding its intentions. The project heading "Legacy is for Everyone" attempted to convey the relevance of legacy, and participant information sheets, helped to explain in positive terms, how engagement with legacy, could help people think about

what they wanted to do with their lives and their wishes and hopes. Hence, an attempt was made to challenge default perspectives, aligned to death and passing on, by including broad interpretations of the term.

Study design

Adding an 'orientation' phase

Interdisciplinary input from Steering Committee helped identify further issues around introduction, framing, accessibility and vulnerability, and gatekeeping, prior to participation in the Creative Session. Hence, an initial 'Orientation session' was added to the 'Creative Session' and 'Reflection Session' already planned. This was in order to better introduce the study to participants; include preparatory work to help inspire and orient both CYP and their SO; conduct a 'pulse check' in order to identify unique circumstances, current paths, and customise support needs; apply a sensitive stepped approach to make the study accessible and meaningful.

Separation of CYP and SO sessions

The main premise of the study was to elicit the distinct voices of CYP. However, within the sensitive and extreme context of paediatric palliative care, the parent or adult caregiver were repeatedly reported to gatekeep participation and speak on behalf of the CYP. Hence, CYP and SO sessions were separated in order to ensure CYP's narratives. This, however, raised further issues around unsupported separation of CYP from their SO, which could put CYP, SO, and the researchers in a vulnerable position.

Framing & Format

A pilot session with teenagers in a palliative care support group, confirmed issues around framing and terminology. Young people at the group struggled with finding meaning in the concept of legacy, which needed to be further unpacked and illustrated with reference to different examples of legacy making. There was a tangible sense that legacy, was not something that was part of their everyday language and experiences, or held age-appropriate significance.

Young people also noted that the project had to be engaging and fun and provide relevant and appropriate opportunities to think through their lives, in meaningful ways. Tapping into contemporary teenage interests, popular culture e.g. music and digital games, and interesting 'hands-on' ways of generating information and insights, were specifically noted as potential hooks.

Pilot phase

Recruitment

Recruitment for pilot phase was led by stakeholder groups who worked closely with CYP and their SO. Early on, the senior consultant co-leading the project had to leave the study due to unforeseen circumstances. This significantly impacted the recruitment as the consultant was well respected as a strong authority and gatekeeper in terms of recruitment, trust and gatekeeping. This raised issues around the sensitive nature, gatekeeping, and hierarchy of

power, authority and expertise in conducting research. Targeting strategies were devised by expert stakeholders based on perceived ability to engage with the activities and appropriate resilience and coping strategies. This raised issues around sample size and purposeful sampling.

A general lack of interest and poor response rate to the pilot initiative was reported by gatekeepers. Introducing the project under the banner of 'Legacy' seemed a barrier to participation. More often the term 'legacy' was understood by parents, in terms of its 'after-death' meaning. Overall, the framing of interventions associated with end-of-life and death were not seen as sympathetic with the cultural context of oncology, for example, where narratives of hope and survivorship predominate.

Tree of Life Activity
Participants introduced to the Tree as a metaphor for life. An example is used to model how to engage with the different dimensions. Participant's then write on the template, their personal responses to the prompts:
Leaves: Important others and role models in your life (e.g. family, friends, heroes & pets)
Branches: Your hopes, dreams, plans and goals for the future
Trunk: Your skills, abilities and talents. As well as your values
Ground: The things you choose to do on a regular basis (e.g. interests and hobbies)
Roots: Where you come from – to do with your family history, your past, culture, and key influences



Figure 4 *'Tree of Life' exercise*

Creative Workshop

The pilot was introduced as part of a legacy project, giving an opportunity for CYP and SO to reflect on their lives, what they had done, the relationships they had made, what they wanted to do in the future and how they could make their own unique mark on the world.

Tree of Life method used predominantly in narrative therapy, (see Figure 4) was presented and participants were invited to reflect on their own lives in relation to each dimension of the tree.

The Tree of Life exercise was generally well received by the CYP as a clear, engaging and meaningful activity. CYP noted that it helped them think about matters not already considered. At the same time, they struggled with the branches level (hopes and dreams). This brought to surface, the inherently different nature of sense of future, perspective and trajectory of life in this context. And while a significant finding in itself, it was seen as a potential negative trigger, reminding CYP of their prognosis.

The small number of participants (2 CYP) was seen as a barrier. Additionally, the invasive nature and considerable level of help needed from support workers to complete typical workshop activities e.g. scribbling or drawing, impacted the information privacy and agency of CYP. Hence, the nature of data collected, was seen as major accessibly and gatekeeping challenges. CYP noted that participants should be given a choice of whether, or not to talk about their tree with the facilitator (for some, this might be considered private information).

4.2 Thematic issues

Various issues captured chronologically, are classified under three overarching themes, and discussed here.

1. Conceptual; Perceptions of legacy in paediatric research

There are challenges in engaging with, or implying, death in paediatric legacy interventions, which can be mis/understood as taking away hope and associated agency from the perspective of adults involved. Accordingly, researchers and practitioners using legacy interventions, have reported various difficulties in framing their work.

A key barrier, was the research focus itself, that of legacy. The impact and consequences of using legacy as an explicit framing device, was noted in both adult and CYP participant groups, across study design, gatekeeping, and recruitment.

Perspectives and attitudes towards legacy vary depending on age and position; while there is an implied onus on a post-death perspective in adult perceptions including SO (Ackard et al., 2013) and healthcare professional (Foster et al., 2012), CYP have differing viewpoints. Ackard et al. (2013) explored children with cancer's interest in legacy-making and contrary to what the research team anticipated, child participants aged 7 to 12, did not articulate or stress end-of-life concerns. Instead they expressed their wishes for others to know about: their personal characteristics; things they like to do, and; their connectedness with and love for others.

Such perception has also been uncovered in health care professional's reflections on interventions in paediatric palliative care settings (Foster et al., 2012). A thematic analysis of key perspectives noted that legacy-making activities are more often introduced at the very end of the child or young person's life, reinforcing the connection between legacy-making

and the termination of life. Interestingly, in qualifying this perspective and endorsing the need for legacy-making interventions at an earlier point, paediatric health care professionals, noted that legacy making interventions could add considerable value to child 'survivors', providing a tangible record of their journey (Foster et al., 2012), opening up new possibilities for the application of legacy interventions. This near uniform adult meaning attributed to legacy, turned the concept, in its context of vulnerability and life-limiting conditions, into something akin to a 'hot potato' that no one was particularly keen on handling.

CYP's feedback also revealed that the term didn't resonate with them and was neither a relevant term to them as teenagers, nor allowed much scope to explore and make sense of their individual life circumstances.

From a study design point of view, the time, resources, and coordination required to prepare the study sensitively for the target population were significantly increased considering the very nature of 'legacy'.

2. Ethical; Flexibility, gatekeeping and inclusivity

The nuances and sensitivities of employing the concept of legacy in paediatric contexts, has also been discussed in relation to the ethics of practice.

Flexibility

Building on the seminal work of Bluebond-Langner (1978), Moxley-Haegart (2015) attempts to articulate to parents and primary care-givers, the CYP's capacity to talk about death, and employs alternate approaches to legacy-making that respond to, and are led by the CYP and SO. These approaches move between 'open awareness', where it is safe to talk about death and, 'mutual pretence' where CYP have trouble talking about death. This has led Moxley-Haegart to omit the term 'legacy' when working with some CYP, adopting alternative frames of reference that still enable meaningful engagement with legacy-making activities, such as: 'a project which lets others learn about us'; 'messages for family and friends'; 'a way of helping others who might have similar experiences'.

Gatekeeping

Gatekeeper refers to an adult able to control or limit researchers' access to participants. Gatekeepers have a positive function in ensuring that children are protected from research that could potentially be exploitative, invasive or coercive (Royal College of Paediatrics and Child Health Ethics Advisory Committee 2000).

The default perception in paediatric research, paints a picture of CYP as 'vulnerable' research subjects that need protection, placing responsibility onto adults to monitor and control access (Carter, 2009). While this can promote a keen and necessary safeguarding sensibility, it can also constrain and downplay children's abilities, competencies and understandings (Campbell, 2008). It also impacts on the perception of research and the position of researchers as potentially 'dangerous' (Carter, 2009).

In paediatric palliative settings, the notion of vulnerability is amplified by an order of magnitude, and argued to impact opportunities for CYP to participate and have their

voices heard (Carter, 2009). In other related research, clinical gatekeepers excluded eligible families due to: perceived burden research would place on the family and their well-being (Beecham et al., 2016; Stevens et al., 2010; Shilling et al., 2011); concerns about anticipated benefits (Westcombe et al., 2003) as well as; the likely impact on patient/family-professional relationships (Castell, 2006).

Accordingly, many studies are hampered by low rates of invitation (Hinds at al., 2007), the highest refusal rates (Gattuso et al., 2006), and identifying issues with recruitment (Tomlinson et al., 2007) due to gatekeepers deeming research with CYP and families, as inappropriate (Crocker at al., 2015).

In the context of this study, all the above were observed to be true. The explicit focus on legacy impacted most acutely on adult stakeholders' protection of perceived 'vulnerable' CYP and their SO, and monitoring and controlling access to the study.

In discussing all these ethical barriers, Tomlinson et al (2007) make a crucial point that whilst research in paediatric palliative care contexts can touch on extremely sensitive issues, none-the-less, research is still required, and perhaps more so, to better understand the context and its challenges, and to help uncover insights and strategies to support CYP and their families.

Inclusivity

Issues of accessibly and inclusion were also paramount. Some stakeholders acknowledged perceived difficulties in recruiting and bringing together CYP from different specialities in the peer-based Creative Session. In more detail, it was felt that such a scenario could bring together CYP at different stages in the journey, privy to different interpretations about the meaning of their condition, as well as create issues in group dynamics.

In addition, the stakeholders noted that the resources required to support the participation of CYP and SO, could prevent potential participants' access to and inclusion in the initiative. These were mainly due to complex and diverse range of CYP support needs, as well as logistical difficulties of bringing together CYP and their SO from across a vast geographical area.

3. Operational; Preparation and groundwork

Beecham et al. (2016) summarise operational barriers to conducting paediatric palliative care as limited time and other resources, small sample sizes, limited funding, difficulties with research ethics committees, the unpredictable nature of the illnesses and professional perceptions of the potential physical and psychological burden for participants.

Additional time needs to be afforded to setting up research in paediatric health settings (Coyne, 2010), with the groundwork required to carry out research, even more time, support and resource intensive in palliative settings (Tomlinson et al., 2007). This matched the findings from this exploratory interdisciplinary study, leading to time slippage in implementation plan. It could be argued that the effort, time and resources required to undertake research in this context were too great for an exploratory study of this size.

Early involvement of stakeholders in applied health research is understood as crucial in ensuring the relevance and cultural competence of research (NIHR, 2015). This would seem even more necessary in sensitive contexts, such as paediatric palliative care (Tomlinson et al., 2007). In assessing challenges in conducting paediatric palliative research, Tomlinson et al. (2007) identified project completion success criteria, which included engaging the opinions of key stakeholders, and crucially families, at an early stage including their involvement in study design. While the study was co-designed with key stakeholders, this was not considered detailed enough in order to hit the ground running, alluding to the highly complex, sensitive, exploratory, and interdisciplinary nature of the project. In this context, the study was deemed as ambitious, and underfunded.

5. Insights and Recommendations

5.1 Insights

Legacy is (not) for everyone?

One major point of discussion is if and how to best communicate the explicit focus on a challenging concept such as legacy, while the aim is to reimagine that very concept. The study's underpinning "Legacy is for Everyone", attempted to convey an obvious yet sensitive insight. In the context of paediatric palliative care however, adult stakeholders and gatekeepers perceived engagement with it as too sensitive for majority of the target population. As with CYP, the concept did not seem to have enough relevance or traction.

Difficult conversation are for everyone?

There is evidence that timely difficult conversations can support better outcomes in paediatric palliative care (Jack et al., 2018; Coad et al., 2014; Lotz et al., 2013; Dyregrov, 2004; Scott et al., 2002). Research can pose difficult conversations that haven't happened, but could, and perhaps need to. There is an evident need for CYP and their SO to enter this conversational space.

The challenges identified in this study are not limited to its specific scope, but reflect on broader systemic and palliative care disciplinary challenges. They also reflect on the organisational culture within a children's hospital that has to deliver within extremely complex and sensitive boundaries, whilst also encourage efforts to make boundary crossings into difficult conversation spaces, worthwhile. CYP and SO need evidence and confidence that more open and potentially difficult conversations can enrich the journey. Equally, adult stakeholders and gatekeepers need evidence and support on why and how to navigate such vulnerable, yet potentially invaluable pathways. The adopted design approaches could be re-purposed to facilitate entering the difficult conversations space, in a creative and inclusive manner.

LIFE DESIGN IS FOR EVERYONE?

Beyond its 'legacy' focus and the healthy tensions embedded within it, this study intended to promote and enhance CYP's agency by adopting a human centred and inclusive design approach. Design's empathic and imaginative approach was deemed suitable in both eliciting how CYP define and evaluate their lives, as well as ideating and leading what CYP want to do with its remainder.

Design and making opportunities are not only expressive but inherently linked to connecting with others (Gauntlett, 2018). These acts of creating, making, and connecting can help CYP and SO navigate the palliative and end-of-life landscape, and communicate and develop coping resources and strategies (Foster at al., 2015). A design-led mindset to CYP life, could assert more agency about the what, when, why, how and with whom of their lives.

5.2 Recommendations

Planning for systematic, extensive and extended research co-design phase with a well-orchestrated network of interdisciplinary expert and lived experience stakeholders.

Capturing paediatric palliative care stakeholders' existing practices and experiences of engaging in difficult conversations with CYP and their SO. This will be instrumental in better adoption and adaption of design approaches to enhance and facilitate difficult conversations.

Linking challenges identified in this study to broader, deep-rooted systemic and organisational challenges in engaging paediatric service users and their significant others, within a default culture of parental and adult gatekeeping. Without acknowledgement of such systems issues, any project within similar realms, will likely fall short.

Exploring diverse and truly inclusive methods of participation where neither creativity of process or output, nor agency and privacy of CYP is compromised. Given the complexity of CYPs and SO lives on the palliative pathway, alternatives to a one size fits all data collection phase, should be considered.

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Understanding Dynamics of Identity Navigation in Social Design

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Abstract: The aim of this paper is to initiate an interdisciplinary dialogue between social design and narrative theory in understanding how vulnerable families navigate personal and shared identities. To exemplify this, we draw upon results from a design research project that introduces board games in prisons to help children develop bonds with their incarcerated fathers. In our case study we offer a method of analysis that enable design researchers to delve into the complex field of identity navigation. Further, we offer a focused reflection arguing that the vulnerability of these families can be conceived as family identities being broken or challenged. We attempt to show that identity is constructed through family members' co-authoring of family narratives, which manifest themselves in different formats such as 'master narratives' and 'counter narratives'. Design research has the potential to examine identity formations by applying narrative theory in practice.

Keywords: social design; identity navigation; family narratives; design research

1. Introduction

Social design is characterised by participatory approaches to researching, developing, and realising new ideas that may lead to increased resilience for vulnerable groups (Armstrong et. al, 2014). The characteristic given by Leah Armstrong, Jocelyn Bailey, Guy Julier, and Lucy Kimbell consists of using participatory design activities to "make change happen towards collective and social ends, rather than predominantly commercial objectives" (2014, p.15). In this context, design researchers need analytical tools, methods and models that enable them to evaluate the impact of a given social design project and whether it offers a qualitative change to the people we design with and for (Knutz, Markussen & Lenskjold 2019; Knutz & Markussen 2019).

In this paper, we reflect upon the preliminary results of a research project aiming to

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help Danish children tackle some of the problems they experience due to their fathers' incarceration. More specifically we argue that the vulnerability of these children has to do with their family identity being broken or somehow disrupted. One way to repair their family identity is by enabling processes and situations where they get an opportunity to co-author family narratives with their fathers and other relatives. This remedying potential of storytelling is recognised by the Danish Prison and Probation Services insofar as it offers "Night Stories," an initiative for inmates who can record themselves reading fairy tales or kids' books aloud to be sent home to their children. Initiatives like these rely on the assumption that the telling and sharing of stories between parents and children play a significant role in children's identity formation and development. While "Night Stories" works for small children, there is a lack of similar initiatives for teenagers and adolescents – a group for which the question of identity formation is particularly important.

The process of identity development is a life-long process but starts during the physical changes of puberty, when a teenager starts to consider issues of identity (Erikson, 1968). In this process, the family and the stories told within a family play a crucial role in how we define ourselves and how we construct meanings of our personal and shared past (Cohler, 1982; Bruner, 1990; Fivush and Baker-Ward, 2005; McLean, 2016). Moreover, empirical studies have documented that the continuous telling and scaffolding of family stories can help children and adolescents to better cope with the separation from or loss of a parent, for instance due to secondment, illness, divorce or death (Saltzman et al. 2013).

The telling and sharing of these stories usually take place in everyday surroundings, for instance during dinnertime, bedtime or day-to-day events. However, when a parent is imprisoned for a long time, it becomes increasingly difficult to maintain and develop family narratives between parents and children, since the family no longer has the home and daily life as the natural setting for sharing stories (Arditti et al, 2003; Jewkes, 2005; Markson et al., 2015). The continuous structure of shared stories becomes increasingly fragmented or broken. To remedy this situation, we have designed a family board game with the purpose of enabling incarcerated fathers and their children (age 11-18) to re-establish the process of co-constructing family narratives by sharing stories during visiting hours. Through different gameplays the players are invited into a serious, yet playful game, where the family members can share their feelings, relive past experiences and important events as well as express their wishes and dreams for the future. The underlying assumption is that, as it helps prisoner families to maintain family narratives, the game can have a positive impact on children and adolescents' coping skills and well-being.

However, this effect study is beyond the scope of the present paper, in which we instead explore how family members, who have played this board game, talk about their experiences. In particular we focus on how the game enables participants to craft stories, how they talk about and represent themselves, how they talk about others and how they construct and navigate identities through the telling of these stories. We also look at how 'master narratives' and 'counter narratives' play a role in the formation of individual and shared identities and how these narratives sometimes conflict.

In the first part of the paper, we start out by providing some conceptual clarifications of what we mean by family, master and counter narratives and how they can serve as valuable analytical lenses for studying identity constructions. While these three forms of narrative can be a good starting point, we need however to introduce Bamberg's (2011) so-called *three dimensions of navigation* to fully grasp identity construction as a fluid and dynamic social process. By introducing these dimensions, we are able to point out some dilemmas in how family members conceive differently of their group identity.

In the second part of the paper, we move on to describe our case project: the design of a game for prisons and the research context. Moreover, we lay out a 3-step method for analysing how the game may prompt family storytelling and what kind of identity construction that takes place through it. In our analysis we identify a number of narrative categories that seem to be at play. Furthermore, we apply Bamberg's three dimensions of navigation in order to single out some dilemmas in relation to the individual and shared family identity. Based on our analysis we then present rich visual mappings that allow for a precise diagramming of how identity navigation takes place between our participants. In so doing, we get a better understanding of whether games as used for social design purposes may offer a qualitative change to the families playing the game.

2. Studying identity constructions through family, master and counter narratives

The term *family narrative* refers to the stories we tell, share and co-construct as family members. They consist of all the things we talk about as a family on a daily basis. That may be past events: stories of family members being remembered; important events like family vacations or birthdays or minor day-to-day events. Creating and sharing these stories help family members to maintain emotional bonds and help children, in particular, to create a sense of who they are and how to relate to others (Fivush et al, 2011; Fivush and Merrill, 2016). Intergenerational stories – the stories that parents and grandparents share with their children about their own past – help children to make sense of their personal and shared past and contribute to the family identity and individual well-being (Zaman and Fivush, 2011).

Inquiries into family narratives increases our knowledge of how people lead storied lives – individually and socially – and how they shape their lives according to stories. They provide a specific insight into how stories play a role in the formation of family identities. Empirical studies suggest that family narratives are important in identity formation and well-being (Bohanek et al., 2006). Furthermore, a family's ability to co-author and scaffold narratives concerning stressful or traumatic events, such as parental separation and loss, can support children and adolescents to better cope with difficult life situations (Saltzman 2013). More recently, Fivush, Bohanek & Zaman (2011) have argued that adolescents, who tell intergenerational stories from diverse perspectives show higher levels of well-being.

As argued by McLean (2016), we use narratives to make sense of ourselves and in this

process, identity is not constructed individually; we define ourselves in relation to others and others also define us. The concept of the 'co-authored self' as defined by McLean, allows us to explain identity as a process that is co-constructed through the stories, we tell about ourselves, through the stories we tell about others and through the stories that others tell about us. Families in this context support, counteract, maintain, and constrain identity formation and influence how we define ourselves. In this context counter narratives and dominant relationships among family members play a key role (McLean, 2015).

Master narratives within a family or a social community are stories that are shared and used time and time again by members of a community to define (for better or worse) who they are and where they belong in the social orders and hierarchies (for instance in relation to gender, sexuality, ethnicity, and age). Narratives in this regard serve a specific function, namely for passing down socio-culturally accepted values, but they also allow individuals to position their own values. According to McLean (2017) we can either agree on these narratives or we can resist, reject and counteract these by telling alternative personal stories.

Counter narratives are the stories that people tell and live, which offer resistance to master narratives (Bamberg and Andrews, 2004). In offering resistance, counter narratives contest what is assumed to be a "correct" or acceptable experience. Therefore, counter narratives always exist in relation to master narratives either in opposition to the master narrative or as minor stories relating to the master story in alternative ways, limiting it to a particularised or more personal perspective of the same event (Throsby, 2002). Yet, counter narratives can manifest themselves at various levels ranging from the personal, group and institutional level, for instance when staff members contest managerial decisions and strategies communicated through preferences, values, beliefs etc. (Frandsen et al., 2016). They may also diverge into minor stories or as disruptive powers that infuse people's personal stories and lived experiences with new meanings, identities and complexities (Bamberg, 2006; Bamberg and Georgakopoulou, 2008).

By analysing what people tell (about themselves and others) and how they react (e.g. assimilate or accommodate) to what others say we can apply the concept of master and counter narratives to *family narratives* and thus study how stories play a role in the formation of individual and shared family identities.

3. Dimensions of identity navigation

Family, master and counter narrative may easily give the impression that identity constructions come in a more or less stable or fixed form. However, identity constructions often involve a fluid and dynamic social process of negotiating multiple roles of identity and self-other relationships. Bamberg (2011) has suggested that this process can be properly understood by introducing what he refers to as three dimensions of navigation. As the dimensions do not follow in a certain hierarchical or logical order, we have taken the liberty to introduce them here reversely to how they are found in Bamberg's original text.

The first dimension of identity navigation is that of *agency*. In this dimension the speaking

subject is perceived as "a bodily agent" that speaks with the body, which allows for non-verbal and embodied actions to be part of the analysis. Here identity can be navigated between the two terminal points of acting as an active "agent" (taking action, acting powerfully, taking responsibility) or as a passive "undergoer" (taking no action, acting powerlessly, taking no responsibility). Speaking subjects with high agency are experienced as being in control (positioning a heroic sense of self), whereas speaking subjects with low agency are experienced as being not in control (positioning a victimized sense of self). In both cases the speaker foregrounds certain events and places him/herself in these events as an "agent" in relation to others.

The second dimension concerns *constancy and change* across time. In this dimension the speaking subjects navigate their identity dilemma "by positioning who-they-are in terms of *some* form of continuity, constructing their identities in terms of *some* change against the background of *some* constancy (and vice versa)" (Bamberg 2011, p. 103). Stories in this dimension can give shape to identity constructions that can be plotted as sudden changes, slow transformations or even give shape to a sense of self that indicates no change at all.

The third dimension concerns *sameness versus difference* and positions the speaking subjects in relation to others (Bamberg 2011, p. 104), either aligning with others ("we are the same as") or positioning themselves as a contrast to them ("we are different from"). Stories in this dimension can give shape to an individual sense of self ("I am not like …") or they can be plotted as a sense of self in terms of belonging to a certain group, community or social category ("my friends and I always …"). Navigations can happen through aligning with or rejecting the values, behaviours or actions of others.

By coding our narrative data according to these three dimensions we will identify dilemmas of navigation in relation to the individual participants (e.g. the father being a parent as well as a prisoner); family members (e.g. father versus sons/daughters) but also dilemmas of the shared family identity vis-à-vis the institutional system (e.g. the participants being "family" as well as being part of a prison system they must comply with). In so doing we get to understand families of prisoners and whether the game that we have designed offers a qualitative change to the families playing this game during visiting hours.

4. Case study: A prison game

The game *Captivated* (see fig. 1) has been designed for the Danish Prison and Probation Service's visiting program to help children and adolescent (age 11-18) to maintain and develop social relationships with their incarcerated fathers. The game, which is today fully implemented in the visiting rooms in all Danish prisons, is a result of the three-year funded design research project *Social Games against Crime* (2015-2018) that involved a cross-disciplinary research team from Denmark, the Netherlands and UK, including design researchers, ethnographers, criminologists, experts in narrative theory and sociologists.

Even though much has been done to make in-visits facilities in Danish Prisons more family-friendly, initiatives are still lacking for teenagers and adolescents. The fieldwork we

conducted as part of a pilot study in prisons from 2013–2015 revealed that visiting spaces rarely offer initiatives to this age group. Additionally, in a report made by The Danish National Centre for Social Research (Oldrup et al., 2016), it was subsequently observed that one of the reasons why children ages 11–17 are reluctant to visit their fathers in prison is due to this lack of meaningful initiatives. This report also showed that the wellbeing of these children is lower as compared to prisoners' younger children. If they lose contact with their fathers in prison, it was further stipulated that they are at higher risk of ending up in psychiatric treatment, placement with a foster family, or that it will significantly reduce their educational performance (Oldrup et al., 2016: pp. 5–14).

To address the unmet needs of this age group, the authors carried out a three-year funded research and intervention study from 2015–2018 to investigate whether a board game designed for children and their incarcerated fathers has the potential to help them maintain family relations. The overall purpose of the game is to use game elements as prompts for restoring family narratives that are challenged or broken due to paternal incarceration. In particular, the game attempts to enable the players to share personal stories through bodily interactions and dialogue concerning the fathers' and the children's daily lives. In so doing, it is assumed that the game will help prisoner fathers and their teenage children to maintain a relationship to the benefit of the children's wellbeing and development (although the study of this impact was beyond the scope of the 3-year project).

The project is targeting families of prisoners, because imprisonment is known for having negative collateral effects on families' wellbeing. These families are vulnerable in several respects. First of all, imprisonment makes it difficult to maintain and develop family bonds between parents and children (Arditti et al, 2003; Markson et al.2015). Secondly the family structure is complicated, since many of the parents in these families are divorced or children have been placed in foster care, which means that children do not visit their fathers in prison together with their mothers, but with grandparents, foster parents or others. For these reasons the continuous construction of shared family stories is challenged.

During the process of designing the game, which lasted 1.5 years, several participatory activities and co-design workshops have been organised, including workshops with children, mothers and incarcerated fathers as well as workshops with prison officers and family therapists. These workshops have helped the researchers to shape game characters and to construct a game world that aligns with the actual needs and dilemmas of the families of prisoners (see previous articles focusing on the participatory design process, Knutz et al. 2016; Knutz et al. 2019).

4.1 The design of the prison game

The final version of the game has a game mechanic similar to that of the board game Monopoly, the difference being that the players do not move around in a city but in a prison with certain places (workspaces, kitchen, visiting room), characters (prisoners and prison staff) and situations that the players learn about. All characters in the game have families and

identities. The players may win the game by collecting certain characters and performing acts triggered by the question cards. The game includes three different types of cards (see Figure 1).

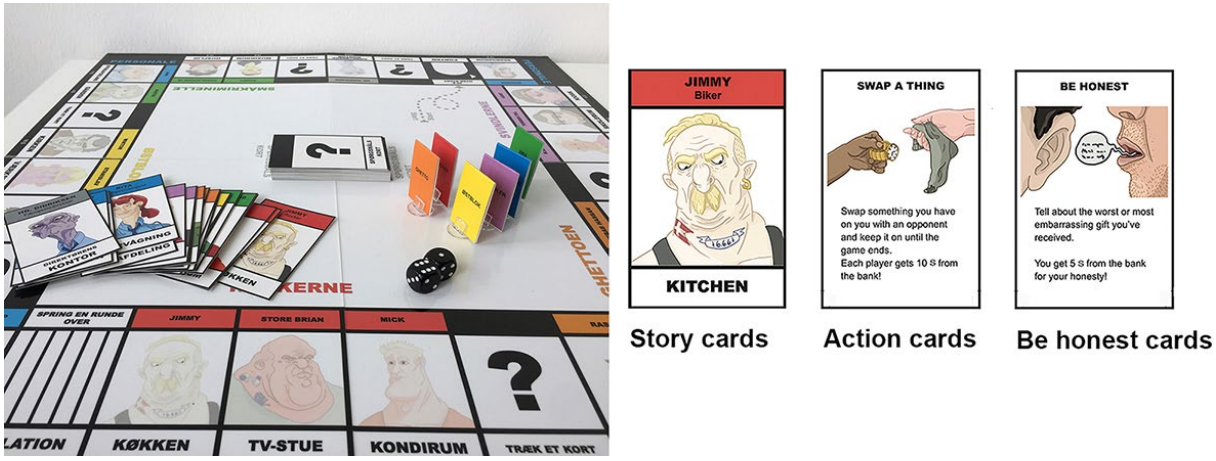

Figure 1 *The prison game "Captivated". The game includes three different types of cards: Story cards (stories about the prison), action cards (that encourages physical interaction) and be honest cards (that foster interpersonal communication between the players).*

Story cards include illustrated stories about the prison and the prisoners. For example, a story card about a particularly muscular prisoner practicing bodybuilding, says; "Oops! Your pants have shrunk and now everyone can see your *Hello Kitty* tattoo". These ironic and "teasing" anecdotes about prisoners have been collected during the co-design workshops with prisoners and children and bring parts of the prisoners' life that is normally not talked about into the parent-child interaction and conversation.

Action cards include eight different actions, for instance "Exchange something you wear with another player;" "Challenge one of your opponent players in arm wrestling;" or "Give one of your opponent players a tattoo" (for this purpose the game contains a black permanent marker). These cards are designed with the purpose of encouraging physical or embodied interactions between children and their imprisoned fathers.

Be honest cards are the third type of cards, which include nine different challenges that encourage the players to open up and talk about past memories, future wishes or personal feelings. For instance, one card says, "Talk about something that makes you angry or sad," another one says, "Talk about the most embarrassing gift you have received." These cards are designed to enable the sharing of emotions, embarrassing events and as well as hopes and dreams for the future. Furthermore, they attempt to the bring personal identity stories of the real world into the family narrative. With the assistance of family therapists working within the criminal justice system, we carefully considered the design of these cards to avoid intimidating fathers and children or eliciting unwanted emotions.

After completing the final game prototype, the game was pilot tested with two families who played the game during visiting hours together with the research team.

Based on this experience the evaluation study was planned and set up.

4.2 Evaluation study

The evaluation study was conducted in two Danish maximum-security prisons and lasted eight months. Five families participated in the evaluation study and played the game during their prison visits. Due to prison regulations the research team was not allowed access to the visiting rooms, since no form of monitoring was permitted. Hence follow-up interviews played a central role in the evaluation study.

The families who participated went through the following process: The family played the game during visiting hours without being monitored. After having played the game, the father and child were interviewed separately by two researchers. The interview with the father took place in the prison under the supervision of a prison officer. The children were interviewed at home, usually with their mother or foster parent present (see Figure 2). All interviews were conducted in Danish, audio-recorded, transcribed and translated.

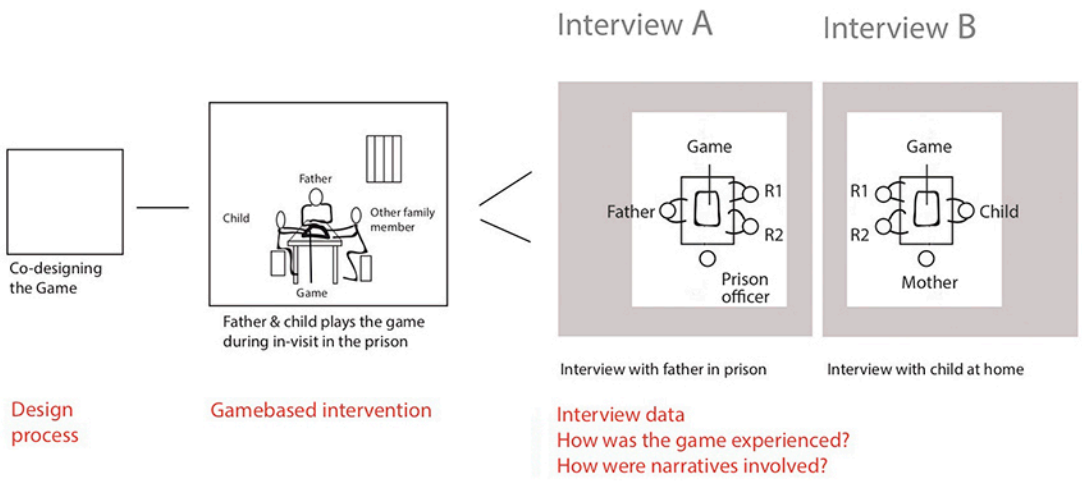

Figure 2 The evaluation study design

During the interviews the board game played a key role, as a research tool enabling dialogue. The two researchers listen to how the participants recalled the game experience of, for instance, what happened when a player got a particular card (e.g. the be honest cards) or landed on a particular place on the game board (e.g. the "visiting room"). This part of the study was not designed to try to reconstruct their authentic game-based interaction, rather, the interview setting itself was conceived as a context for family storytelling, yielding data for analyzing the stories that fathers and children told about their family visit. The empirical data is analysed according to a series of analytical steps (see below).

Due to the limitations of this paper, we focus on excerpts from interviews with one particular family and two of its members (for a more extensive study, see also Markussen & Knutz 2020a; 2020b forthcoming). The family in question consists of 11-year old Oskar and his

incarcerated father John who has been in prison for 14 years. John is a leading member of a criminal gang and is the father of three children. Oskar is his youngest son. John is divorced from Oskar's mother and therefore Oskar visits John with John's new girlfriend.

5. Method of Analysis

In the following we focus on the conversation with John (Interview A) and the conversation with Oskar (Interview B). We will provide examples from excerpts of how John talks about himself, how he talks about Oskar, and how he talks about being in prison. Likewise, we will give examples of how Oskar talks about himself, how he talks about his father and how he talks about the prison. Furthermore, we provide examples of how the prison officer Henry addresses John during the conversation as parent or prisoner. Our aim is to identify different identity constructions and navigations, which are perceived through the various ways in which the participants talk, interact and perform, based on the materiality of the prison game.

Our method of analysis follows a series of analytical steps that enable us gradually to tap into the identity navigation:

- **Step 1: Detecting identity construction in relation to roles**
  In this step we apply Bamberg's first dimension by looking at the speaking subjects as "agents" that may take on certain roles (e.g. the concerned father, the powerful prisoner etc.) and we attempt to identify a number of these.
- **Step 2: Foregrounding relevant narrative categories**
  This step allows us to identify a number of counter-, master- or family narratives manifested in the personal relationship between the participants
- **Step 3: Plotting identity navigation in relation to dimensions and narrative categories**
  In this step we activate the dimensions of *constancy and change* across time as well as the dimension of *sameness versus difference.* This final step allows us to make a comparative analysis of the two interviews in relation to a particular game card/topic that was activated during the game sessions and talked about in both interviews. We will refer to these mappings as "plottings" (see Figure 4 and 5).

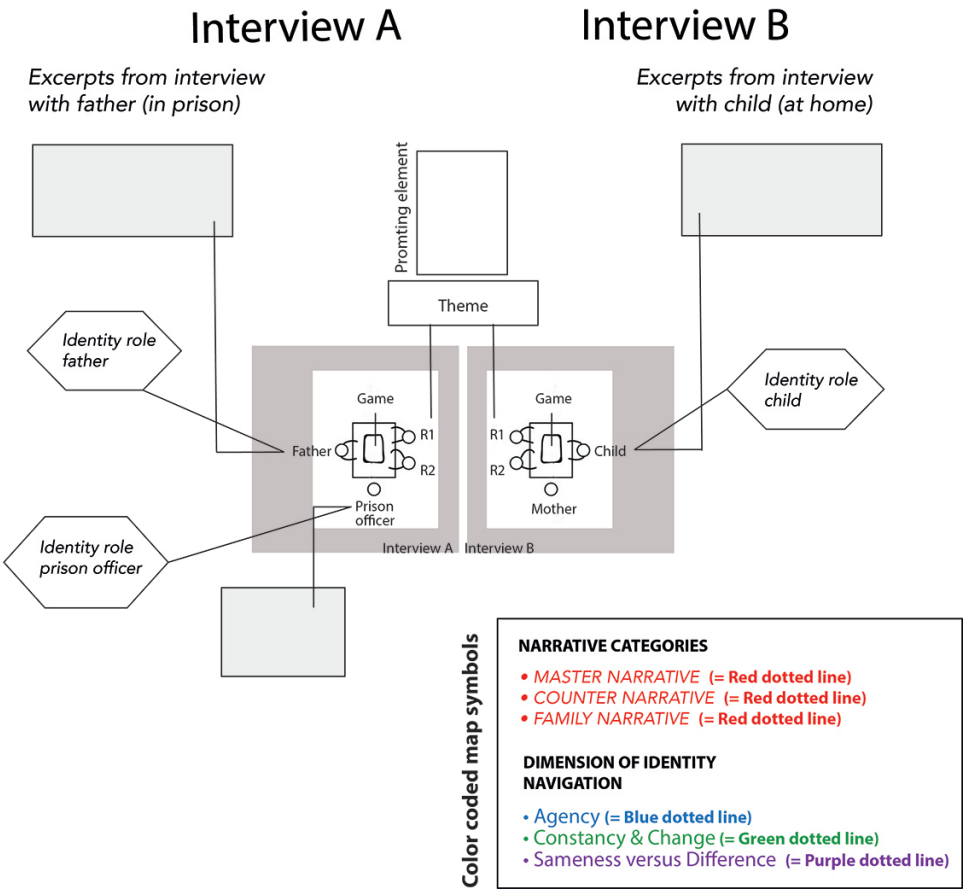

Figure 3 *Model of analysis. Step 3 will result in visual mappings that attempt to diagram the identity navigation taking place between the participants*

6. Analysing the "talk"

6.1 Examples of the participants positioning different identities that engage in different narrative categories (step 1 and 2)

When John talks about his son Oskar and how they played the game, he says that Oskar, during the game session, drew a be honest card, which made Oskar talk about how much he misses his dad. To this John adds: "I was a little nervous that it came to close" and "then I hurried on so that he didn't get too sad". John says about the be honest cards, that they are "good" but also a bit "offensive". He further explains that he is afraid "to step into something that hurts". During the interview John poses questions about the game and about his son's involvement in the project: "Have psychologists been involved?"; "Can the drawings made with the marker be washed off?"; and "I've talked to his [Oskar's] mother. He is willing to talk about these things." About his own participation in the project John says: "I will do everything to help when it has something to do with our children."

In these excerpts John positions himself both as the responsible father but also worried and protective father who is concerned about his son getting upset or sad when he draws the be

honest cards; or whether the black marker can be washed off, and that he is on good terms with his ex-wife, Oskar's mother ("we have talked about these things"). The prison officer sometimes supports and co-constructs John's responsible father identity, for instance by remarking: "But it's also great that he [Oskar] can tell you that he misses you." In so doing, the prison officer positions himself as "the caring prison officer" who empathises with the prisoner and supports him in assuming his parenting role.

A second identity role of John is that of being a prisoner and a gang leader. When talking about the story card that reveals the "Hello Kitty tattoo," John jokes about confronting his gang members "checking their ankles." He later explains, "there is a conflict between us and another group", which causes some violence, but he adds that this is a "business risk." And he confirms his role as a gang leader by indicating that within his group he is the one who controls ("in our group it's just me who decides"). A third identity construction is the funny-friend identity. John says: "Me and my 11-year-old son we manage a lot by using humour. We do a lot of really funny stuff together." This statement indicates that he looks at his bond with his son as a kind of partnership or friendship built around "having fun together."

If we compare this with Oskar's account about his father, the funny-friend identity seems to mirror his father's positioning: "I know everything about my father," he says and continues "We know each other well." Oskar also says that they have fun together and points out that he and his dad's girlfriend "always cheat on Dad," when they play the game. This indicates that Oskar and his father seem to share a family identity of "being friends" and a family narrative that points towards "having fun together." But Oskar's personal narrative does not always align with the shared family narrative of "having fun."

Oskar repeatedly expresses a need to be heard, seen and felt. He says about the be honest cards that "It was nice that you could just say things as they are...and that you can say something that you do not really talk about, for instance if your mum or dad is not listening." It seems as if Oskar doesn't want everything to be "just fun". His account seems to counteract how he defines himself within the family and his experiences of the be honest cards seem to represent a counter narrative to his father's perception about the cards as being "too hard" and as something that makes his son "sad."

During both interviews Oskar and his father look back at the old prison where John was previously imprisoned. Here the children could walk in and out of the visiting rooms. Oskar says: "I actually got to know somebody there." John also comments several times on the old prison. It was better, according to him, because the children could experience an open door "and play with the other children." "We are family people," John continues. "I want to get to know my brothers' children."

These statements express multiple identity constructions. John speaks both as "the responsible family father" and as a leader of his criminal gang and his so-called "brothers" whose children he wants to know better. John seems to switch seamlessly between two different positions: that of the "the responsible father" and that of a "leading member of a criminal gang." Through these excerpts we also learn how the old prison is part of Oskar's

and John's shared family narrative and that it's visiting facilities are assessed as "good" or "better" compared to those in the new maximum-security prison.

John and Oskar's narratives are counter narratives to the prison officer Henry's conception of "the good visit". Henry believes that the doors to the visiting room must be closed, so that the family can have some privacy. "It is best for the family," he repeatedly states. As John continues to insist on the open door, Henry explains that it would never work because "our security system would explode completely." Henry's identity construction is caught between two competing master narratives that exist within the Danish criminal justice system: one master narrative that articulates incarceration as a process of rehabilitation and care and another that emphasises imprisonment as a matter of punishment, control and security. Both John and Oskar seem to reject Henry's conception of "the good visit" and they construct a counter narrative that aligns with their shared family narrative: the narrative about the good (old) prison that allows prisoners and their families to meet freely during visiting hours.

During his talk about the old prison Oskar is asked what it was that made these visits good. To this Oskar replies, "I just think it was...it was because it was my mom and my dad and me who were together." This does not represent a counter-narrative as such, but it does indicate that Oskar and his mother have their own alternate family narrative and shared understanding of what made these previous visits "good:" they were together as a family.

In the first part of our analysis we have looked at the speaking subjects as "agents" that navigate identity by performing certain roles. Furthermore, we have identified a number of narrative categories that seem to be at play in the construction of personal or shared identity, including master, counter and family narratives. In the last part of our analysis we will attempt to extend the analysis to include the dimensions *constancy and change* as well as the dimension of *sameness versus difference.*

6.2 Plotting identity navigation (step 3)

This part of the analysis will be carried out visually by thematically clustering some of the excerpts that we have already presented above. In addition, we then map out the identity navigation according to the last two dimensions. We will focus on two particular topics that was prompted by the game and talked about in both interviews: the "be honest cards" and the conception of "the good visit".

The first plotting (Figure 4) concerns John and Oskar's descriptions and experiences of the be honest cards. The interview with the John ("Interview A") is placed on the left side of the figure, while the interview with Oskar is mirrored on the right side (as "Interview B"). In this plotting we have attempted to focus on identity navigation in relation to the dimension of *agency* (blue line) and *constancy and change* (green line). Master-and counter narratives are marked with red lines.

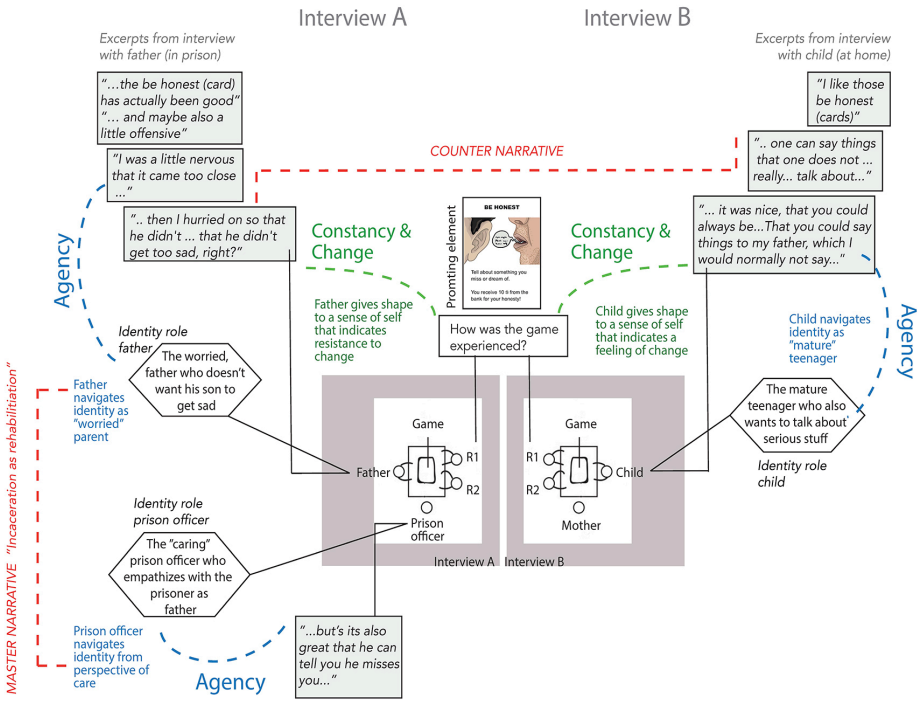

Figure 4 *The first plotting concerns John and Oskar's descriptions and experiences of the Be honest cards. The identity navigation is mapped in relation to the dimension of "agency" (blue) and that of "constancy and change (green).*

In John's interview the be honest card has prompted talk about the father being concerned that the be honest card will make his son "too sad." In the dimension of *agency* (blue line) the father is positioning himself as "the worried father" (afraid of Oskar getting too sad). The prison officer supports and scaffolds this identity formation by positioning himself as "the caring prison officer" who empathises with the prisoner and supports him in his parenting role. In their identity process both father and prisoner assimilate with the institutional master narrative within the Danish criminal justice system that articulates incarceration as a process of rehabilitation and care.

If we compare John's concern about the be honest card making his son "too sad" with Oskar's reflection on the same game card, then he is positioning himself rather differently. For John's son the be honest cards seem to open up for a possibility to "say things" to his father that he "would not normally say." Here the son is positioning himself as "the mature teenager" - an identity role that does not align very well with how the father defines him within the family (as a small child that needs attention or protection). Oskar's account represents a counter narrative in terms of how the be honest card is experienced and valued as well as how his father defines him within the family narrative.

In the dimension of *constancy and change* (green line) the father gives shape to a sense of self that indicates a resistance to go into things that gets too emotional ("I was a little nervous that it came too close."). The son, on the contrary, expresses a sense of self that

indicates a feeling of something being different than before ("one can say things …that one does not really talk about"). Based on this we argue that Oskar feels that a change has happened (between him and his father) and that the be honest card has prompted this change.

The second plotting (Figure 5) concerns the participants' experience and description of the "good" prison visit. In this plotting we focus on identity navigation in relation to the dimension of *agency* (blue line) but we will add *sameness versus difference* (purple line) to get a more profound understanding of how the father and son navigate identity in relation to other groups (their own family versus other prisoner's families).

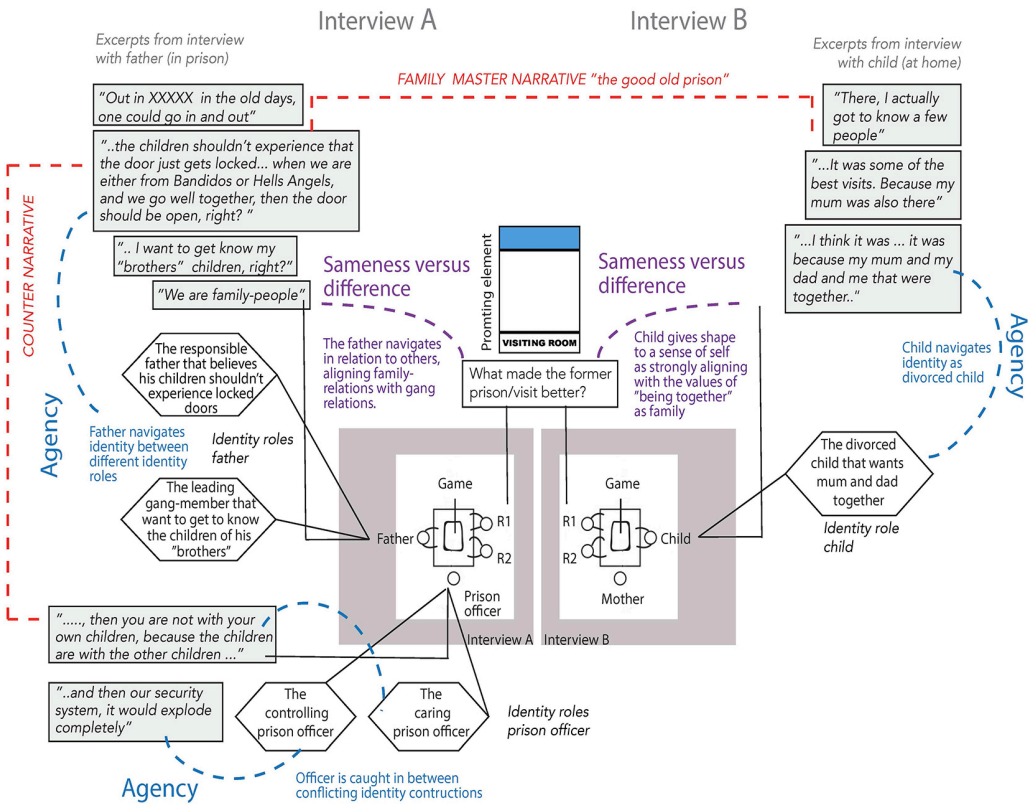

Figure 5 *The second plotting concerns John and Oskar's descriptions and experiences of the "good" prison visit. The identity navigation is mapped in relation to the dimension of " agency" (blue) and that of "sameness versus difference" (purple)*

In interview A and B, the game has prompted family talk about the difference between past visits and present visits. In both interviews, the father and child (independently of each other) seem to share the idea of the old prison somehow having been better than the present one. But this family narrative about the "good old prison" is more complex than that.

If we apply the dimension of *agency* as well as the dimension of *sameness versus difference,* John positions two different identity roles; "the responsible family father" ("the children shouldn't experience that the door just get locked") and "leading gang-member" ("I want

to get to know my "brothers' children"). In the dimension of *sameness versus difference* John seems to navigate his identity by equating family relationships with gang-relations. If we activate the same dimensions in the interview with Oskar we get a different insight into why these past events have relevance for the child's experience of the past ("It was some of the best visits. Because my mum was also there"). The child positions the identity role as "divorced child" and the self-other differentiation in the dimension of *sameness versus difference* is navigated by giving shape to a sense of self that strongly aligns with the value of the three of them (him, his dad and his mum) being together "as a family". This navigation tells us that even though both father and son share a family narrative about the "old" prison as "better", they might not share *what more precisely* made these visits "good".

The prison officer is countering the father's family narrative of the "good visit" (the visit with open doors) and the plotting visualizes his identity dilemma; he is caught between two conflicting identity roles. One that aligns with "care" ("then you are not with your own children") and another that aligns with "control" ("our security system would explode"). Whereas the father navigates rather unproblematic between "responsible dad" and "leading gang-member", the prison officer has more difficulties in navigating between "care" and "control".

7. Conclusion

Through our case study we analyse the various narrative categories that are involved in a family's co-construction of identity and how these narratives work in a social context. Here master narratives as well as counter narratives plays a central role in how families navigate individual and shared identities. For instance, Oskar and his father have a shared family narrative that offers resistance to the Prison & Probation Service's Master narrative of the "good visit". But Oskar also give shape to a sense of self that indicates that the good visit for him positions different values and preferences than those of his father.

Identity constructions are complex matters as they often involve a dynamic social process of negotiating multiple roles of identity and self-other relationships. By applying the dimensions of navigation and turning these into visual plottings we gain a more profound understanding of the dynamics of identity formation and how these work across time (e.g. in relation to present or past family visits); how these works in relation to group-identity (e.g. criminal gang relations versus family relations); or between family members. For instance, Oskar expresses a sense of self that indicates a feeling of something being different than before and that a change has happened between him and his father, through the activation of the be honest cards.

We state that design researchers need analytical tools, methods and models that enable them to evaluate the impact of a given social design project and whether it offers a qualitative change and value for the people interacting with the design. Value in this context, can be a matter of giving families the opportunity to share 'family narratives' and to negotiate and navigate identities. By co-designing a game world particularly for families

of prisoners, narratives can be shared and at the same time this storytelling space can allow individual family members to position their own values and preferences in relation to past, present and future events. Our contribution is a method of analysis that enable design researchers to examine identity navigation. This method forms the first step in developing a more extensive theoretical framework and interdisciplinary dialogue between social design research and narrative theory.

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Thinking while drawing and drawing to think: Exploring the critical reflective practice of 'reflective doodling'.

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Abstract: This paper attempts to articulate what is typically tacit within the process of 'reflective doodling'. By dissecting different types of artefacts created during reflective doodling, the paper demonstrates how this critical reflective practice creates a synergy between design research and design practice. The nuances of reflective doodling are unpacked and its relevance to complex problems is explored through the emergent practice of 'design for transitions'. Discussion reveals the importance of external inputs into the process and explores how the layers of thinking and action embedded in its processes expand the dynamic interplay between research and practice.

Keywords: design for transitions; reflective practice; reflective doodling; sensemaking

1. Introduction

I think and draw as a form of meditation, as a form of exploration, as a form of creation and as a form of occupation. This thinking-drawing process of reflection is habitual. What happens within it often feels tacit, unknowable or at least unexplainable. Schön (1983) explores the inherence of tacit knowledge in practices such as design and describes how practitioners usually know more than they can articulate. Documenting the typically tacit thinking-drawing process of 'reflective doodling' during my PhD brought a deeper consciousness to my reflective process. That consciousness extends to this paper, which explores the critical reflective practice of reflective doodling in the context of 'design for transitions', an emergent design approach focussed on systemic change encompassing social justice and ecological sustainability (Boehnert, 2018; Escobar, 2018; Fry, 2009, 2017; Irwin et al., 2015; White, 2018; Willis, 2006, 2015). This emergent approach was a core focus of my PhD which examined the designer's role in the complex problem of excess consumption and waste. The PhD documented the transformations needed personally and professionally within design practice in order to address complex structural problems.

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Reflective doodling emerged from this research as an active and critical process of drawing and thinking. The process intertwines *thinking while drawing* with *drawing to think*, and from the convergence of these non-linear reflective processes, 'design as sensemaking' (Cross, 2008) emerges. Here the marks made and the actions taken shift from reflective to deliberative, and the practitioner starts to make sense of the work, leading to the creation of knowledge and/or artefacts. Unlike typical exploratory drawing and sketching processes, reflective doodling is reliant on clear contexts and critical inputs, from multi-disciplinary literature and from a range of diverse perspectives.

2. Methodology and Methods

This analytic autoethnographic paper further explores the critical reflective practice undertaken throughout the researcher's PhD (Wallace, 2020). Anderson (2006) describes how analytic autoethnography recognises the researcher in their research but avoids traversing an auto-biographical path by maintaining strong connections back to a theoretical framework. Reflection on previous action research cycles informs a new cycle of reflection and action; one that is more deliberative in its attempt to make sense of the processes undertaken as part of this work. Building on Schön's reflective practitioner (1983), is Forester's deliberative practitioner (Forester, 2009) who reflects in/on action, but also on possible future action, using participatory processes to engage multiple perspectives. Forester describes this as a form of 'critical pragmatism', where a practitioner's potential actions are critically examined as part of an informed process. In this paper, the overarching frame of critical pragmatism is informed by two key perspectives: firstly, by the ontological, plural and participatory approaches from Escobar (2018), and secondly, by the prudent, ecological and relational thinking approaches from Plumwood (2002).

This paper is also informed by an ongoing living lab study, where participants are documenting their practice of reflective doodling over a 12-month period. Initial reflections on data collected through a workshop and interviews with two emerging designers are captured in this paper. Both participants have attended a 3-hour workshop followed by a two-week exploration of the reflective doodling process in their own practice. They each discussed their early experiences with the process through one-on-one semi-structured interviews. Additional interviews will be conducted with these participants throughout 2020 with a view to repeating the study with a larger participant group.

3. Critical reflective practice for uncertain futures

The need for critical thinking in design has never been more urgent. Humanity faces multiple ecological and social crises that present uncertainty and opportunity and require transformative change. This also presents design with opportunities to transform. Critical reflective practices could foster greater synergies between design research and design practice. One such critical practice, reflective doodling, is explored throughout this paper.

The need for criticality in design is evident in design's mediation of consumer culture

(Bordieu, 1984; Julier, 2008; Wallace, 2020). Design is used to reinforce a linear economy and promotes a way of being in the world that is unattainable by all, unjust to many, and unsustainable by design (Fry, 2009). Design's historical and current contributions to structural injustices and unsustainability are evident in artefacts and their legacies. Many reinforce a rationalism that is anthropocentric, particularly androcentric, colonial, and unjust in multiple and intersecting ways (Boehnert, 2018; Fry, 2009; Plumwood, 2002). Design also reinforces power structures through its expert performance of acts of differentiation, through its transmittance of persuasive communication, and through its industrial symbiosis with business (Wallace, 2020).

Designers are trained to be expert consumers who mediate and participate in consumer culture (Bordieu, 1984; Julier, 2008; Papanek, 1988; Wallace, 2020) and in commercial practice designers become caught in a complicated tangle of complicity and conditioning. Awareness of the wicked problems humanity faces often fails to translate into practice, and can be eclipsed by designers' commercial context (Boehnert, 2018). The feedback loop between education and industry reinforces this approach, leading to waves of newly-graduated designer-consumers who appear to be incapable of conceiving design outside of commercial contexts (Thorpe, 2008; Wallace, 2019).

In emergent areas of practice and research such as design for transitions (Boehnert, 2018; Escobar, 2018; Fry, 2009, 2017; Irwin et al., 2015; White, 2018; Willis, 2006, 2015) there is an acknowledgement that who we are (designers) and what we do (design) contributes to and is bound by that which is structural and systemic. Design for transitions' intent is to design in ways that enact or facilitate systemic change by approaching design in everyday contexts (Kossoff et al., 2015; Manzini, 2008). As an approach to design it acknowledges the hypocrisy of designing this change whilst being embedded within these systems, however the power dynamics within the system cannot be ignored as part of this attempt at change (Boehnert, 2018; Willis, 2015). Building this understanding in practice expands creative thinking in ways that require greater criticality, reflection and deliberation. Early insights from a study of this process with two emerging designers indicate it may be a generally useful process for a critical thinking and problem articulation. This paper's focus is on its usefulness as a method in 'design for transitions' for approaching complex and wicked problems that are entangled with one another in social systems (Rittell and Webber, 1973).

4. Thinking while drawing

It is not uncommon for practitioners to think while they draw. In reflective doodling, this process can be harnessed as a way of processing new theoretical knowledge and concepts from multi-disciplinary literature. These doodles take a variety of forms, and dissecting this process identifies what each form shares and what is unique amongst them.

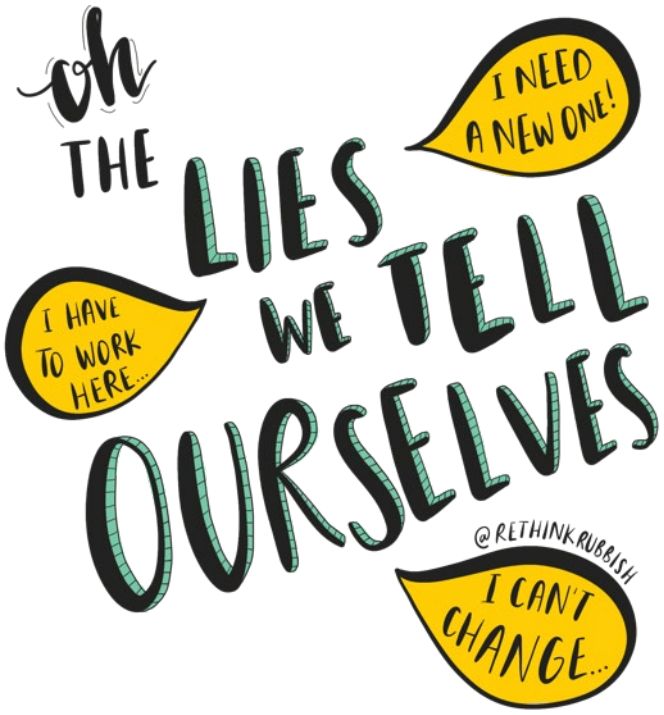


Figure 1 *A reflective doodle, used to explore philosophical and socio-economic concepts in PhD research.*

Figure 1 presents a doodle that was created during reflection on Sartre's (1993/2012) concept of 'bad faith'. According to Sartre, to live in bad faith is to live incongruously to your true desire or calling. He describes how self-deception is used to justify actions that are disingenuous and how this impacts one's identity (Sartre, 1993/2012). This doodle used illustrated typography to unpack the larger concept. On face value, it is nothing special, it is 'just a doodle'. However, the process of creating it unlocked a larger critical thinking process. Each mark, each stroke, each block of colour was made while thinking. Particularly, about 'bad faith'. And specifically, about 'bad faith's' role in hyper-consumption, a significant contributor to structural unsustainability. What differentiates reflective doodling used in this way from the usual *thinking while drawing* processes used by designers, is the role played by critical thinking, the context and inputs into the thought process—namely the philosophical concept of 'bad faith' and the socio-economic concept of hyper-consumption in the context of design. The process uses drawing to let the mind wander and critical thinking to make the wandering more pointed.

4.1 Embodied reflection and sensemaking

The reflective processes performed by designers through sketching and doodling draw on a combination of tacit designerly skills and knowledge that intersect thinking and doing. In this sense they are often processes of embodied reflection, where the practitioner's lived experience both informs and reveals itself through acts of thinking and doing (Kinsella,

2007). The tacit knowledge embedded in creative processes is also described by Cross (2008) as a designerly way of knowing. Sensemaking converges thinking and drawing and is used for synthesis and communication of what the designer 'knows' but cannot verbalise (Cross, 2008). Further articulation of embodied reflection is provided by Escobar (2018 p. 54) who recognises embodied reflection as a dance between action and reflection, which in turn makes the act of reflection an experience in its own right. This metaphor of movement aligns neatly with Schön's (1983) descriptions of the back and forth exchange that occurs between a practitioner and their sketch during reflective processes. Embodied reflection and sensemaking both play key roles in *thinking while drawing* and in reflective doodling.

4.2 The role of languages in reflection

Schön (1983) frequently makes connections and comparisons between music and design, which both use languages learned through practice. Playing music relies on a comprehension of musical language, and likewise, design is reliant on a fluency in visual language. Neither practice is solely elite or expert and both can be performed with varying degrees of skills and knowledge. However, a practitioner's proficiency in any given language will certainly be evident in their processes and outcomes, be they musical, visual or otherwise.

Brown (2010) presents a visual alphabet consisting of 12 forms that can be combined in any number of ways. Not unlike music which also works from a base of 12 notes to create complex compositions, these 12 visual forms provide Brown with the foundation for building a visual language with shapes/marks. The forms include a point, line, angle, arc, spiral, loop, oval, eye, triangle, rectangle, house and cloud. Each form is a symbol that is pre-coded and then re-coded as they combine to create new forms. Ungerleider and Bell (2011) describe the neurological processing of complex visuals as "combination-coding" (pp. 785-786) where something complex is coded by a breakdown of its simpler parts—much like breaking down longer words into their short-chain syllables when learning to read. In Figure 2, three forms from Brown's (2010) alphabet (angle, loop and line) combine to create an arrow element.



Figure 2 *Combining forms from Brown's (2010) visual alphabet to demonstrate "combination coding"*

On first glance this might read simply as a decorative arrow, however, reading the "combination coding" reveals more than the suggestion of direction that is pre-coded in our interpretation of what an arrow means. The line indicates movement, and a secondary read

of the quality of the line suggests the motion is fluid rather than formal. The addition of a loop communicates movement along a non-linear path, and the angle placement provides a sense of direction, in this case, downward. Conversely, if this arrow was drawn without the loop form, it would communicate a more linear direction. Likewise, a more formal line would communicate an increased structure to the path taken. The nuances that stem from the way a mark is made and how it is combined with other marks become important communicative tools when drawing. The complexity embedded within a visual language becomes a kind of shorthand that a practitioner can use to move them through their thought process at pace. These nuances are not captured explicitly in Brown's (2010) description of the visual alphabet, but they are certainly evident in a reading of its use. Using visual language as a form of shorthand is particularly helpful during reflective doodling where action can shift between the need for faster and slower paced doodling to capture initial thoughts quickly and then explore them more slowly. Simple marks and their complex combinations can be used by the designer just like notes and chords are used in simple and complex combinations by a musician.

Visual language is often supported by verbal language to aid in communication and in some instances a doodle is reliant on both languages in order to effectively communicate. Schön (1983) uses communicative terms such as 'back-talk' to describe the exchange that occurs between a practitioner and their work. This exchange is coded with years of knowledge and experience, artistic and analytical skills, material understanding, tactile ability and capability. 'Back-talk' is often recorded through notations that combine visual and verbal cues. One participant described their experience of 'back talk' in reflective doodling as an interactive process that felt like a conversation between their mind and the page. To think and draw in this way is to speak a visual language that does more than communicate ideas, it visualises the process of reflective thinking and can contribute to the creation of new knowledge. Responding to 'back-talk' aptly demonstrates embodied reflection and a mastery of the languages of reflection.

4.3 Drawing as part of reflection

Drawing is a commonly used process for ideation and reflection in creative practices. Reflective doodling is a designerly reflection and sensemaking process that blends drawing processes and reflective practice with theoretical knowledge and insights gained through the distinct and recognisable set of thinking and doing practices from design. Not unlike the descriptions above, its exchanges are coded. Each additional input expands upon the typical designerly skills/material knowledge to include a more explicit focus on theoretical knowledge and diverse perspectives. Figures 3, 4, and 5 show a progression of thinking that occurred through the reflective doodling process that began during (and continued after) a 2018 workshop with Tony Fry based on his paper, *Design After Design* (Fry, 2017). The paper and workshop both provide a critique of the 'defuturing' role design plays in contemporary settings. The workshop explored Escobar's (2018) autonomous design approach as a response to the growing social and ecological crises being faced by humanity. Autonomous

design has roots in the Autonomía movement from the Global South. It is participatory, decolonial and disconnected from design's usual neo-liberal contexts. Instead of promoting an unsustainable status quo filled with technocratic responses to our current crises, the autonomous designer partners with communities and movements to explore convivial and communal ways of being in the world (Escobar, 2018; Fry, 2018).

Figure 3 displays page six of a ten-page documentation of Fry's workshop. On first glance these notes appear to be a clean documentation of information, but upon reflection I recognise multiple embodied reflections in the notes. Prior to reengaging with this 'first pass' of information, I assumed it to be a relatively 'pure' documentation of the workshop content. Discovering embodied reflections within my notes was unexpected, despite this kind of cognitive processing being common in high quality notetaking (Jansen et al., 2017). In previous discussions of the reflective doodling process I have failed to recognise this aspect of notetaking as reflection in action. In documenting and responding to new knowledge, and by adding fragments of old knowledge to it, the notes form part of an active exchange. It was noted by one participant that reflective doodling was "more involved, mentally" than normal note taking. Much like 'mind-page conversation' noted by the other workshop participant, these notes start to reveal the embodied nature of this interactive process.

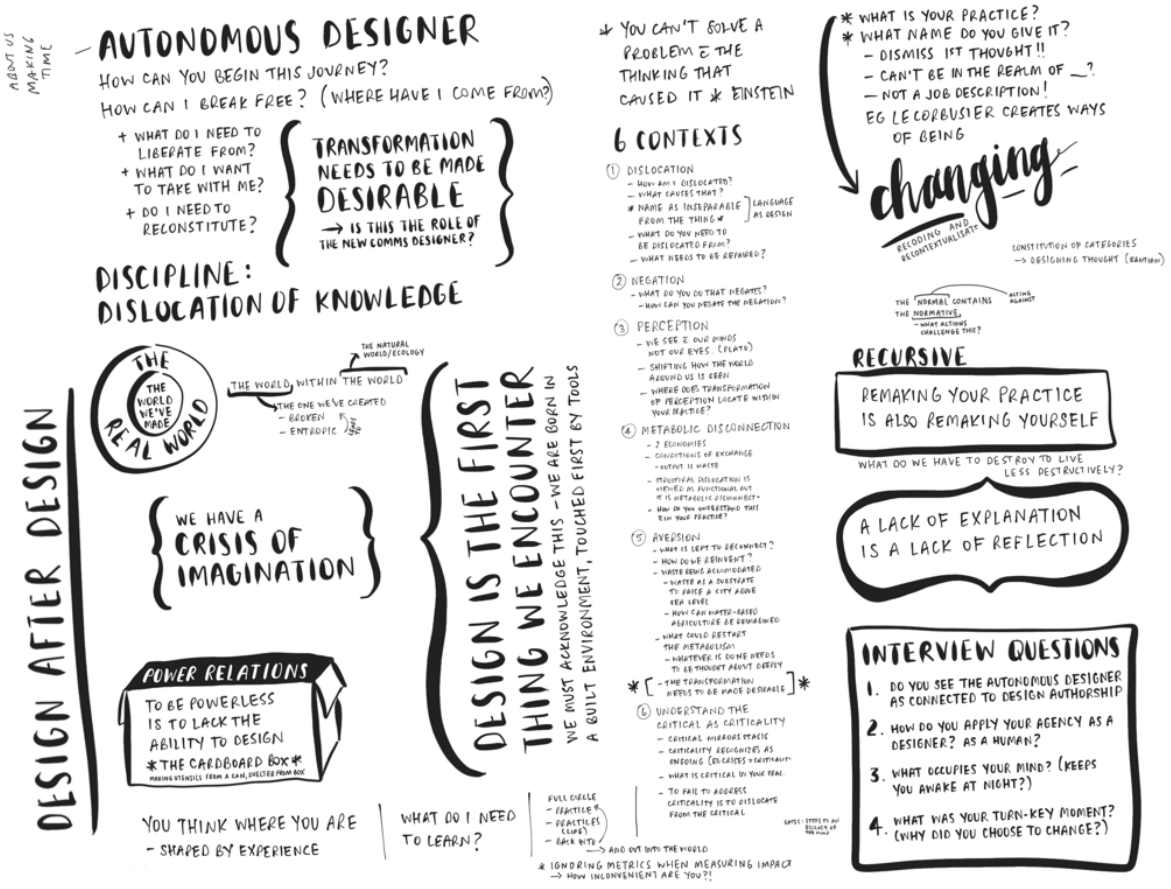


Figure 3 Initial notetaking and reflection in action during a workshop (page six of ten).

Figure 4 shows a mid-point of reflective doodling, one that uses the process of doodling in order to think. As key themes and insights are transcribed into visual notations their concepts are considered more deeply and another cycle of reflection begins. As each cycle passes, the process shifts to sensemaking, (see Figure 5) where the concepts of others are connected more directly into my own work and into the literature I am currently engaging with, and provocations are made into the larger context of design and the designed world.



Figure 4 *A mid-point: here reflective doodling is used as a form of visual notation where notes become more illustrative. The time taken to arrange them, connect them and make them more visual is also used to think and reflect upon their content and meaning.*

Both workshop participants initially found it challenging to describe what occurred during their own notetaking and doodling processes. Two weeks later in their post-workshop reflections, they each described their initial experiences with the process. One described the ways the flow state evoked by reflective doodling unlocked knowledge buried in their sub-conscious or helped them make new connections in their work. The other described how it helped them to digest and recall new concepts. The visual explorations in reflective doodling appealed to both participants as visual learners. One described how "I feel like I'm writing down what my brain is producing *while* it's producing, and I think there's great value in that". For this same participant, there was also value in the tactility of drawing as an explorative

process, which they felt created a stronger connection between their research and their practice as a designer. They believed it provided both creative nourishment and clarity of thought which they felt improved the connections being made through their writing. Both participants will continue to use reflective doodling and will be interviewed again in six months as part of the ongoing study.



Figure 5 *Here reflective doodling is being used as a form of sensemaking. A smaller notation system connects concepts to my own work and that of other authors and theorists to integrate this new knowledge. These notes were later dissected again as part of a slide deck where they were carved into sections and visually simplified.*

In the examples above and others yet to be explored in this paper, the focus of the reflective doodles is on the integration of new theories or concepts that are particular to the intersection of sustainability transitions and design. The doodles presented in this paper were drawn at different times during a three-year period using a tablet and stylus with custom brush settings for both visual mark-making and written documentation. Each process occurred iteratively and built knowledge cumulatively, often occurring in discrete yet overlapping phases of 'doodling to understand', 'doodling to explore', and 'doodling to communicate'. The digital environment these doodles were created within facilitated a layered approach, and iterations were captured on separate layers in a single file. In the

context of thinking while drawing, reflective doodling is an informed, multi-layered multi-stage process, structurally and conceptually. It draws continually on the practitioner's skills, knowledge, experiences and contexts, and in doing so it demonstrates a form of embodied reflection. During interviews, discussions explored how the 'unfinished' doodles aided the practitioners' thought process, while the 'finished' reflective doodles created a simple visual entry point for an audience to engage with complex concepts. The potential for reflective doodles to improve complex communication for an audience was noted. This aspect will continue to be explored through the study, in addition to the usefulness of the process as a form of embodied critical reflection for practitioners.

5. Drawing to think

While sketching is an accepted form of communication, particularly for visuospatial ideas used in architectural drawing (Tversky, 2002), it appears to be less easily recognised as a process of thinking and is easily subjugated when described as a form of doodling. This is captured in the contrast between Brown's (2010) description of doodling as "thinking, albeit in disguise" and in Ammon's (2019) critique of the glorification of the 'paper napkin sketch'—a type of intuitive sketch that is commonly held up as proof of an a-ha moment of creative genius. As Ammon argues, celebrating an isolated sketch as 'genius' ignores the presence of multi-layered systematic drawing processes that are typically shaped by different actors, contexts, tools, cultural settings and epistemologies (Ammon, 2019). Ammon is careful not to erase or devalue inspiration and insights within creative processes, instead arguing for greater recognition of what underlies these a-ha moments. She describes how the spontaneous napkin sketch is not a perfect render of a mind's eye image, rather, there is much informing the spontaneity. Through processes of analysis a practitioner might recognise traces or breadcrumbs of it in their knowledge bank, or in their earlier sketches, notes and doodles. This critique of oft-glorified napkin sketches also offers insights into drawing as an integral part of the creative thinking process, and as part of the hard work that is performed by creatives. This is further evident in Ammon's (2019) analysis of practitioners' drawing practices, where their comments reveal further insights into the practitioners' experiences: "I can't get very far just thinking about it without drawing something", "when I sit down to work, it's hard", and "the process of thinking only unfolds as she draws" (Ammon, 2019 pp. 598-599). Each comment tells a story about how some practitioners will innately draw (or doodle) in order to think, and how both thinking and drawing present challenges that must be faced as part of the process—it is hard work. Yet if we return to Schön, (1983) practitioners' failure to articulate what they know and how they know it, gives the napkin sketch phenomenon an unfortunate credence.

Schön's (1983) music analogy helps recognise the value provided by skills, knowledge, experiences and context underpinning creative processes like the impromptu napkin sketch. When musicians improvise (or 'jam') they are performing a set of very specialised skills and enacting specialist knowledge. A musician's ability to listen and respond accordingly is no more spontaneous or genius than a designer's napkin sketch. This aural read-and-respond

process is informed by years of practice of their craft, knowledge of the instrument(s) being played and heard, of musical scales, of timing and tempo, all aided by tacit knowledge of what will work in the context of the jam. The context plays a crucial role; a feedback-induced hard rock riff is unlikely to work in a freeform jazz exploration, even if both are being played in the same tempo and key. Musicians tacitly know what feels right in the context of a jam.

A reliance on skills, knowledge, experiences and context is also inherent within reflective doodling which has a meditative, iterative and deliberative nature wherein these multi-layered processes become visible. This physical and metaphysical layering was demonstrated in Figures 3 to 5 and will be discussed again in the upcoming presentation of Figures 6 and 7. Reflective doodling is a temporal process that leaves breadcrumbs of itself in the work; a line here, a thought there. Each remains part of the doodling artefact as it undergoes continual processes of refinement. Engaging with these breadcrumbs is a non-linear process. Newly defined marks often become new jump off points for enquiry, creating a web-like exploration not unlike reflective practice as described by Schön (1983). A web is also evident in the way reflective doodles speak to one another both as a part of cumulative cognitive processes and as a series of artefacts.

To observe someone *drawing to think* is to witness their thought process unfolding, but not all that is embedded within a drawing, sketch or doodle is readable to others. The uniqueness of a practitioner's visual coding operates like shorthand to its creator, (as seen in Brown's (2010) visual alphabet) imbuing a sketch with meaning that may be unknown to those outside the process—though this is not always the case. In my own notes there are shorthand codes drawn from a variety of sources, from visual sketches to stenographer's marks. Some of these are readable, while some are less likely to be understood by others. Workshop participants also used visual cues that acted as a shorthand, whilst this was less readable to others, it captured their thinking in ways that allowed further engagement either through more drawing or through a writing process.

Some shorthand visual devices—and the ways they are used—are pre-coded; to draw on an earlier example, the arrow seen in Figure 2 is pre-coded as a symbol for direction and so becomes a device that automatically reads in a particular way. Reading its nuances expands our interpretation. A triangle shares this directional coding but can also represent other things, such as nature elements (fire and water), change (in shorthand), power (or hierarchy), gender, religious and spiritual trinities, and even warning messages. The triangle is pre-coded and then re-coded by its given context and relationships with connected or surrounding marks. It is through this process of reconfiguring and re-coding marks that the practitioner is led to new interpretations, new meaning and new knowledge. This responsive process was noted as highly valuable by workshop participants. By following breadcrumbs and responding to them, the practitioner converses with their drawing (Schön, 1983). When engaging in this way, the practitioner's thinking and the resultant work both shape and shift one another in new directions. The practitioner is neither thinking nor drawing as independent processes, rather one is used to enhance the performance of the other and in doing so enhances the performance of both. In this sense, thinking and drawing become blended and somewhat

inseparable in certain contexts. Developing this inseparable blend takes time, however both participants felt an immediate value from their early engagement. During the workshop, participants demonstrated their understanding through shared discussion of their doodles. In their interviews, one stated that "the entire process spoke to me" and the other suggested that "if people are taught this earlier on they'll be able to express their ideas better and in more concise ways." Both agreed that they needed more time with the process to fully master it, particularly in relation to *drawing to think*.

Drawing to think uses the entangled thinking-drawing process to build new knowledge in ways that *thinking while drawing* cannot. To offer a visual example of this process in action, Figure 6 presents a series of snapshots from another reflective doodling process. On the far left is Geels' (2002) visualisation of a multi-level perspective (MLP) in socio-technical transitions theory. By way of a brief overview, the MLP is a theory that describes three levels in socio-technical systems (landscape, regime and niche), how activities in these levels evolve and how they interact in periods of systemic change. The MLP was a catalysing theory in my PhD. My investigations into designing systemic change engaged closely with the MLP, its constraints and its applications within design. Using reflective doodling to examine the current socio-technical conditions of the wicked problem of consumption and waste, led to an operationalisation of this theory in design contexts: communicating an understanding of the conditions of this wicked problem, that could be used deliberatively to identify points of system intervention.

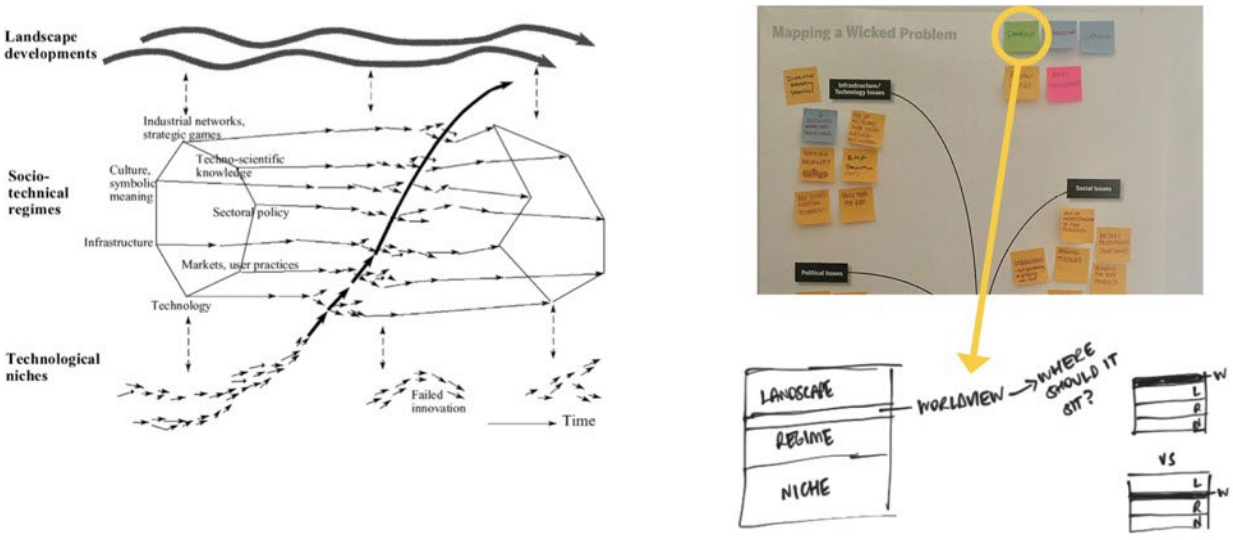


Figure 6 *A start point: reflecting on how to operationalise Geels' (2002) MLP theory through reflective doodling.*

As seen in the far-right image in Figure 6, the reflective process began with recognition of side notes that highlighted the dominant paradigm in a system. The paradigm was important yet obscured in the MLP, and the thought process that followed is contained in a doodle,

exploring where the paradigm could be positioned in a reimagined MLP. A handwritten note accompanies this sketch, it says 'worldview—where should it sit?'. This seemingly simple question sparked a year-long process of reflective doodling to explore how the MLP changed as a result of adding this fourth level, and what the implications were for MLP theory and design for transitions. In Figures 7 and 8, multiple snapshots of this process are presented to show how this investigation took place both within the MLP map and through a notation system that overlaid it. At the bottom of Figure 8, a new draft of the MLP map includes a fifth band to represent ecology as the context in which the MLP situates. The addition of these bands further advances the MLP by operationalising it for design.

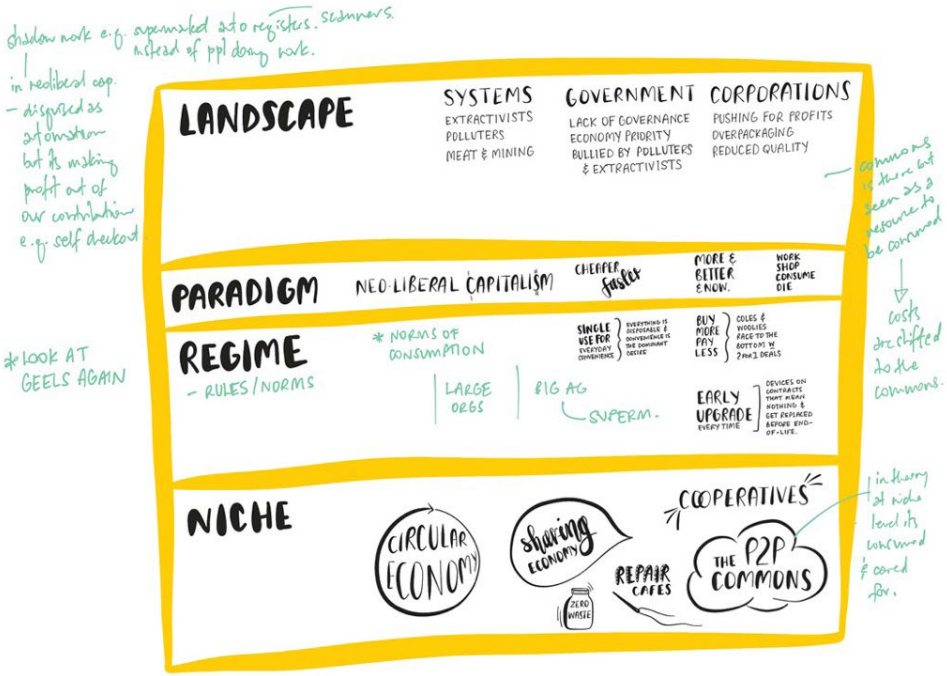
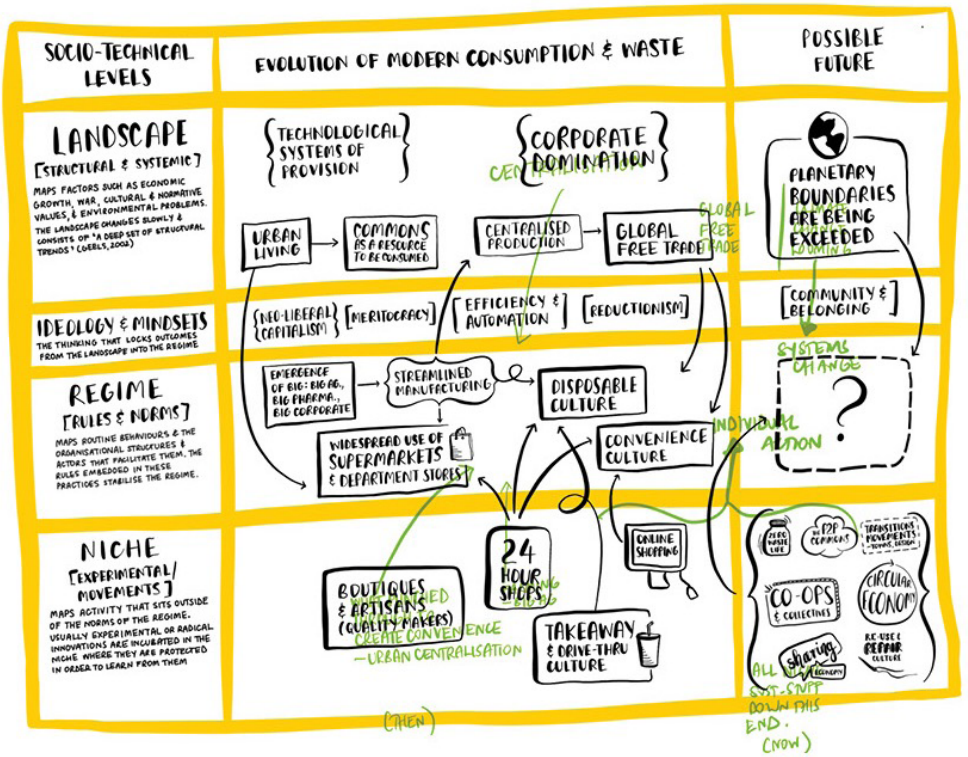


Figure 7 *A snapshot of the reimagined MLP in an early draft format. The concept is still being digested and notes in an additional layer suggest changes to consider for the next iteration, including the suggestion to return to the original source material.*



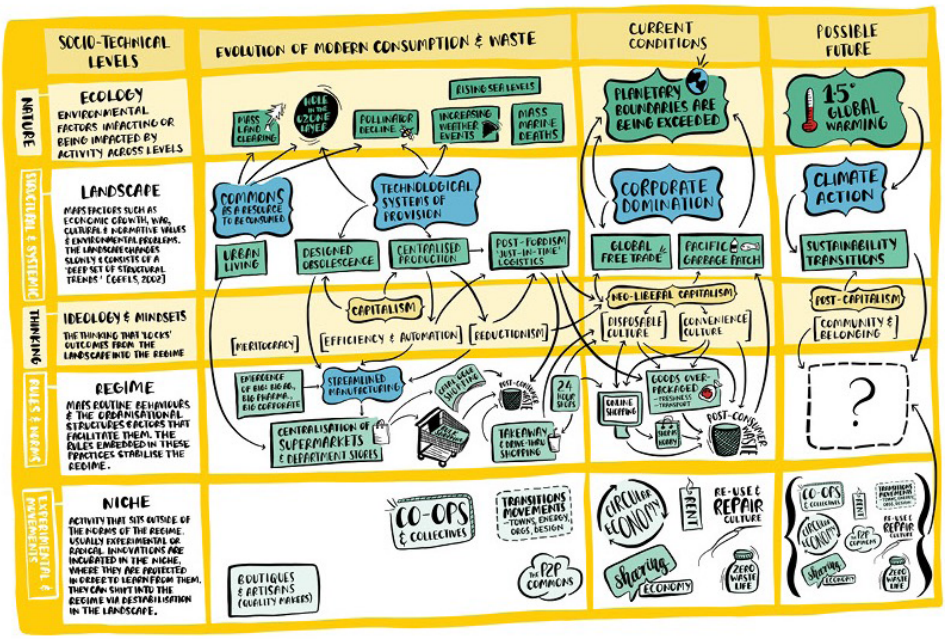


Figure 8 *Top: A mid-point of reflective doodling displaying the conceptual shift to add columns and sub-levels with reflective notes made in a layer of the sketch. Bottom: A finished sketch mapping the problem of consumption and waste using a reimagined MLP that operationalises Geels' (2002) MLP theory.*

Communicating this theory using a past-present-possible future model also extends how

this theory could be used in design for transitions for problem articulation and intervention identification. These advancements led to another reimagining of the MLP as an organic holarchy, where each level is nested and the overall communication shifts from one that feels hierarchical, to one that more effectively communicates the web of interactions that occur between levels and across systems (see Figure 9). This created a much-needed shift in communicating how intervening in a wicked problem could impact the system and/or the larger context in which the system is located. By making modes of thinking and their larger ecological context more explicit, the MLP becomes a tool that designers can use not only to map a problem, but to identify points of intervention, to explore how these might impact the system and its context and to communicate these findings to others.

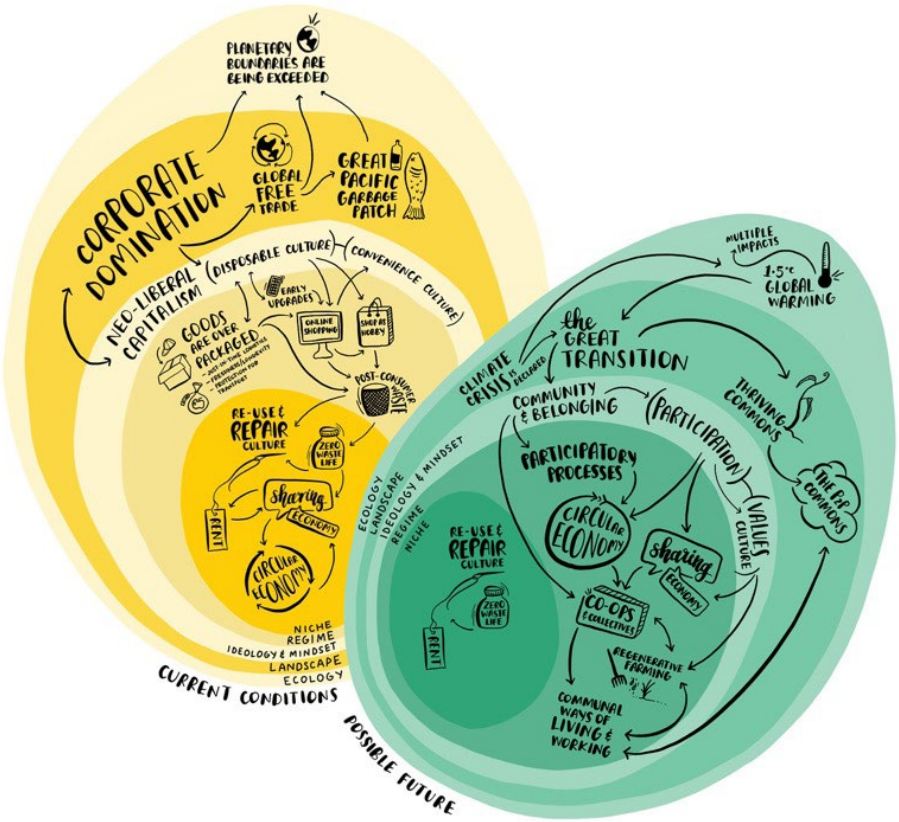


Figure 9 *The MLP reimagined as an organic holarchy where the system mapping has a simpler narrative and the visual shape has a less hierarchical feel.*

Drawing to think facilitated this process of exploration and embedded within these figures is evidence of a multi-staged approach. At the top of Figure 6 it is clear that I am still deciphering the theory—I am doodling in order to understand it. In the central and bottom sketches in Figure 7, I am doodling to explore. This is demonstrated by the nuancing of terms used, the shuffling of cultural frames between levels, by the evolution in elements/activities mapped, and by the addition of columns to show stages, from historical emergence, to current conditions and into a possible future. It is not until Figure 8 that doodling to

communicate begins. Evidenced by the simplified content, use of organic forms to mitigate the hierarchy of rows and columns and instead present a truer representation of the socio-technical system as a holarchy. The usefulness of these revised MLP tools for other practitioners exploring wicked problems is currently being tested.

Whilst there is a breadcrumb of my initial a-ha moment traceable in the process presented in these figures, there is certainly no spontaneous genius aspect to any of it. Rather, early and repeated engagement with the literature along with a continual process of reflective doodling led me toward this particular end-point. It was hard work. Enjoyable, but hard. As I continue to engage with these and other tools that were developed using reflective doodling, my understanding and appreciation for the process continues to develop. Without *drawing to think* I do not believe these tools would have advanced in this particular way. But reflective doodling provided more than a process for thinking—its meditative nature provided an albeit strange way of relaxing whilst continuing to think. In many ways, reflective doodling served as an exercise in mindfulness, allowing me to switch off (relax) in order to switch on (create). In fact, many significant advancements in this work occurred at night while I was 'relaxing'. The sometimes-repetitive act of doodling also appeared to increase my well-being and engaging with these creative processes often brought enjoyment to what was otherwise hard work. This side effect was unexpected but welcome. Recognising this and reflecting on it during my PhD provided much clarity around the role that creativity and in particular, the practice of drawing, plays in my satisfaction of needs.

5.1 Drawing to think in the context of wicked problems

As the problems that designers reflect upon become increasingly complex and wicked by nature, our reflection must also become increasingly informed; by theory, by experiences (our own and others'), by criticality and by processes (known and as yet unknown). This kind of reflection is a learned practice. It relies on reflection in and on action, reflection in and on time, and in addition to this, a deliberative approach that considers what might come and what might be. Reading and responding; listening and responding; acting and responding; these can be slow processes and they warrant frequent reflection. This way of working is a dance, a movement, a shift to, from, and between one thing and another (and another and another and so on). Plurality and movement are key in addressing wicked problems, which are typically found in complex adaptive systems. The diversity in a system calls for diversity in our responses to it (Ashby, 1957). The adaptive nature of a system requires continual responses to the surrounding conditions and continually adapting actions that shift them again. These processes are as fluid as they are innately reflective. This calls for designers to make adequate time for reflection, to find comfort amongst the chaos, and to be agile thinkers who are willing to change themselves in the process of changing the systems they are embedded within.

Context is a necessary aspect of understanding and responding to the current conditions of a system, but these contexts can be partially obscured if the capacity for reflection is limited. Making the ecological context for design activity more explicit in the MLP was done in an

attempt to avoid any obscuring of this context during reflective doodling. One's capacity for critical reflection can be further nudged through tools such as the MLP canvas, but the capacity for reflection using such a tool is strengthened through the practice of reflecting with the tool itself. This is amplified through a constant nurturing of the mind performing the reflection, by ensuring that knowledge is continually built, dismantled and rebuilt, and that multiple and decolonial perspectives are sought. This is an important note for reflection on wicked problems such as climate change, where truths and contexts are plural and continually shifting, and where the knowledge needed exceeds that which most designers hold.

6. Some final thoughts on what reflective doodling is and does

Throughout this paper my understanding of what reflective doodling is and does has been shifting, and as the study of this process continues in the living lab, this understanding will likely continue to evolve. I hope here, as this paper concludes, to provide more clarity by redefining its processes as they are currently understood. In *thinking while drawing*, the process of making marks is used to make sense of something. Reflective doodling as part of this process can take a number of forms, not only as a method for documenting thinking, such as in ideation, but also as a method of information processing, demonstrated in this paper through doodling to process concepts, and through doodling as part of notetaking. The reflection conducted for this paper revealed how reflective doodling attempts to construct new knowledge on-the-fly, as a form of reflection in action during notetaking and by using drawing as a more deliberate and visual way of thinking through something. In *drawing to think*, reflective doodling is used as a way of opening neural pathways to understanding new theoretical knowledge, as an approach to unpack the complexity of wicked problems, and in the examples shown, as a thinking process to identify leverage points in everchanging systems. In these contexts it is reliant on a number of inputs including (but not limited to) theoretical concepts, knowledge from other disciplines, and diverse perspectives. Each input serves to increase practitioner capabilities through cumulative knowledge building that broadens thinking and reduces biases and assumptions.

Reflective doodling is more complex than its simple name suggests. It is a critical reflective practice underpinned by a range of inputs that inform its processes. Highly developed critical thinking is necessary not only for those engaged in design for transitions, but also for any researcher or practitioner who is focussed on complex or wicked problems. Through the layered processes of reflective doodling, designers might find new and unexpected synergies between research and practice.

Acknowledgements: I live and work in Kaurna country. I acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture. I pay my respect to their Elders, past, present and emerging. This land was stolen from them and I acknowledge that sovereignty has never been ceded. I also acknowledge that the processes of embodied reflection and drawing that I frequently engage in are part of a rich tradition in both Australian Aboriginal and Indigenous South American cultures. I wish to acknowledge the privilege that is tied to working with these cultural processes as a white Euro-Australian woman. I am eternally grateful for the significant contribution they continue to make to how I think about and do my work.

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The space between us: how designers and the general population see typographic emphasis

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Abstract: The typographic emphasis of headings in a document clarifies the structure of the content for the reader as well as assisting them with locating information. The visual presentation of these headings is important so that they are effective visual markers. The typographic methods used to emphasise these headings can vary greatly and are potentially perceived different by those consuming the document compared to those who are designing it. The research presented in this paper investigates through a paired comparison study whether designers perceive the typographic emphasis methods used for headings in the same way as the general population. While the effectiveness of heading styles is generally agreed between both groups, the greatest discrepancy occurs regarding the use of spacing. Through the comparative study assessing seven methods of typographic emphasis, it was found that designers consider spacing to be more effective for indicating typographic hierarchy than those in the general population.

Keywords: typography; document design; hierarchy; space

1. Introduction

Headings serve multiple functions for readers including signalling the structure of the document to assist with understanding the content, as well as helping readers to locate information. The majority of the knowledge and recommendations for how headings should be presented in text has been developed by typographers over many years; it is primarily intuitive and concerned with the aesthetic aspects of the printed page and creating visual rhythm; however, little of this is supported by empirical research. Despite typographic research and practice often providing different recommendations, both make a valuable contribution to advancing our understanding of typographic features and their relationships (Lonsdale, 2014).

The study reported here investigates whether people with greater typographic understanding find the same heading emphasis methods easiest to identify as the general population. It

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is hypothesised that education in the field may alter the judgments made in the study. A paired comparison study was conducted with 40 graphic designers to determine whether the ease of identification of headings for graphic designers was the same as for a more general population.

2. Related Work

The design of text is affected by three main factors: the way items are ordered and grouped on the page affects the syntactic structure; restrictions of the media, such as page size, have artefactual effects; and the way the text will be used affects design decisions (Waller, 1982b). Previous studies have shown that readers can more easily discriminate greater differences between typeface stimuli, but have greater difficulty when there are subtle changes (Dyson, 2011; Sanocki, 1987) and that greater consistency improves the efficiency of letter identification when reading (Sanocki & Dyson, 2012).

Readers use headings to identify subject matter and clarify the structure of a text; they can also help draw attention to specific information (Kools et al., 2008). Disruption to the stylistic consistency of body copy text may be useful for the purpose of drawing attention to aspects of the text such as headings, as the change in visual form disrupts the reader because the changes makes the text slightly more difficult to process (Dyson, 2014). As a result, headings are important for readers when searching for information.

Headings provide at least three types of information to assist readers with searching, they can indicate distinct sections within the text, they can indicate the likely content of a section of the text, and they can create hierarchy to provide structural and relationship information (Klusewitz & Lorch, 2000a). As a visual cue headings are used to help readers discern structure, the changes in typographic appearance aid the reader in discriminating target items (Foster, 1979).

The compositional structure of a document is revealed by emphasising headings to creating a hierarchy of information in the document (Wallschlaeger & Busic-Snyder, 1992). Bosler (2012) explains that headings need to be noticeable as readers use these to know where they are in the text. Headings assist readers with understanding the structure of the text and with orientation within the content.

The importance of headings and their place within the heading hierarchy can be indicated using; size, weight, position, spacing and colour (Mitchell & Wightman, 2005; Bosler, 2012). The use of size, placement, colour and other graphic means can make it easier to locate items within a layout, including headings to assist readers by directing them to content (Jennett, 1973).

Black (1990) explains that there is a fine balance in determining typographic appearance of headings. Emphasis is often necessary to differentiate the heading structure and while emphasis should provide clear differentiation, it should also be as modest as possible and provide good clarity and assist with establishing the varying degrees of importance (Bosler,

2012). Fewer formatting dimensions is more useful to readers, as using a greater number of variations is likely to lead to confusion (Williams & Spyridakis, 1992). Consideration needs to be given not just to creating headings which are sufficiently emphasised, it is also important that they do not disrupt the flow of reading. Typographic elements such as headings and subheadings create a break in the rhythm of the text on the page. After the break, the text should return to its rhythm (Bringhurst, 2004).

The perception of headings was also studied by Williams and Spyridakis (1992), where they used a card sorting study to compare four typographic emphasis methods (type size, underlining, case and position) of different combinations. Their study focussed on four typographic emphasis methods (type size, underlining, case and position), that can be used for emphasising a heading and different combinations of these four attributes. For their study, they asked participants to sort index cards which were printed with paragraphs of dummy text and headings into an order which reflected the most important headings through to the least important. They found that when used alone, increasing type size was considered the strongest indicator of hierarchy for headings and that relative, rather than absolute, size difference provided the greatest indicators of hierarchy, with a difference of approximately 20 percent being the most useful. They suggest that to create headings the fewest formatting dimensions possible should be changed to create the necessary number of heading levels.

Paterson and Tinker (1940) found no difference in reading speed between text that is bold and that which is regular lowercase type. Readers in the same study though felt that it was less legible, but because it has greater visibility than regular text Paterson and Tinker recommend using bold for emphasis of text content such as section heading. “Although some designers may have a strong esthetic (sic) objection to boldface for headings, this does not mean that readers react the same way” (Tinker, 1966, p. 136). Research

In his discussion of Bold as an ideal method for emphasising headings, Tinker (1966) suggests that although designers may or may not prefer certain methods of typographic emphasis, these preferences may not always be what is preferred by readers. Research conducted by Bartram (1982) found that design students perceived the semantic associations of typefaces differently to non-design students.

3. Paired Comparison Study

A paired comparison study was undertaken with 40 graphic designers to compare whether their perception of the effectiveness of typographic emphasis methods was the same as those from the general population.

3.1 Method

A balanced paired comparison study with graphic designers was conducted to determine whether graphic designers perceive the emphasis of headings within a text differently to

those who have had no formal visual design education or experience. This study employed a paired comparison method where all of the stimuli were presented to participants in comparison to each of the other stimuli and participants asked to evaluate them in relation to each other Davis (1988).

A paired comparison method, as described by David (1988), was employed as it is an effective method for establishing a ranked order of preference for a number of items when a direct comparison can be made directly between two items. It is especially useful when the judges of the items may perceive little distinct difference between items, meaning that decisions on order in a card sorting activity may become arbitrary. There was potential for participants in this study to feel that the differences between the compared items were subtle and the paired comparison method helps to avoid choices being made on arbitrary factors (David, 1988; Cattelan, 2012).

The material developed for the study consisted of the same passage of text, one page long, with three headings spaced throughout the page formatted according to the typographic emphasis method being assessed. The body copy was consistently presented as 9-point Times New Roman with 13-points of leading. The column of text was 98mm wide and 175mm high, presented on a page 176mm wide and 250mm high.

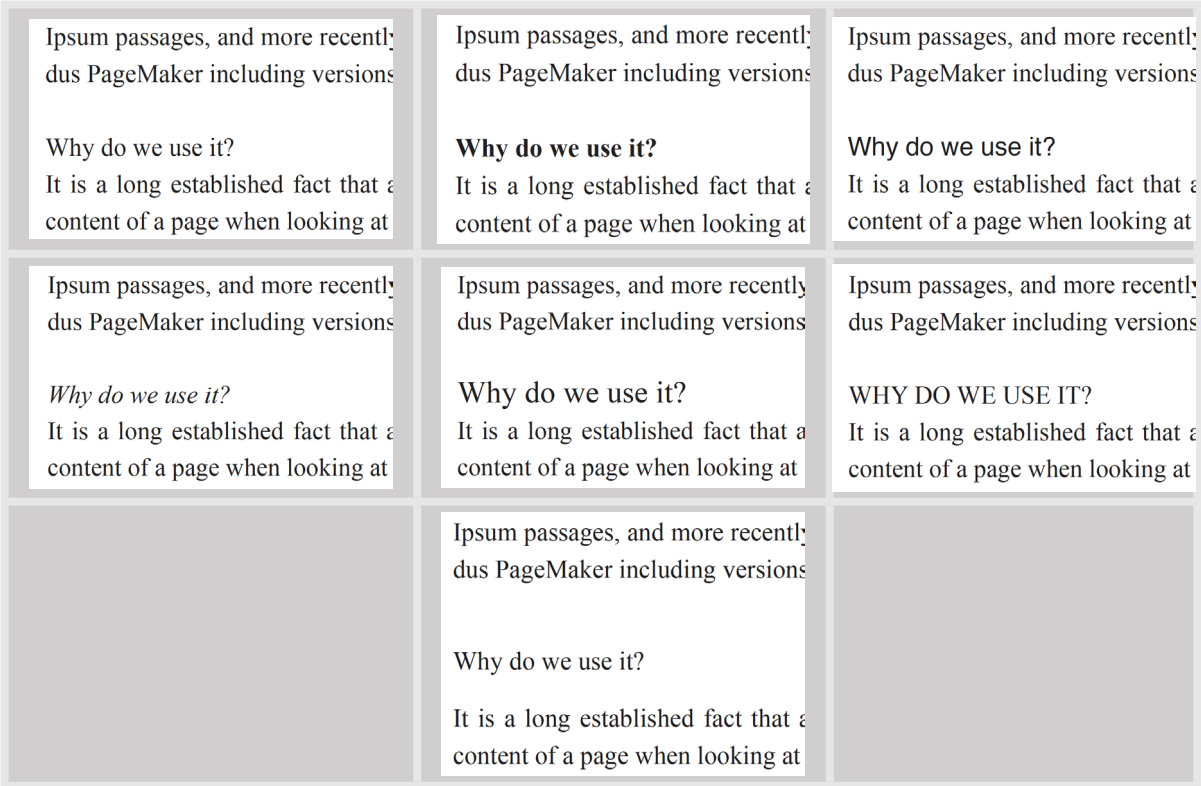

Figure 1 *Examples of each heading style (Top l-r: Control, Bold Sans Serif. Middle l-r: Italic, Size, Capitalisation. Bottom: Spacing.)*

The seven typographic emphasis methods compared in the study, as illustrated in Figure 1, were:

- Control (no difference between the heading and body text)
- Bold
- Italic
- Increased Spacing between the heading and the body copy
- Sans Serif (Helvetica)
- Capitalisation
- A Size increase 20% larger than the body copy

Each heading style was shown paired with each other heading style, which resulted in each participant being shown 21 pairings to compare. Figure 2 shows the pairing of the Bold style (left) and Control style (right). The 21 pairings were bound into an A3 booklet and shown in one of four random orders. The pairings were also alternated between sides of the page to attempt to eliminate bias.



Figure 2 Example of text materials (Bold and Control)

For each pairing they were asked to indicate which passage of text the headings were easiest to identify or whether they felt they were equally easy or difficult. Ease of identification was explained to participants as how easy they felt it was to visually recognise the headings in relation to the body copy surrounding them.

3.2 Sample

Demographic information was collected from participants at the commencement of the study, including gender, age and their background; student, industry professional or design educator. Potential participants were defined as "graphic designers" if they had more than two years of visual design or typographic education at a tertiary level or if they had more than one year of experience working in the visual design industry. A total of 40 graphic design participants took part in the study.

Twenty (50%) of the graphic design participants were design students, 15 (37.5%) were industry-based professionals and 5 (12.5%) were design education professionals.

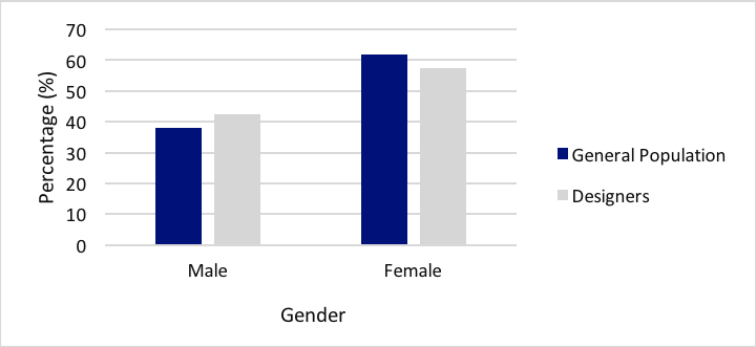

Figure 3 Gender of participants, graphic designers (n=40) and general population (n=100)

Figure 3 shows the balance of genders in the two sampled populations. In the group of designers with 17 (42.5%) of the participants being male and 23 (57.5%) female. In the sample of participants from the general population a similar gender balance was seen, 38% were male and 62% were female.

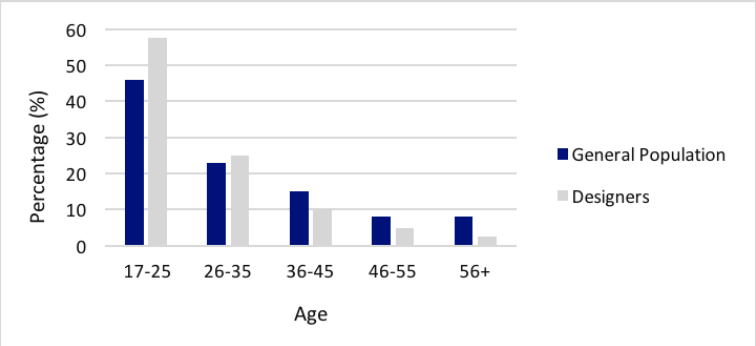

Figure 4 Age of participants, graphic designers (n=40) and general population (n=100)

The spread of ages in both populations was also similar, these samples are shown in Figure 4. Participants in the 17-25 age bracket made up 57.5% of the designer participants and 46% of the general population. In the group of designers 25% of the group were 26-35, whereas in the general population 23% fell into the same age bracket. The group of graphic designers was made up of 10% 36-45 year olds compared to 14% of the general population.

Participants in the 46-55 age bracket made up 5% of the designers and 8% of the general population. The remaining 2.5% of the designers were over 56 years old and 8% of the general population were above 56 years.

4. Results

The data collected from the paired comparison was analysed using a head-to-head comparison method to create totals to reflect the ranking of the items being compared (David, 1988). The total number of favourable choices for each heading style was tallied for each pairing as well as an overall tally to create a ranking of the seven heading styles being compared. The results in Table 1 show the percentage of choices in favour of the heading style in the column when compared to the heading style in the row. A favourable choice contributed '1' to the total, and a neutral response contributed '0.5' to both of the heading styles being compared.

Table 1 Preference tally for graphic designers compared to the general population as percentage

Graphic Designers (n=40)								General Population (n=100)						
Control	Bold	Italic	Spacing	Sans Serif	Caps	Size		Control	Bold	Italic	Spacing	Sans Serif	Caps	Size
---	95	76.25	100	96.25	92.5	97.5	Control	---	99	74.5	86.5	90.5	90	91
5	---	17.5	26.25	15	16.25	12.5	Bold	1	---	11.5	25.5	26.5	27	27
23.75	82.5	---	72.5	56.25	65	52.5	Italic	25.5	88.5	---	65	68	68	72
0	73.75	27.5	---	37.5	30	46.25	Spacing	13.5	74.5	35	---	65	63	74.5
3.75	85	43.75	62.5	---	40	65	Sans Serif	9.5	73.5	32	35	---	35.5	66.5
7.5	83.75	35	70	60	---	50	Caps	10	73	32	37	64.5	---	46.5
2.5	87.5	47.5	53.75	35	50	---	Size	9	73	28	25.5	33.5	53.5	---
7.08	84.6	41.3	64.8	50.0	49.0	54.0	Total (%)	11.4	80.3	35.5	45.8	58.0	56.2	62.9

* 0-19% | 20-39% | 40-59% | 60-79% | 80-100%

Shown at the bottom of each column in Table 1 is the total number of choices in favour of each of the heading emphasis methods (out of a possible 240 for the graphic designers and 600 for the general population), as well as a percentage of times each heading emphasis method was chosen across all of its paired comparisons.

Within the population of 40 designers there are some differences to the preferences of the general population for the frequency each of the heading emphasis methods were chosen as being the most easily identifiable in a paring. As with the general population, Bold was most frequently chosen as the more identifiable heading emphasis method in a pairing, being chosen 84.58% (203) of situations. The second most frequently preferred heading emphasis

method amongst designers was Spacing, chosen 64.17% of the time, more frequently than the second ranked heading emphasis method with the general population, Size (62.92%). Size was the third most frequently chosen heading emphasis method being chosen by designers in 53.96% of instances, followed by Sans Serif being chosen overall in 50% of pairings. Capitalisation was chosen by designers in less than half of its paired comparisons, at 48.96%, followed by Italic which was chosen 41.25% of the time. The Control was again the least frequently chosen heading emphasis method with just 7.08% preference choices, scoring 17 out of a potential 240.

The most surprising result seen in the head-to-head comparison is that all 40 of the participants chose Spacing over the Control, this was the only perfect agreement between all participants in any of the pairs across all of the studies conducted. Also of note is that in the pairing of Capitalisation and Size, each was chosen an equal number of times (20).

4.1 Neutral Choices

Neutral choices by participants were recorded when an individual either could not discern the difference between the two heading emphasis methods being shown to them in a paired comparison, or if they felt the two heading emphasis methods were equally easy, or equally difficult, to identify as headings from the surrounding text. Table 2 shows the percentage number of times each pairing was given a neutral response by a graphic design participant or general population participant.

In the general population, 5.42%, approximately 1 in every 18 choices made, were neutral. In the sample of designers who participated in this study, neutral choices were made less frequently than in the general population. Overall, only 2.86% of choices made by the designers were neutral. The greatest number of neutral choices by designers occurred with the Italic heading condition (4.17%), and the greatest number of neutral choices between a single pairing being the comparison of Italic and Sans Serif. With the general population the greatest number of neutral choices was made with Sans Serif headings (8.0%), and the greatest number of neutral choices for a single pairing was between Sans Serif and Size.

Many pairings had no neutral choices made for that pairing of heading emphasis methods including; Bold/Control, Spacing/Control, Sans Serif/Spacing, Capitalisation/Control, Capitalisation/Spacing, Size/Control and Size/Italic with the design group. In the general population there was only one pairing that had no neutral responses, Control/Bold. The group of designers made just 2 neutral choices with the control (0.83%), one in comparison to Italic and one when compared to Sans Serif.

Table 2 Neutral choices percentages for graphic designers and the general population

Graphic Designers (n=40)								General Population (n=100)						
Control	Bold	Italic	Spacing	Sans Serif	Caps	Size		Control	Bold	Italic	Spacing	Sans Serif	Caps	Size
---	0	2.5	0	2.5	0	0	Control	---	0	11	11	7	4	6
0	---	5	2.5	2.5	5	5	Bold	0	---	3	5	9	8	4
2.5	5	---	5	7.5	5	0	Italic	11	3	---	6	8	8	4
0	2.5	5	---	0	0	2.5	Spacing	11	5	6	---	4	4	3
2.5	2.5	7.5	0	---	5	5	Sans Serif	7	9	8	4	---	7	13
0	5	5	0	5	---	5	Caps	4	8	8	4	7	---	7
0	5	0	2.5	5	5	---	Size	6	4	4	3	13	7	---
0.8	3.3	4.2	1.7	3.8	3.3	2.9	Total (%)	6.5	4.8	6.7	5.5	8.0	6.3	6.2

* 0-0.9% | 1-5% | 6-10% | 11-15% | 16-20%

4.2 Preferences of Student and Professional Graphic Designers

The graphic design participants were asked whether they were students or professionals (industry and educators). The sample were equally divided between the two groups, with 20 participants identifying themselves in each group. A comparison of the relative preferences of each of these two groups within the graphic design population shows both similarities and differences.

As seen in Table 3, showing preferences choices for each heading style for students compared to industry participants, there is little difference between the responses from students compared with professionals. Both groups had a clear preference for Bold, followed by Spacing. The professionals then showed little difference between Sans Serif, Size and Capitalisation, followed by Italic and lastly Control. Whereas, the students had a stronger preference for Size and ranked Sans Serif, Capitalisation and Italics all closely grouped, with the Control by far the least preferred.

Table 3 Preference tally for students compared to industry participants as percentage

Students (n=20)								Industry (n=20)						
Control	Bold	Italic	Spacing	Sans Serif	Caps	Size		Control	Bold	Italic	Spacing	Sans Serif	Caps	Size
---	92.5	77.5	100	92.5	85	95	Control	---	100	75	100	100	100	100
10	---	17.5	32.5	7.5	17.5	7.5	Bold	0	---	17.5	20	22.5	15	17.5
22.5	82.5	---	72.5	52.5	60	50	Italic	25	82.5	---	72.5	60	70	55
0	67.5	27.5	---	25	25	45	Spacing	0	80	27.5	---	50	35	47.5
7.5	95	47.7	75	---	40	65	Sans Serif	0	77.5	40	50	---	40	65
15	82.5	40	75	60	---	57.5	Caps	0	85	30	65	60	---	42.5
5	92.5	50	55	35	42.5	---	Size	0	82.5	45	52.5	35	57.5	---
10	85	43.3	68	45	45	53	Total (%)	4.2	85	39.2	60	54.6	52.9	54.6

* 0-19% | 20-39% | 40-59% | 60-79% | 80-100%

Comparison of the responses of the two subgroups within the designers show that there are only subtle differences in the responses.

4.3 Comments

Pertinent to the comparison with the graphic design population though are those comments from the general population that relate to the reasons for preference (or lack thereof) for Bold, Spacing and Size. The designers seemed less inclined to make comment when participating in the study, with far fewer comments overall being recorded. In print, many general population participants commented that Bold stood out more and created “more distinct” items, rather than indicating “more fluid content”. Another participant also recognized the need for headings to not be so distinct or obtrusive that they interrupt the flow of reading; this positive perspective on Spacing was that it provided better flow than Capitalisation, which interrupted the page and flow of reading too much. Several participants felt that Spacing alone was not enough to indicate a heading as it may be mistaken for a single line paragraph, “When there’s a gap I don’t think of it as a heading”. One participant in the general population commented on their preference for both Bold and Spacing, which was against the trend of the general population, but aligns with the designers’ choices. Other participants liked Spacing in some situations and not others.

The graphic designers’ comments on Spacing reflected practical considerations; analysis by one participant suggested that light conditions might dictate which is better, in low light conditions space might be more effective than methods such as Bold. One participant commented that he liked both Bold and Spacing and felt they were both important and this was brought to his consciousness when seeing the two compared.

5. Discussion

This section discusses the results of the paired comparison study conducted with graphic designers to understand which styles of heading emphasis they find easiest to identify in a passage of text. The results from this study are compared to those of a previous study undertaken with a general population. This study sought to understand if there were differences in the way designers perceive typographic emphasis.

5.1 The General Population Compared to Designers

The relative ease of identification for the graphic designers compared to the general population for each of the heading styles can be seen below in Table 4.

Table 4 Ranking of preference for graphic designers and general population

	Graphic Designers	**General Population**
1	Bold	Bold
2	Spacing	Size
3	Size	Sans Serif
4	Sans Serif	Capitalisation
5	Capitalisation	Spacing
6	Italics	Italics
7	Control	Control

As was the case amongst the general population, Bold was also considered the most easily identifiable of the seven heading styles. In his discussion of Bold as an ideal method for emphasising headings, Tinker (1966) suggests that although designers may prefer or not prefer certain methods of typographic emphasis, these preferences may not always be what is preferred by readers. In this study, bold was preferred by both designers and non-designers, but their second preference differed.

The only change in rank order between the two groups of participants was the placing of Spacing within the ranking, all other heading styles remained in the same order. Spacing moved from being ranked fifth with the general population, to being ranked second with the graphic design participants. The leap in ranking of Spacing is the only distinct difference between the results of the two groups and there was little difference in the preferences between the student participants and the industry participants. Dyson (2014) explains that the ability to recognise differences between typefaces through categorical perception is easier for those who have had training. The importance of interlinear spacing or leading is known by designers. Sufficient leading improves legibility and increases reading speed for readers (Chung 2004; Paterson & Tinker, 1940).

Size was ranked the second most easily identifiable heading style with the general population. Size as a heading emphasis method in Study 1a had greater visual weight than

most other heading styles that were compared, but was not as easily identifiable as Bold for indicating a heading.

As Dyson (2004) explains, no typographic variable can be viewed in isolation and any change in typographic appearance will influence the perception of all other surrounding text.

Spacing was ranked fifth by the general population, but second overall by the graphic designers. Spacing is considered by designers to be an important consideration in typesetting, allowing for ease of reading and definition of relationships between aspects of the text. In contrast, this typographic feature does not seem to be viewed by the general population with the same level of importance when it comes to ease of identification for headings. Comments made by the general population seem to indicate that when Spacing alone is used to indicate a heading to readers, it can be perceived as a paragraph which is a single line of text – it does not create enough visual distinction to be used alone.

The use of Sans Serif gives a greater visual weight without the use of Size or Bold and also uses a change in style to create further difference to the appearance of a heading. This heading emphasis method gives the greatest visual change between the heading and body copy in this study, but does not have the same visual weight as Bold.

Italics was consistently ranked sixth of the seven heading styles in all environments and across all populations, it does not provide sufficient visual weight compared to the body copy text when used alone. The relative ranking of Capitalisation changed considerably between environments and populations. With the general population, it was ranked fourth, in comparison, it was ranked fifth by the graphic design participants.

Calculations were made to understand how consistent the responses were for the paired comparison study. In a paired comparison study, the choices made by an individual participant may not always be consistent, the degree of consistency within a participant's choices can be calculated as a coefficient of consistence (Kendall, 1970).

The lowest coefficient of consistence score for a designer was 0.5 with all but six (15%) having a coefficient of consistence of 0.7 or higher. Three designers (7.5%) had a coefficient of consistence of 1, meaning that they were completely consistent across all of their choices to create a perfect ranking of the seven heading styles. For the 40 graphic design participants, the average coefficient of consistence was 0.804. The lower number of neutral choices made by the designers in this study is also reflected in the higher coefficient of consistence calculated for this group.

In the general population, 96% of participants had a coefficient of consistence of 0.5 or higher. All of the design participants had a coefficient of consistence of 0.5 or higher. Therefore, with the graphic design participants, as with the general population, the choices made were unlikely to be made at random, despite not exhibiting perfect consistency.

The Coefficient of Agreement, defined by Kendall (1970), is used to help understand the degree of agreement between participants' in a paired comparison, as even if several participants have a coefficient of consistence of 1, they may still not agree on the order of

their choices. The coefficient of agreement for the designers (0.335) was higher than that for the general population (0.294). This means that there was greater agreement between the paired comparison choices of the designers than in the general population. Greater agreement does not necessarily mean a higher level of consistency; there can still be a high level of agreement between inconsistent responses.

5.2 The Importance of Spacing

Spacing was considered by the designers to be the method of typographic emphasis giving the second greatest ease of identification, after bold. A comparison of these two heading styles is shown in Figure 5.



Figure 5 Comparison of 'Bold' and 'Spacing' headings used.

The reason for graphic designers viewing Spacing so differently to the general population is likely due to the use of space as a method for creating emphasis and indicating headings; graphic designers are therefore more attuned to the semantic associations that spacing can indicate. The general consensus among typographers regarding the use of spacing for headings is that there should be more space above a heading than below so that the heading is closer to the text it directly refers to and creates a semantic relationship (Mitchell & Wightman, 2005; Twyman, 1981; Williams & Spyridakis, 1992).

The gestalt principle of proximity is a key idea in regard to visual organisation and grouping of information. The proximity of two objects influences the perceived relationship of those objects and can assist with creating emphasis in combination with other visual organisation or gestalt grouping laws (Wallschlaeger & Busic-Snyder, 1992). To make something that is important stand out from surrounding objects it can be placed away from the content surrounding it (White, 2002). Objects that are placed closer together are viewed as being more closely related to each other and those that are further apart are viewed as less closely related (Wallschlaeger & Busic-Snyder, 1992).

Bringhurst (2004) discusses the importance of spacing in the typographic layout of headings and provides recommendations for the effective use of space when defining a heading style of hierarchy of headings. These recommendations include ensuring that any additional spacing is in multiples of the leading of the text. However, he does not recommend the use of Spacing as the sole indicator for a heading in text.

The use of spacing to create hierarchy adheres to the general principles of sematic association, that an object will have a closer relationship to the items it is placed most closely to (Wallschlaeger & Busic-Snyder, 1992). Bringhurst (2004) discusses the importance of spacing in the typographic layout of headings and provides recommendations for the effective use of space when defining a heading style of hierarchy of headings. These recommendations include ensuring that any additional spacing is in multiples of the leading of the text. However, he does not recommend the use of Spacing as the sole indicator for a heading in text.

Design education and an assumed better understanding of typography was shown to mean that participants are more certain about their choices regarding identification of headings and choices that are more consistent than the general population. This was reflected in the consistency of choices made by the designers, both within the 21 choices that each individual made, and across the pool of participants. The Coefficient of Consistence scores were on average far higher in the group of graphic design participants, then the general population. Likewise, the Coefficient of Agreement for the graphic design participants was closer to 1, and perfect agreement than the general population.

5.2 Neutral Choices

In this study the graphic design participants made fewer neutral choices than the general population did in the previous study, with the graphic designers making almost half as many neutral choices as the general population when posed with the same decisions. The smaller proportion of neutral choices could be attributed to the designers being more aware of the stylistic changes in typographic appearance and more attuned to subtle design changes based on their education and industry experience.

In the general population, pairings that included the Sans Serif heading style had the highest proportion of neutral choices made regarding them. However, amongst the graphic design participants pairings containing the Italic heading style had more neutral choices for them (10) than pairings with a Sans Serif heading style (9). The Sans Serif/Italic pairing had the greatest number of neutral choices for it (3). With a low number of neutral choices across just 40 participants, it is hard to draw any strong conclusions from those pairings or heading styles that had more neutral choices than others.

There were several pairings where no neutral choices were made, indicating that participants were more certain about the choices they were making about these pairings. No neutral choices were made in four of the six pairings with the Control heading style as well as with Sans Serif/Italic, Spacing/Sans Serif and Spacing/Capitalisation. These were not necessarily the pairings in the general population that had the fewest neutral choices. This also resulted in just two neutral choices being made for pairings with the Control heading style. Combined with the Control only having a total of 17 choices for it in all pairings this indicates that designers were certain about the Control heading style not providing satisfactory typographic emphasis to provide ease of identification for the heading.

5.3 Limitations of the Study

The population of designers surveyed was smaller than that of the previous study with the general population and therefore the smaller sample size may mean that despite the demographic parameters of the two groups being similar, the results are not as easily compared to the general population. The selection of the population of graphic designers for the study could also have been refined to limit the number of students and focusing on only recruiting participants who had a minimum of three years of graphic design education or more than a year of industry experience. This may have produced more distinct differences between the two groups of participants., however, the results from this study showed that the differences in responses between the two groups of designers varied little.

6. Conclusion

This paper reported on the results of the paired comparison study comparing the preferences for heading emphasis methods of a group of graphic designers with a general population. The purpose of this study was to understand if those with knowledge and experience in design find the same heading styles easiest to identify. With this different group of participants, Bold, was found to be the heading style that was most easily identified within a passage of text, as was also the case with the general population. The heading style that was second easiest to identify with this group of participants was Spacing, which differed to the general population. It is anticipated that the medium of reading may have an influence on the perception and identification of the headings within the text. It is intended that future studies will investigate the differences in ease of heading identification between print and screen.

The results of the study into graphic designers' preference for heading emphasis methods, show that designers understand typographic hierarchy differently. Overall, they ranked Bold as the easiest heading emphasis method to identify, but their perception of Spacing, ranked second, compared to fifth in the general population, means that their perception of headings is different to that of the general population. Therefore, designers need to be conscious when typesetting that those they are designing for may not perceive the typographic hierarchy in the same way as they do.

These findings imply that bold is a heading emphasis method that should be given preference when choosing how headings should appear within a text. However, the use of space should be used in such a way that it is not the sole distinguishing factor for discriminating an important typographic feature such as a heading. Designers should consider combing the use of spacing for emphasis of a heading with a second variation in the typographic appearance to help ensure that readers are more likely to identify the heading text easily. The combining of two heading emphasis methods should be considered in future studies.

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Toward Deeper Understandings of the Cognitive Role of Visual Metaphors in Emerging Media Art Practices

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Abstract: In this paper, we explored the role and impact of a visual metaphor and the metaphoric-thinking process in emerging media art practices. We also examined how designers can leverage the metaphoric-thinking process to empirically create a visual metaphor. Our primary focus was to explore what kinds of design considerations are involved and what types of cognitive operations are performed to support designers as they create visual metaphors. By employing a critical analysis method, we probe how participants used metaphors to leverage their prior knowledge, expertise and experience when creating visual metaphors from an information-processing perspective using a cognitive task analysis method.

Keywords: visual metaphor; design process; emerging media art; critical task analysis

1. Introduction

Throughout history metaphors have made significant contributions to expanding our range of thinking. Using the associations between the source and target domains, metaphors enable rich expressions of arts and culture, from literature, painting, and music to user interface design. Indeed, metaphors enable us to integrate disparate entities and bring new perspectives into existence by way of "understanding and experiencing one kind of thing in terms of another."

In the field of visual arts, from traditional painting to the emerging media arts, visual metaphors have been widely used as a means of allegorical, iconic, symbolic, or sign expression. Visual metaphors are also considered as a framework to identify and analyze the underlying structures and intentions of the artwork. Creating visual metaphors is about mapping abstract concepts to visual, experiential elements with their own cognitive percepts; as new insights emerge, deeper levels of meaning are tapped as shown in Figure 1.

Leveraging such unique characteristics, artists and designers have used visual metaphors to produce creative and aesthetic solutions to design problems. According to Casakin (2011),

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designers use visual metaphors in the design process for various reasons: 1) to identify, frame, and solve design problems, 2) to justify design decisions, 3) to develop products that resonate with users, and 4) to render the values and meanings they wish to assign to the design outcome.

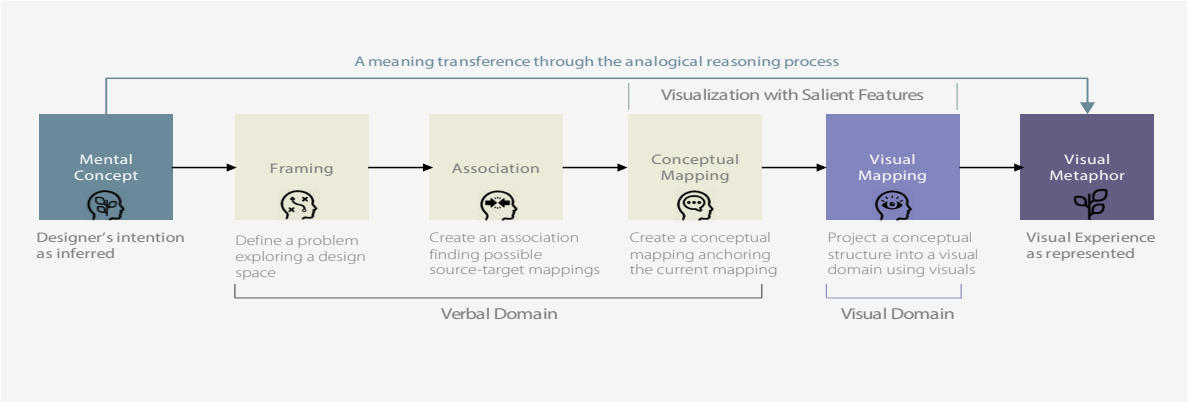

Figure 1 A meaning transference through the metaphorical reasoning process

Recent studies in related disciplines have created new methods for studying and exploring the potential of visual metaphors. Researchers have investigated the roles and impacts of visual metaphors in relation to visual art (Aldrich, 1968; Feinstein, 1985; Kennedy, 2008), architecture (Casakin, 2011), gestures (Cienki & Müller, 2008), cartoons (Forceville, 2005), cinema (Carroll, 1996), advertisements (Forceville, 2002; Phillips & McQuarrie, 2004), interface and software design (Blackwell, 2006; Fishkin, 2004; Hurtienne & Blessing, 2008), information visualization (Ziemkiewicz & Kosara, 2008), and visualization as art (Cox, 2006).

Nevertheless, the focal point of previous studies was geared toward metaphoric expressions and the differences in graphical elements at the presentation level rather than understanding the roles and influences of visual metaphors in the design process. Also, previous investigations did not provide sufficient explanations regarding what design considerations were involved and what types of cognitive operations were performed to support the visual metaphor creation process. Investigating visual metaphors in the field of design is a challenging problem because metaphors are mainly discussed in the context of language.

Thus far, only a few researchers have proposed structured means to incorporate metaphor in design research (Cupchik, 2003; Forceville, Hekkert, & Tan, 2006; Hey et al., 2008; Krippendorff & Butter, 2008; Van Rompay, 2008). However, none of these studies provided a thorough analysis including the visual metaphor's characteristics and the particular type of thought process that generates with a focal point of visual design to see whether the metaphor and metaphoric thinking will play a pivotal role in the creation of emerging media arts.

With these motivations in mind, our goal was to understand the roles and impacts of visual metaphors in the design process. To the best of our knowledge, previous studies did not examine what kind of design considerations were involved when participants created visual

metaphors, nor did they examine how participants with different backgrounds can seek different benefits and values through metaphor.

In this study, we will examine how our participants used metaphors to leverage prior knowledge, expertise and experience while creating a visual metaphor adopting an information processing perspective. A cognitive task analysis (CTA) method was applied with a retrospective verbalization method to analyze the participants' tacit knowledge and cognitive operations involved in the process.

2. Background Related Work

In this section, we will review various research perspectives in metaphoric-thinking process that are heavily influenced the theory of conceptual metaphors and the recent advancements in visual metaphor research to build a theoretical foundation for our user studies. We will address how and why there has been significant gap between conceptual metaphor theory research and its application to the visual domain. Also, we will also discuss the working definition of a visual metaphor and its characteristics.

2.1 Interdisciplinary Approach on Metaphor Research

As Gibbs Jr (2008) pointed out, metaphor research becomes multidisciplinary and interdisciplinary as any topic being studied based on the conceptual metaphor theory. Researchers in the various fields of study investigate the functions and meanings of metaphor. In this section, we will discuss a multifaceted metaphor research that is related to our research context. For example,

Metaphors in Information Processing

Gentner (1983) claims that metaphors enable the reflection and communication of complex topics and the anticipation of new situations, but also affect further perception, interpretation of experiences. Therefore we consider that metaphors an important matter for information process not only for its instrumental value for self-reflection and communication but also an important function as mind settings, which influence our cognition of the self and the world as Ottati et al. (1999) suggested.

Metaphors as Reliable and Accessible Measurement to Tacit Knowledge

Sternberg (1999) reported that on tacit knowledge and tacit expertise, not only the representation but also the accessibility of tacit knowledge is an important issue. As metaphors are a linguistic manifestation of tacit knowledge, which is easily accessible because metaphorical expressions cannot be avoided in everyday or professional language, it can be used as reliability measurement to psychological studies.

Metaphors as Holistic Representations of Knowledge

Metaphors can be a representation of complex knowledge and analogical problem-solving. Compared to propositional representations, mental models and metaphors can be a more

holistic representation of understanding and knowledge as Schnotz (1988) noted. By investigating on one's metaphoric expressions, we can understand how one understands his or her present situation, but also indicates a more general understanding of his/her situation to know about which problem-solving skill is preferred more than others.

Combining Quantitative and Qualitative Approaches to Metaphor Research

While the quantitative analysis of metaphors reveals general tendencies in metaphor use, the full potential of metaphor analysis can only be reached when combining it with a qualitative approach according to Moser (1999). He suggested that the qualitative approach enables the analysis of metaphor use in context and understanding the function of metaphorical expressions. The combination of qualitative metaphor analysis with content analysis and narrative text analysis proved to be especially productive for the understanding of situational, biographical and social functions of metaphor use.

2.2 Visual Metaphor Research

For this study, we consider a visual metaphor is a visual representation of a metaphor that reflects an artist or a designer's mental image as our working-definition. In more detail, a visual metaphor is non-verbal, a visual manifestation of metaphorical thought, where one or both domains of the metaphor are rendered with various visual elements. With this difference, especially in the related field of visualization, researchers or practitioners have faced significant challenges in developing appropriate and comprehensible modes of abstracting and representing complex information in order to have deepened our understanding of how metaphors shape information and how different visual elements can influence our comprehension in the field of information visualization.

Carroll et al. (1988), who pioneered the field of user-interface design, proposed a systemic, five-stage methodology for developing user-interface metaphors. Before proposing this five-stage framework, the authors identified three distinct cognitive stages of metaphorical reasoning: instantiation, elaboration, and consolidation. The authors were concerned with the tension between metaphorical representation based on the real world and computer functionality as well as the mental model gap between the users and designers.

Cox (2006), who coined the term, "visaphor," explored the possibility of using a visual metaphor to visualize complex, high-dimensional data with an artistic eye. The author claimed that there is a direct relationship between data visualization and the cognitive, creative-mapping process but emphasized that the relationship cannot be formulated in a one-to-one or arbitrary manner. The author also used the term "concept network," which includes various sociocultural values, such as beliefs, concepts, symbols, cultural biases, assumptions, and personal impressions.

Casakin (2006) also considered metaphors to be powerful problem-solving tools for dealing with design tasks in terms of architectural design. Because metaphors enable structural alignments between the design problem and other domains that eventually serve as an

inspiration to designers, the author suggested that the use of metaphors in problem-solving can be characterized by the following: (1) the retrieval and interpretation of a concept, (2) the mapping and transference of a new relationships, and (3) the application of new relationships to generate and develop a design solution. The idea of reorganizing the framework from a design-thinking perspective was heavily inspired by this approach. Ziemkiewicz and Kosara (2010) considered metaphors as "a set of structural properties that provide a framework for meaning." Based on this, they developed various design strategies to use such structural properties to aid the user's understanding of visualized information. The results of their empirical study suggest that the nature of information visualization can rely on the visual metaphors it uses to structure information.

3. User Studies

In this section, we explore the cognitive processes of artists and designers while they create visual metaphors, through a cognitive task analysis method. From a conceptual, intermediate, and surface level, we identified what kind of design considerations were involved while our participants were materializing the significance of metaphoric expressions to achieve their design goals. We also address how participants' backgrounds could lead them to seek different benefits and values during the creation of metaphor.

3.1 Methods

In this study, we examined how our participants used metaphors to leverage prior knowledge, expertise and experience while creating a visual metaphor adopting an information-processing perspective. A cognitive task analysis (CTA) method was applied with a retrospective verbalization method to analyze the participants' tacit knowledge and cognitive operations involved in the process.

With this in mind, all interview sessions were analyzed and verbal protocols transcribed and segmented for coding according to our coding schemes using the principles of protocol analysis suggested by Suwa and Tversky (1997) and Gero and Mc Neill (1998). In every interview session, we assumed that practitioners had more stories and design rationale than they have could represent in their works. It means that we were not just focused on the knowledge exhibited in a piece of artwork explicitly, as the final outcome, but also the tacit knowledge used in its creation.

For an observation approach, usually a talk-aloud/think-aloud method is used, meaning individuals are asked to say out loud what they are thinking, as Ericsson (2006) noted. Similar approaches have been applied to examine designers' activities and intents, demonstrating their suitability for this study's purpose (Casakin (2011, 2006); Kavakli and Gero (2002); Lu and Liu (2011)).

3.2 Participants and Procedure

For this study, we recruited six experts highly respected in the field of emerging media

(two females and four males). They had a mean of 9.17 years (range was 5-18 years) of professional experience in their fields. Four of the participants had a Ph.D. in a field related to emerging media arts, such as a doctorate of design, media arts and technology, and one of the four had a Ph.D. in mechanical and aerospace engineering. The sixth had an MFA in interaction design as shown in Table 1. Please note that we removed their names, gender and current positions, as some of our participants wanted to remain anonymous.

Table 1 Brief participants' profiles.

	Research Interests	**Background**	**Experiences in the related field**
P1	New Media Design	Interaction Design	5 years with a Ph.D. in Media Arts and Technology
P2	Information visualization	Interaction Design	5 years with a Ph.D. in Computer Science
P3	Interaction Design	Visual Arts	10 years with a Ph.D. in Media Arts
P4	Interaction Design	Visual Arts	18 years with a M.S. in Media Arts and Sciences
P5	Human-Computer Interaction	Machine Learning	5 years with a M.F.A. in Computational Arts
P6	New Media Design	Interactive Robotics	12 years with a Ph.D. in Mechanical and Aerospace Engineering

Each interview was conducted via Skype, as our participants were scattered all over the world. Five of the interview sessions were conducted in Korean and translated into English, whereas only one interview was conducted in English, which was the participant's mother tongue. The sessions were audio-recorded.

The protocol involved three phases. In the warm-up phase, we explained the procedure of the experiment, and participants were trained in the practice of retrospection; this took 10-15 minutes. After, in the semi-structured interview phase, participants were asked to recall the design process of a specific work of their choosing and answer various questions based on our survey design; this took 60-80 minutes. In the final phase, we conducted follow-up interviews in which we asked about the potential benefits of using a visual metaphor to achieve a design goal, and here we used a five-point Likert scale to record responses.

We also asked participants to describe their typical design process, focusing on its relative length, the order of tasks and the number of attempts to use a metaphor, if any; the final phase took 15-20 minutes. During the early phase of the interview, we did not mention the word that is related to a metaphor or visual metaphor in order to minimize possible interviewer-interventions, as well as to remain as neutral as possible so that they can recall their own design process as natural as it can be. After the interview, we collected the recorded audio and transcribed it to investigate participants' visual-metaphor creation process according to our coding scheme described in Tables 2 and 3.

3.3 Development of Coding Scheme

We have developed three coding schemes that allow us a further analysis organize designers' intentions into certain categories. according to our coding scheme. Our coding scheme comprised three categories: (1) design considerations, (2) cognitive operations in a visual metaphor creation process, and (3) potential benefits of using a visual metaphor. The design-consideration category was developed and refined based on the Carole et al. (2009)'s Kansei Information Processing protocol.

The cognitive operation scheme was based on the work of Finke et al. (1992), as their empirical studies of creative-idea generation demonstrated how conceptual structures that give rise to imaginative thinking are revealed. In more detail, five categories and their definitions were developed based on association Finke et al. (1992): decision-making Lu and Liu (2011), perceptual action Suwa and Tversky (1997), transformation Finke et al. (1992) and questioning Casakin (2006) as described in Table 2.

Table 2 Coding scheme for cognitive operations

Category Label	Description	Examples
Association	Find similarity/difference between domains or explore possible combinations to create a proper conceptual network	**P1***: We treat the distinct visual features of fingerprints as an open musical score whose performance can be executed in diverse ways* **P2**: *What the audience sees is a kind of memory of her through the lights so that was a conceptual inspiration* **P5**: *Your likeness is appeared to be white flakes of snow*
Decision Making	Select or not select one option over another with rationale and evaluate ideas according to the design information, or artistic motif	**P1**: *This tended to create a very limited range of output timbres even though .... In order to broaden the diversity of timbre, we employed FM synthesis* **P2**: *I started trying to apply logic as to what is it that I like about this and try and shape it towards something that I like ...*
Perceptual Action	Create, modify and refine visual elements and information to achieve the visual concept	**P5**: *... starts to become a shape and things like that and that creates something that we haven't really thought of in the first place ...*

Transformation	Transform abstract ideas into visual elements with or without a functionality for the work to be more interesting, engaging and useful such as new value and analogy	**P1**: *Finding their own sound identities through the fingerprints gives a unique experience to the audience.* **P4**: *it's kind of a digital body and thinking about how what it means to have a body in the digital space and how it can be copied and pasted just like regular digital data*
Questioning (Reflection)	Inquiry about the concept and methods that are related with dealing with emerging issues	**P3**: *I pondered hard on what should be the most natural material to use at that time ... What makes our work more unique?*

Remaining responses, such as short pauses or vocal expressions that did not agree with any of the main categories, were recorded in a miscellaneous category. This category was small relative to the others. Please note that we are aware these operations can happen in a non-linear fashion, and a strict line between categories was not always possible because some operations happened concurrently. We attempted to build a coding scheme that helped us better understand how different cognitive processes and considerations happened in the different phases in our participants' design process.

Our coding schemes have been developed over time as shown in Appendix A. With the guidance from Saldaña (2015), we started to explain the reality of our data, the interview scripts, and aim to progress toward a more thematic, conceptual, and theoretical direction, from the top to the bottom in the diagram.

In the first iteration, we focused on building some vocabularies and categories that allow us to describe various design activities. To develop an initial coding scheme, we adopted three themes that are considered as core principles underpin visual design any designer create such as Visual grammar, Visual syntax, and Sensation. The category of visual grammar and visual syntax has adopted the concept of Dondis (1974)'s work that provides the basic building blocks that are essentially required and used for visual communication.

In addition to the first two categories, we added the sensation category, which is closely associated with the image schema or a primary metaphor, because we, as designers, empirically understand that using imagined physical sensations can help us to make the visualization vivid and realistic. We also expected that our participants would use lots of vocabularies related to this category as the conceptual theory emphasizes the importance of embodiment as well as an experiential basis in a metaphor. However, as the interview process went further, we realized that the three categories in the first iteration were not appropriate to capture various aspects in the design process. It means that each category and element was precise enough to describe a certain behavior.

In the second iteration, we went in the direction of building more generalized categories,

as we were inspired by other approaches such as that of Grady (2005) and Ortiz (2011), who mostly focused on primary metaphor and the multimodal quality of a metaphor. We expected that we could better capture the participants' design considerations from a macroscopic perspective than the previous iteration.

For example, we identified concrete dimensions such as form, color, texture, and patterns, and procedures, as these elements can be explicitly presented. We also decided to create a function category since we expect it would help us describe some aspects of interactivity. For the abstract dimension, we added various categories that can be presented implicitly such as values, semantic descriptions, emotions, and considerations for users/audience and their contexts. We applied the categories derived from the second iteration to the interview scripts as explained in Table 3.

Table 3 Coding scheme for design considerations

Category Label	Description	Examples
Conceptual Level		
Analogy	Words that are closely related to a metaphorical process including inspirations, conceptual references	Like a funhouse mirror; as if we were in the ocean;
Semantic Descriptors	Words that are related to color, form, or texture of an object, but also can represent a personal impression or attitude	cheerful, welcoming, talkative, soft
Style	Words that represents specific characteristics of an object or mood	classic, futuristic, fluid, cool
Values	Words that represent behavioral values or socio-cultural values	freedom, defamiliarization, fulfilling, rewarding, strange
Intermediate Level		
Context	Some circumstances that form the setting for an event such as time, place, environment of the product use	morning, at night, at the gallery, in the dark
Function	Technical solutions or properties that operate as intended	computer vision, recognition, frequency analysis
Structure	Words that describe how all visual elements can and should go together for the best results	harmony, emphasis, hierarchy, balance, gestalt
Surface Level		
Color	Basic element of light that help convey emotions in and add variety and value	green, red, golden, shiny, matte
Form	Words that describe visible contour or some quality that encloses a volume or three dimensional area	rounded, open, symmetrical

Texture	Words that describe patterns, material and touch of a surface	bright, rough, smooth, woody

4. Results

Based on the coding schemes, we identified what kind of design considerations were involved in our participants' creation of a visual metaphor. The results are reported using three levels of design-information analysis: a conceptual, an intermediate and a surface level. The first level presents the basic design tasks and considerations that participants reported in their process. The second level is a type of common component analysis that shows what types of cognitive operations were performed to support design activities; in this case, the cognitive operation was association.

4.1 Design Considerations Involved in Visual Metaphor Creation

Figure 2 shows the distribution of keywords related to design considerations. The analysis suggested that conceptual keywords were used most frequently (45.4%), while intermediate level and surface level keywords were observed 37.3% and 17.3% of the time, respectively. Therefore, the conceptual level activities, such as values, analogy, semantic descriptions and style, were the most dominant during the design process.

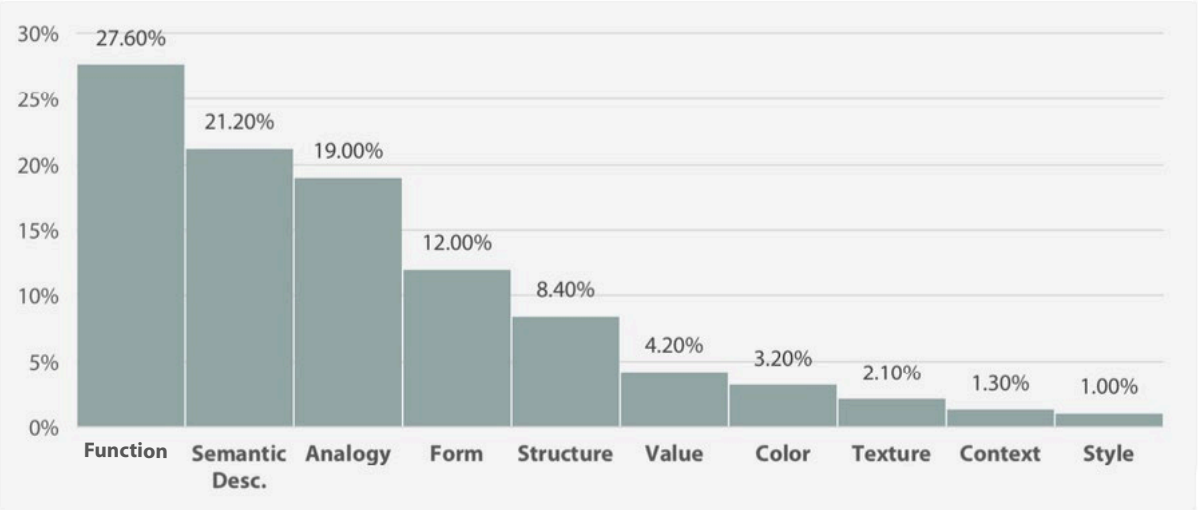

Figure 2 Distribution of words observed within the categories of design considerations

From a microscopic perspective, activities related to function (27.6%) were used the most to describe technical solutions or properties that helped participants shape their work as intended. For example, the following technical terms representing a specific functionality were observed: "computer vision," "recognition" or "frequency analysis."

Semantic description (21.2%) followed in frequency. This category is related to the color, form or texture of an object, as well the participant's personal impression of the object. For example, "blueish," "darky," "hairline" or adjectives that described forming and shaping were

often observed.

The third category examined analogy (19.0%). This category is related to a metaphorical process that included inspirations and conceptual references. One of the participants described a possible “audio- and visual-like composition” as a “fingerprint.” Another used a metaphoric expression to describe the impression of visual elements, saying they appeared as “white flakes of snow.”

The fourth and fifth most-observed categories were form (12.0%) and structure (8.4%), and they were ranked as surface level. The remaining categories were mentioned relatively less frequently: value (4.2%), color (3.2%), texture (2.1%), context (1.3%) and style (1%).

4.2 Cognitive Operations Performed in Visual Metaphor Creation

Figure 3 shows the distribution of different cognitive operations performed in the design process. On average, associations accounted for 44.9% of all cognitive operations observed; decision-making accounted for 18.0%; perceptual action, transformation and questioning accounted for 12.9%, 12.1% and 9.7% respectively. As an association is a cognitive operation performed to find similarities or differences between domains or explore possible combinations to create a proper conceptual network, it is reasonable that we observed association-related operations the most. For example, one participant said her work offers her audience a memory of her revealed by partial lighting, while another described a visual structure as a likeness created by tiny flakes of what appear to be snow.

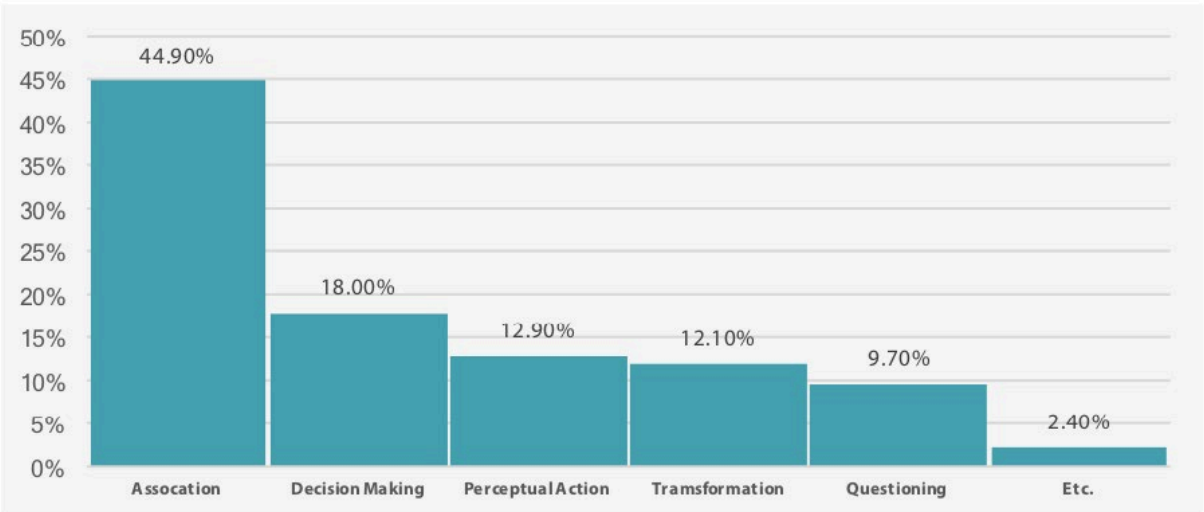

Figure 3 Distribution of words observed in the categories of cognitive operations

Since operations related to making an association should come before a design task is begun, decision-making was observed as the second most frequent cognitive operation. Perceptual actions and transformation were less frequently observed, as participants were more focused on operations to create and refine visual elements.

It is also considered a reasonable consequence because the focal point of our semi-

structured interview was to search for any cognitive operations performed in support of visual-metaphor creation, rather than the creation of other forms of design, such as graphic design, interface design or generative design. In addition, it is possible that interviewees answered with metaphorical expressions, as our questions were open-ended and required they retrieve and recall all related tasks and rationales after the activity was complete.

Since we observed that association was frequently used to describe elements of the process belonging to another category, a more detailed analysis was conducted within the category of association, as shown in Figure 4. Similar to the results of the design consideration category, 35% of responses within the association category were related to describing a function that represented the intent of the visual metaphor; 19.82 % responses were related to the structure that represented how the visual elements were organized; 16.26 % accounted for the form category that represented visible qualities, such as rounded, open or symmetrical. Color (12.03 %) and texture (12.03 %) were considered another category used frequently to make associations. Only 8.02% of the words were related to the style category. This may be because words describing or explaining styles can be quite literal and self-explanatory in this study.

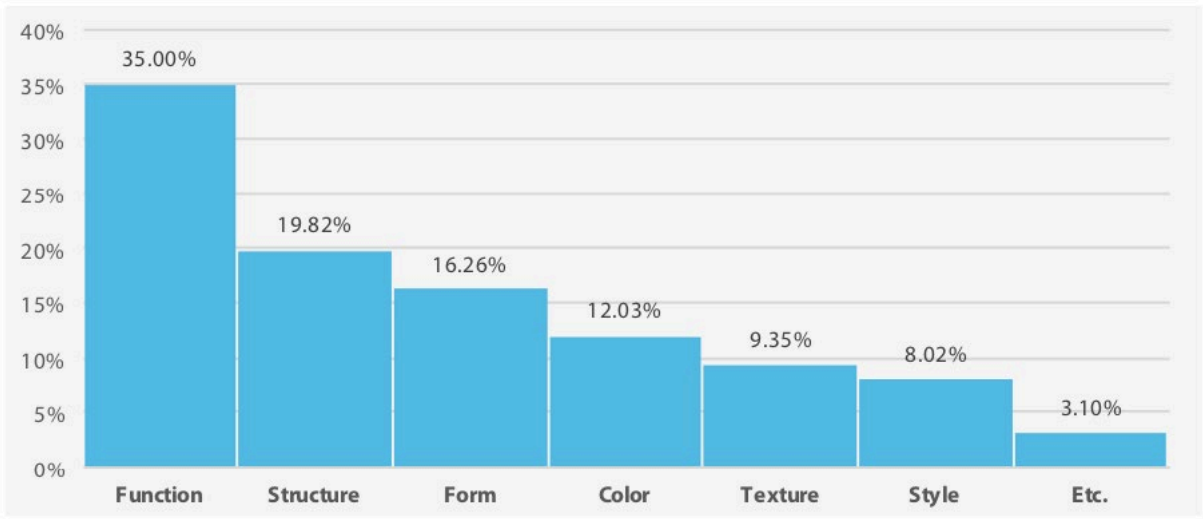

Figure 4 Distribution of words observed within the categories of association

5. Discussion

As the conceptual-metaphor theory suggests, metaphoric thinking is a fundamental cognitive mechanism in the human brain. From this point of view, we understand that a design researcher or practitioner, whether consciously or subconsciously, draws from previous experience or knowledge to solve problems, and they use implicit, tacit and experiential knowledge to accomplish this, as argued by Bang (2009), Lawson (1979), Stolterman (2008). Findings from the CTA and coding-scheme analysis extend our understanding of the role and impact of a visual metaphor and metaphoric thinking in one's design process; they also explain how one can leverage metaphoric thinking in empirically solving a design problem

especially in the field of emerging media arts.

One of our study's most important findings is the systematic analysis of a visual-metaphor creation process based on empirical evidence. This analysis deepens our general understanding of what kinds of design considerations and activities are involved when artists create visual metaphors. As previous research results, both in theoretical works and empirical works, suggests, the entire visual-metaphor creation process can be considered as a design process that involves various design considerations and activities in order to build a logical map leading from a verbal domain (more abstract) to a visual domain (more concrete). During this process, one can leverage a metaphorical thinking process, association in this case, or information that is acquired in the early stage of his or her design process to reduce abstraction and clarify constraints, as noted by Bonnardel and Marmèche (2005).

As Figure 2 suggests, our participants extracted various conceptual properties from a metaphor, such as semantic description, analogy and value. They used such information to develop their concept. The surface-level properties, such as form or color, were more frequently used to transform their abstract concept into a visual element, whereas function was the only property that was observed frequently at the intermediate level. This suggests that a visual metaphor and the thinking that created it can be seen as a source of inspiration and knowledge influencing one's design process from the conceptual level to the surface.

In addition, two distinctive operations were observed in cognitive operations that supported visual-metaphor design activities: association accounted for 44.9%, whereas decision-making accounted for 18.0%. Association is a cognitive operation needed to find similarities and differences between domains or to explore possible combinations to create a proper conceptual network. It predicts the presence of association-related operations more than any other; the results proved that an artist relies considerably on association throughout the design process.

Furthermore, association plays an important role in supporting other design considerations and activities, either indirectly or metaphorically. To acquire an in-depth understanding of which categories are supported by association, we conducted further analysis within the categories of association, as Figure 2 demonstrates. The results show that properties such as function and structure were most used in the intermediate level.

Form and color on the surface level were also supported by association. The results suggest that participants drew inspiration from a visual metaphor as it allowed them to describe a specific function or structure intuitively. However, we did not find any evidence that one can consider an order between two properties such as function-structure or structure-form.

6. Conclusion

We explored the role and impact of a visual metaphor and the metaphoric-thinking process in design. We also examined how designers can leverage the metaphoric-thinking process to empirically create a visual metaphor. Our primary focus was to explore what kinds of design

considerations are involved and what types of cognitive operations are performed to support designers as they create visual metaphors. By employing a CTA and qualitative research approach, we explored how participants used metaphors to leverage their prior knowledge, expertise and experience when creating visual metaphors from an information-processing perspective.

We successfully explored the visual metaphor creation process by analyzing different participants' design processes through the retrospective verbalization method. For this purpose, we created coding schemes to identify what kinds of design considerations were needed and what cognitive operations were relevant. Our empirical studies clearly demonstrated the kinds of design considerations and activities involved when artists create visual metaphors; their design processes were significantly influenced by metaphorical thinking. For example, our participants extracted the various conceptual properties of a metaphor from a conceptual, intermediate and surface level.

A limitation of the current experiment is that five of our interviews were conducted in Korean and translated into English. Therefore, it is possible cultural differences may not have been fully accounted for. Analysis of these variables may prove interesting with a larger pool of designers. The current study does not focus on the differences between experts and novices, unlike other formal experiments that adopted a CTA. These factors and related questions are certainly deserving of further study.

Validation of the roles, impacts and potential benefits of a metaphor, a better understanding of what causes it, and ways to leverage such characteristics in the creation of visual metaphors will help lay the foundation for future visual-metaphor research and artistic practice especially in the field of emerging media arts. Continued exploration of the implications and nuances of this theory will contribute to the understanding of how and why a metaphor works, whether we use it consciously or subconsciously.

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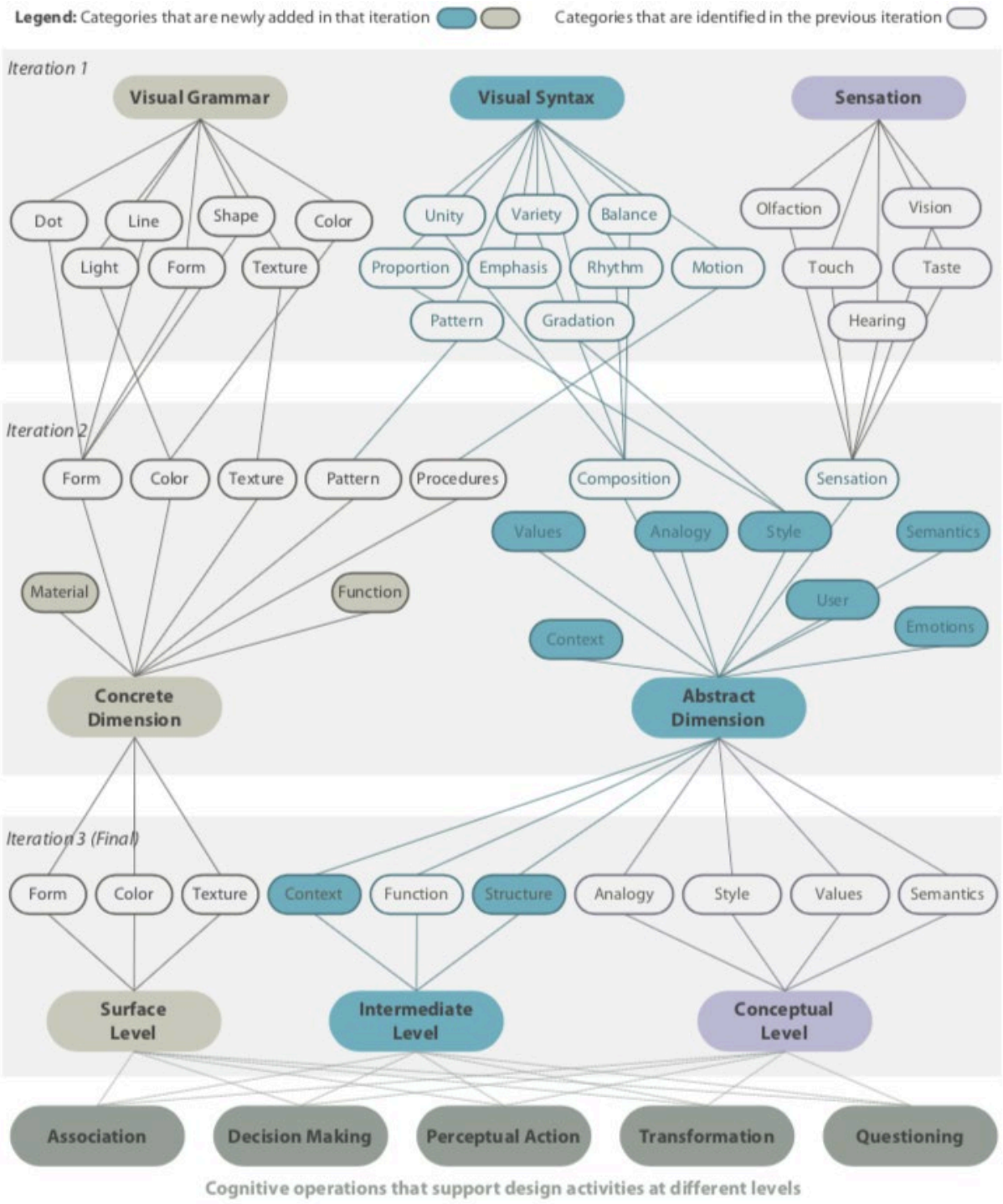
Appendix A: Iterative development process of the coding schemes



Pluriversal Design SIG

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DRS2020
BRISBANE, 11–14 AUG
SYNERGY

Editorial: Pluriversal Design SIG

Dr. Renata M. LEITÃO[a]* and Dr. Lesley-Ann NOEL[b]
Co-conveners of the DRS Pluriversal Design Research Special Interest Group (PluriSIG)

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> The notion of civilizational transition(s) designates the complex movement from dominance of a single, allegedly globalized, model of life – often designated as 'capitalist hetero patriarchal modernity' – to the peaceful, though tense, co-existence of a multiplicity of models, 'a world where many worlds fit', a pluriverse. (Escobar, 2019, p. 121)

What is Pluriversal Design? We believe it is a form of design that aims to nurture and highlight multiple ways of world-making and create conditions for multiple worlds to flourish. The concept of the pluriverse challenges one of the pillars of Western Modernity that is *universalism*—the idea that we all live in a single world—in favor of a multiplicity of possible worlds (Kothari et al. 2019). Since the 16th century, the world's history has been told from the point of view and voices of people from Europe and, subsequently, English-speaking North-America (Global North). Today we see the limits of this form of civilization translated into unsustainability, as multiple crises of climate, pandemics, loss of biodiversity, depletion of natural resources, poverty, etc. The recognition that the crises spring out of this model of civilization fosters a conversation about alternatives and new worlds—e.g., transition initiatives. Furthermore, the call for a pluriverse entails an understanding of the destructive impacts of Western civilization (colonialism, globalization, development, etc.) on the worlds of numerous peoples on Earth. Therefore, an important theme is enabling people who were historically marginalized to tell their own story.

The aim of the Pluriversal Design SIG (PluriSIG) within the DRS is to bring the call for multiple perspectives to design research, practice, and education. The foundations of our field are interwoven with the values of modernity, particularly *universalism*, since design was established as a career path as a result of the Industrial Revolution. Could the practice and theory of design be detached from the values and ideals of modernity and used to create new possibilities? PluriSIG aims to explore the many facets of this challenge.

The papers of our sections present several sub-themes of a Pluriversal design. An important

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sub-theme is the visibility of worlds that are usually invisible in the mainstream design narratives, as the experience of mobility in the daily lives of urban marginalized women residing in New Delhi, India (paper 161). Paper 165 examines queer, trans, and non-binary people's potential contribution in designing for sustainable futures. It suggests that a transition to a new civilization is about "changing our frames so that everyone, including women, queer, trans and indigenous people, can be included while holding onto their difference".

A notably significant sub-theme is the ethics, principles, and practices of collaborations between designers and non-Western communities (papers 228, 277, and 387). Paper 228 interrogates the notion of 'whiteness' in design practice, particularly the issues associated with non-Indigenous designers working with Indigenous peoples. Paper 277 looks into anti-oppression mindsets for collaborative design, recognizing that designers can unintentionally harm the people with whom we collaborate without an awareness of historical privilege and oppression. Paper 387 examines community-based co-design initiatives through an equity lens, recognizing pitfalls of co-design and design thinking approaches and proposing modifications to these frameworks.

By discussing these sub-themes, we hope to contribute not only to the call for a pluriverse but also to the debate about the future of our discipline in a civilizational transition.

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For more information on the Pluriversal Design SIG, please visit the SIG's webpage at https://www.designresearchsociety.org/cpages/sig-pluriversal-design. To find out whether the SIG is organising a satellite event to the DRS2020 conference, or just to get in touch with members and see news on the SIG, please visit the SIG webpage.

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SYNERGY

The context and experience of mobility among urban marginalized women in New Delhi, India

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Abstract: Gender and mobility are two different yet complex themes that intersect to reveal the impact of the latter on practices related to gender. Indian women experience restriction on their movement because of social, cultural and economic issues. In such contexts, the informal modes of transport emerge as bottom-up solutions to fill in the voids left by public transportation system. Transportation is not just a means for geographical mobility but impacts social mobility of women resulting in enhancement of their overall quality of life.
This research takes a descriptive approach to reveal the experience of mobility among urban marginalized women residing in New Delhi, India. The study investigates the issue with the means of reviewing related literature and a pilot study. Ethnography and informal interviews were used as methods of inquiry into the subject. The study revealed significant findings on the social aspects related to the mobility of urban marginalized women.

Keywords: gender; mobility; social mobility; social exclusion

1. Introduction

This research analyses and discusses the results of a study developed to examine the experience of mobility (both, spatial and social) among urban marginalized women residing in New Delhi, India. The research is based on a pilot study supported by in-depth document analysis. The study will be used to identify and understand the experiences of informal transport modes (spatial mobility) on the lives of urban poor women based on their marital status. This understanding will be further used to analyse the social aspects related to spatial mobility of unmarried urban poor women.

The results of the study are analysed and discussed with regard to how the motivations to have a better social status that originate from the desires and aspirations of these young women take a full circle and ultimately give up to the socio-cultural taboos of their closed society. The findings are also discussed from the perspective of the social background of

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the participants and their daily routine. Specifically, the findings and issues are discussed with regard to the abilities possessed by these young women that are enhanced with the availability and accessibility of (informal) transport modes.

2. Context

New Delhi is the capital city of India and is also one of the important developing megacities in the world (Kumar et al., 2014). It is situated in the northern part of India with two other states, namely, Uttar Pradesh (to the east) and Haryana (spanning to the north, west and south) surrounding at its borders. The total area of Delhi is 1486 sq. Km, with 500 sq. Km as the urban area (RITES, 2005). The large number of inflow of migrants into the city initiated the reason of the expansion of Delhi. The city has witnessed rapid urbanization since past few decades like other cities in developing countries. According to the 2011 Delhi city census data, the population of Delhi is 16.3 million and is expected to reach 23 million in 2021 (RITES, 2005). Out of the 16.3 million people residing in Delhi, 46% are female (2011). Due to immense difference in various income levels and social differences in the society, the city is sub-divided into many smaller cities- as 'cities within cities' (Tiwari, 2002).

3. Urban transportation

With the ever-growing population of Delhi, the city lags behind to cater to the existing and growing transportation needs of its people. The rapid urbanization has made Delhi one of the most motorized cities in India (Badami & Haider, 2007). The urban transportation system in Delhi relies mostly on road based transport by means of various vehicles that include cars, trucks, buses, motorcycles, two-wheeler scooters, three-wheeled vehicles (auto-rickshaws and other para-transits), cycle rickshaws, bicycles, animal drawn vehicles and pedestrians (Siemiatycki, 2006; Tiwari, 2002). This resulted in a chaotic situation on roads with all the different vehicles with varying speeds struggling to find the space to move. Private vehicles like cars form major part of road-based transport in Delhi. Shifting land use patterns has been a core reason for increase in the number of private vehicles. Besides this, change in local culture and social structure of Delhi has also led to change in mobility patterns and aspirations of the residents (Siemiatycki, 2006). These inter-related scenarios play a major role in keeping people who belong to a particular social class away from the public bus system.

3.1 Informal Transport

Most of the informal modes of transport in New Delhi (vikrams, gramin sewa etc.) contribute towards time economization and enable passengers with a possibility to access the otherwise inaccessible areas. These informal modes have become an integrated part of the city structure as they contribute towards inter-regional mobility and urbanization. The informal sector generates employment for many marginalized people and hence its contribution towards the economy of the city is not to be ignored (Turdalieva & Edling, 2018). Like other

places of interaction, the informal modes of transport also present themselves as a space for personal and social negotiations. These modes of transport influence the 'day-to-day displacement' (Kaufmann, Bergman, & Joye, 2004) of passengers through the means of spatial difference and identity. According to Kaufmann, mobility helps in creating new identities outside of the immediate societal structure of the individual (Kaufmann, 2017). The existing public transport system in New Delhi, i.e., the 'bus' system for urban poor people, has several problems that make women avoid it as far as possible. These problems include poor frequency, over-crowding and sexual harassment (few men tend to take advantage of over-crowded buses). This forces women to make use of inferior modes of transport (informal modes). Women belonging to the lower-income section of the society hugely depend on these informal modes because they are able to meet their transportation needs that involves challenging and complex travel routines (Turdalieva & Edling, 2018) along with safety as compared to buses.



Figure 1 Informal transport modes - important part of city infrastructure.

4. Urban marginalized women

Similar to any other infrastructure of the city, gender defines the basic structure of the society. Gender in a way lays down set rules of behaviour and action for men and women. The fact that women constitute around 50% of the total population of Delhi draws attention to the potential possessed by women in raising the economic bar of the city. However, gender inequality is visible at different spheres and at different levels in the society. The issue of gender inequality needs attention from three main perspectives, namely, cultural, economic and spatial (Gupta, 2017) (as discussed in sections 4.1 and 4.2).

4.1 Social Exclusion and Contribution to Economic System

Women in India experience several cultural bindings, which result in many kinds of sacrifices, including giving up their independence. Among the many cities of India, Delhi has been tagged as the crime capital with number of crimes against women being the highest. As per the statistics, women in Delhi receive high levels of education and yet are not able to contribute to the employment sector. The reason being that later in the lives, women have to take the burden of several domestic responsibilities that refrains them from pursuing their careers. Moreover, from spatial perspective, the improper infrastructure of the city also acts

as a deterrent (especially for urban marginalized women) with respect to safety that restricts their movement to the interior of the house taking care of domestic responsibilities and self-excluding themselves from taking up employment that involves some mode of travel.

Despite all the programmes focusing towards upliftment and empowerment of Indian women by the Indian government, women in India still have to face discrimination at various levels, starting from class, income, race, ethnicity and also at territorial level (Gupta, 2017). Women belonging to the marginalized group often contribute to the economic stability of the household by taking up daily wage or monthly wage jobs. In order to spend less time in travelling and make-up for other household responsibilities, it is preferred by them to find work in close proximity to their homes. There are unsaid constraints on the mobility of women in India, which also becomes a reason for not being able to contribute to the economic system of the country. Women in India are involved in both, productive and reproductive works. The activities that yield some economic value are termed as 'productive work' whereas 'reproductive work' is concerned with taking care of the household and its members. The scope and nature of reproductive work for women is often ignored and is not stated in the official data and hence remains in the category of unpaid work (Anand & Tiwari, 2006).

Amongst the various groups of women, the most vulnerable are the urban marginalized women. This group of women are marginalized from two perspectives; first, they belong to the low-income social groups and second, that they are women. 'Urban marginalized people' are people whose rights have been violated and those who possess little economic and political powers. Amongst various kinds of discriminations, as mentioned above, the urban marginalized women in Delhi face exclusion which includes right to property and access to various other assets of the household. Urban poor women are often deprived of access to transport, both at family and at city level, as compared to men. For instance, if a household owns a vehicle, like a bicycle or a two-wheeler, general assumption is that it is for the male members of the family. The reason for this exclusion is both cultural and social. Women in Delhi do not ride a two-wheeled vehicle, which could be because of cultural stigma and also safety issues related to women. These exclusions along with their greater share of domestic responsibilities have had significant effect on their travel choices and status (Anand & Tiwari, 2006). The presence of patriarchal system is evident in all spheres of the society, not just in Delhi but also all over India. The patriarchal system is the social phenomenon that puts men in the forefront when it comes to gaining access to various spaces and assets of the household. Even at the city level, the public transportation system of Delhi is designed to cater to the needs of men (Anand & Tiwari, 2006). That is, it is planned for point-to-point travel patterns (from residential hubs to city centre – places of employment – catering mostly to formal sector).

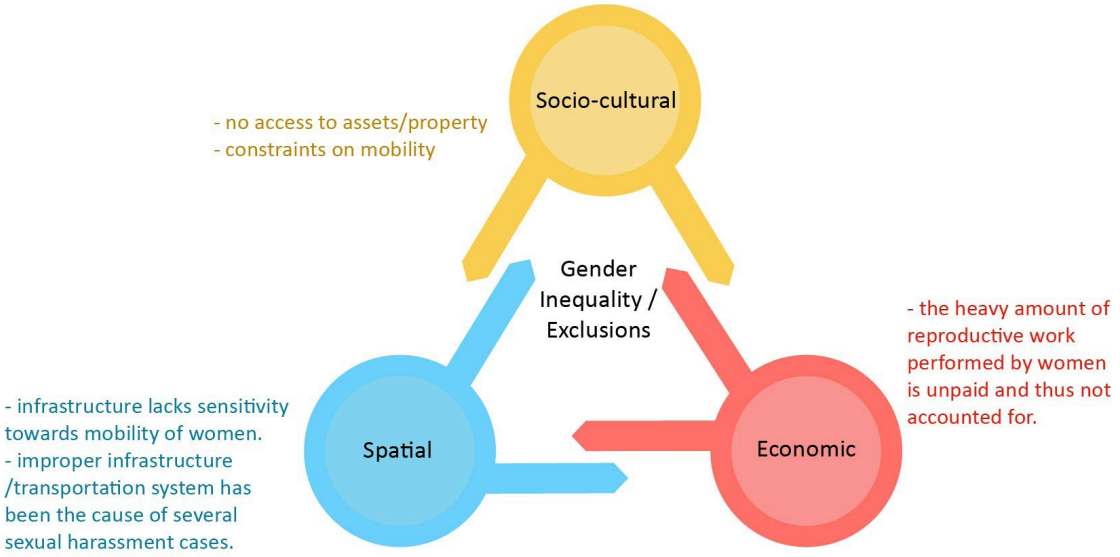

Figure 2 Gender inequality/exclusions - derived from (Gupta, 2017).

The daily routine of working women is quite complicated as compared to men. It involves taking care of all household members' routines and includes a variety of activities that need to take place in a harmonized manner. For women, because of the continuous shift of activities between private and public realms there is a lot of unpredictability of travel time (Jurczyk, 1998). This diversity in the travel pattern of women demands a system that is flexible. This leaves the urban marginalized women with no choice but to resort to making use of other modes of transport that are slow and inferior as compared to the formal public transportation system of the city (informal modes).

4.2 Urban Marginalized Women and Mobility

Mobility is a symbol of independence. To be able to travel independently gives a sense of confidence to an individual. Sadly, the mobility of women hasn't been given much importance or rather has been suppressed since a long time. Several authors have established through their studies the gender biased nature of transport policies as they do not provide for the transport needs of women (Bamberger, Lebo, Gwilliam, & Gannon, 1999; Turner & Grieco, 2000). Usually, the planning and development of the cities lacks the sensitivity towards the needs and requirement of women who in a way form the bridge between the interior space (home) and the public realm (urban structures). Women have to undertake a variety of journeys in order to fulfill the daily tasks for running the household that are neglected in the urban transport planning. Several studies conducted in developing countries reveal that the urban transportation system is planned around the needs of men and is not gender sensitive (Borja & Castells, 2001).

Urban marginalized women have always struggled with resource and time poverty. This aspect of women's lives has direct relation to their limited mobility. In Indian context, no importance is given to the effect of poor accessibility on the daily lives of urban marginalized

people, especially to women within this group. However, to whatever extent these women are mobile in the city, there exists a significant difference between the travel behaviour and pattern of women across different age groups and women belonging to different castes. For instance, unmarried women who are not so much bound with domestic responsibilities, tend to travel longer distances for work, with available transport facilities in the vicinity as compared to married women and women with children.

Women account for longer travelling time as compared with men. For men, traveling is focused between home and workplace whereas in case of women it is more diverse due to activities such as picking and dropping off children to school, grocery shopping, taking children and parents to health centers and reaching their part-time jobs (McKnight, 1994). This multi-stop travel takes longer time and may spill out of the regular scheduled timing for buses or other public transport (Borja & Castells, 2001). Several scholars identify this type of travel undertaken by women as 'feminised by routine events' (Hanson, 1995; Law, 1999). Considering the flexible and complex routine of women it is required of the transportation system to be more diverse and flexible.

Anand and Tiwari identify several specific characteristics of urban marginalized women in Delhi. It is highlighted in their study that this group of women are resource and time poor, i.e., they do not have access to transport modes and huge load of reproductive work leads to time scarcity in their everyday routine. This implies that women have a longer workday as compared to men. These factors in turn result in their low participation in productive activities (paid employment) that leads to their involvement in informal, home-based production and service sectors. Women employed in the productive sectors depend immensely on social policy care and intermittent regular means of transport that are low in cost (Anand & Tiwari, 2006), I.e., informal modes of transport. Studies also show that due to risks associated with travelling in public transport or other informal modes of transport, such as, sexual harassment, women tend to 'self-exclude' themselves from certain activities hence limiting access to other social, leisure and economic activities. Having access to resources depends majorly on the access to mobility and the ability to reach those resources (Turdalieva & Edling, 2018).

5. Area of study – Sangam Vihar, New Delhi

Delhi has more than 250,000 migrants coming into the city every year in search of better job opportunities (Center, 2001). Most of the migrant people are settled in unauthorized colonies in Delhi. Today, these unauthorized colonies have unintentionally become an essential part of the socio-spatial and economic system of the city. Besides using the infrastructure, these colonies also establish social and economic ties with the city by providing inexpensive services to the affluent areas of the city. Most of the people living in unauthorized colonies depend on job opportunities provided by the informal sector such as peons, waiter, driver and domestic worker. However, there are few people who are self-employed and start as a shopkeeper, junk-dealer, tailor, milkman, rickshaw puller and hawker (Anand & Tiwari, 2006).

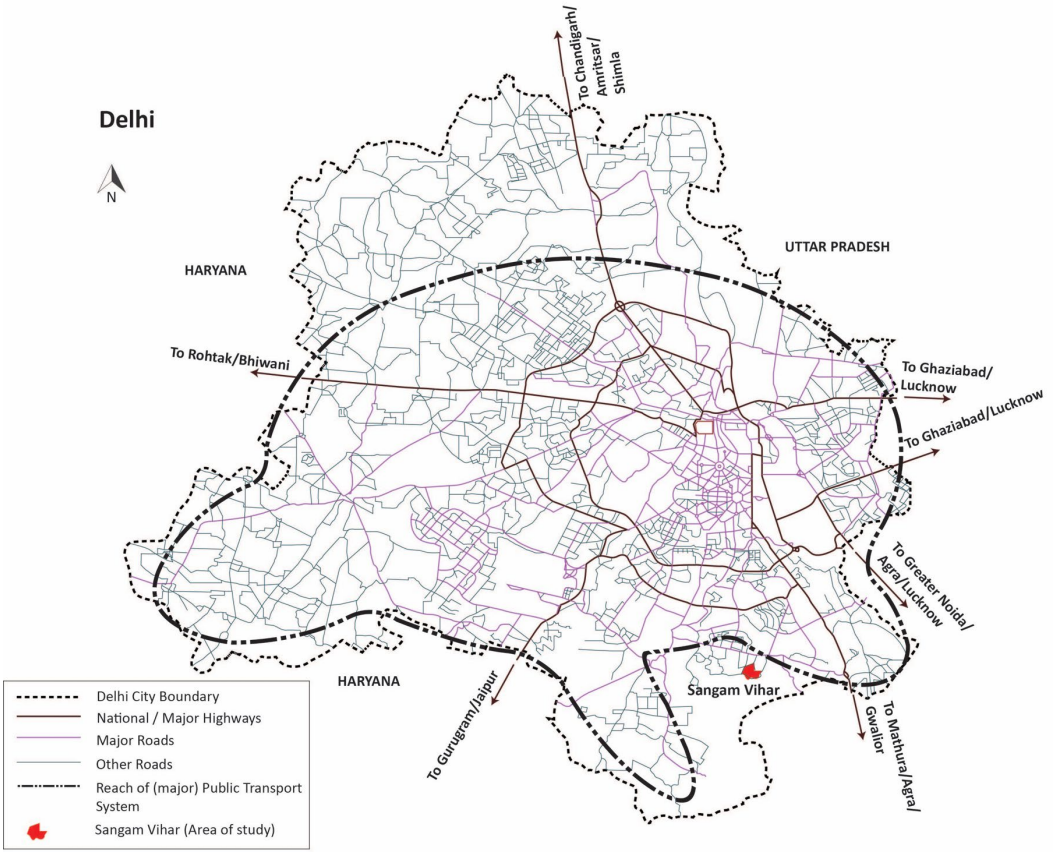

Figure 3 *Context map of the city of Delhi showing Sangam Vihar (study area) that lies on the periphery of the city and falls outside the limits of planned transportation system.*

The study was carried out in Sangam Vihar, which lies in the southern part of New Delhi. Sangam Vihar is an unauthorized colony on the urban periphery of Delhi (Figure 3) with about 400,000 inhabitants (0.4 – 0.6 million) in that area (Singh, Mittal, Yadav, Gehlot, & Dhiman, 2011). Majority of the people living here are migrant poor who have travelled from neighbouring states like Uttar Pradesh and Haryana in search of employment opportunities. Sangam Vihar is in close proximity to Delhi's rich 'South Delhi' area to which it provides majority of service in terms of domestic helpers, laborers, petty vendors, unskilled workers, low-level public sector employees etc. (Kacker & Joshi, 2012; Priyam, 2015).

6. Research methodology

The study presents the methodological insights of a multi-methods approach of studying the daily mobilities of marginalized women living in Sangam Vihar (and nearby areas). For this study, the participants were selected through the process of snowballing. In part one, the study uses document analysis as a method to identify the characteristics of movement patterns of these women in an Indian context. The study also focused on specificities of the subject with respect to the city of Delhi. Several documents that were used for the study included published case studies, journal articles and government reports. Analysis was done using the coding method.

The second part of the study adopted a combination of two complementary ethnographic methods (shadowing) and using phone GPS (in whichever case it was available). Before commencing the fieldwork, a preliminary socio-demographic study was carried out. The socio-economic survey revealed that not all participants were comfortable with writing or filling in forms. This could be because of their education level or lack of confidence. Hence as a first step, informal interviews were conducted with individual participants in order to understand their daily travel patterns. A traditional form (pen and paper) of travel diary was used to record daily routines of participants. The purpose of the travel diary was to get information on three levels – personal information, information related to family/ demographic details and to understand their travel patterns throughout a day. According to Axhausen, travel diaries are a useful method to identify and study travel behavior of individuals (Axhausen, 1995). Questions regarding other household members were asked to understand the family size, family income, and access and ownership of household assets. The participants were asked to describe their usual day starting from morning till night. From the description of their daily routines information regarding their travel patterns was extracted for further inquiry (Table 1). The next step involved, mapping the travel patterns of the participants, understanding the context and their motivations. This was further followed up by unstructured interviews.

Considering the time factor, both for identifying suitable participants and for arranging GPS loggers along with imparting training to participants, it was decided to use participants' smartphones for getting GPS data of their movement throughout a day. However, it was found after the initial socio-economic survey that most participants either do not possess a phone /or possess a keypad phone (and not a smart phone)/ or do not have access to the Internet (even if they own a smart phone).

A total of five participants were studied. Out of these, two lived in Dakshin Puri, which is a squatter settlement close to Sangam Vihar. All of the participants were working women between 20 –55 yrs. of age and belonged to low income group. Out of five, two were married and had the responsibility of taking care of their respective families. They were employed as part-time domestic helpers in the neighbouring areas. The other three participants were unmarried and were working as beauticians in other affluent areas of Delhi. Two different types of methods were used based on the availability of a smart phone (and the Internet) with the participant or without this technology. For participants who owned smart phones, an app called 'Open GPS Tracker' was installed on their phone. They were given initial training on how to use the app. These participants were comfortable using other apps like 'WhatsApp' that enabled them to share pictures of their journeys. The study also included shadowing and conducting a second round of informal interviews with the other set of participants (participants without smart phones).

7. Findings and discussion

The data from this study will be examined based on the marital status of women with regard

to the impact on their physical and social mobility. The information will be analyzed for those who travel either using informal modes of transport along with walking and for those who use informal transport along with formal public transport (bus). The information provided by the respondents will be used to understand the experience of mobility (informal transport), household characteristics and other issues on the aspirations of these urban marginalized women.

In order to understand the motivations of the participants it was important to know about their daily distance travelled, modes of travel, the number of inter-changes, their monthly salary and how much time and money they spent on travel every day (Table 1). This data helped to reveal certain crucial aspects that are connected to the impact of transport modes used by the participants.

Table 1 Initial participant information based on informal interviews and travel diaries.

Variables	**Ramkali**	**Reena**	**Gulabsha**	**Sonam**	**Rinki**
Age	55	28	20	22	21
Marital Status	M	M	Un	Un	Un
Dist. Travelled /Day (Km.)	8.4	9	16.1	27.6	28.2
Using Transport Mode (Km.)	6	5	15.1	26	26
Walking (Km.)	2.4	3	1	1.6	2.2
No. of Interchanges	1	1	2	2	2-3
Travel Time/Day (Hours)	1.5	1	3.9	4	3.6
Travel Cost/Day (INR)	20	20	50	110	140
Monthly Earning (INR)	8500	8000	7500	8000	3000

Based on the above information it was possible to investigate and reveal certain inter-relationships that guided the study further. For instance, a comparative time use chart was generated (Figure 4) that revealed the total added time spent by the participants (individually) on daily travel.

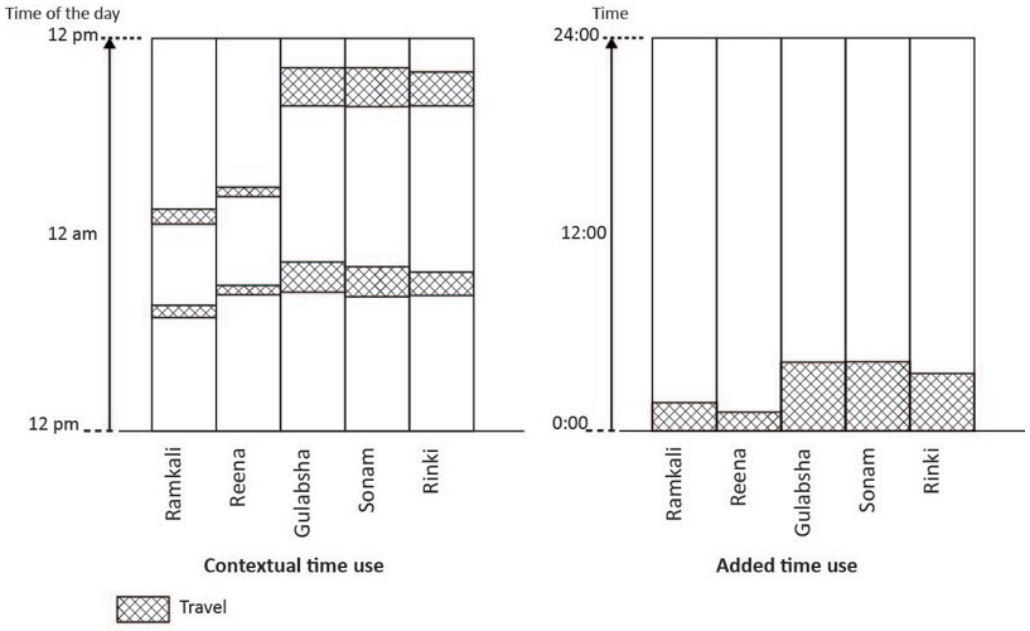

Figure 4 *Participants' travel time within 24hours of a day displayed as added time use (right) and contextual time use (left).*

7.1 Mapping the Travel Pattern

After the initial interviews with the participants the next step involved understanding their daily travel patterns. The data from this survey was then plotted over the map of Delhi. Maps help in presenting a holistic picture of the case and are a great means of visual representation. Shadon and Dudek mention that maps help to reveal answers to "how and what" questions. After plotting the movement pattern on maps, the study followed up further by using ethnographic methods to get a better explanation of "why" questions (Shadon & Dudek, 2013). Mapping can help to recognize spatial patterns through its interpretive practice and provoke questions that are context-based. According to Hsu, maps have the capacity to introduce a completely new line of inquiry by making invisible patterns visible (Hsu, 2014). These plotted maps were then used to develop time-geography[1] diagrams (Figure 5).

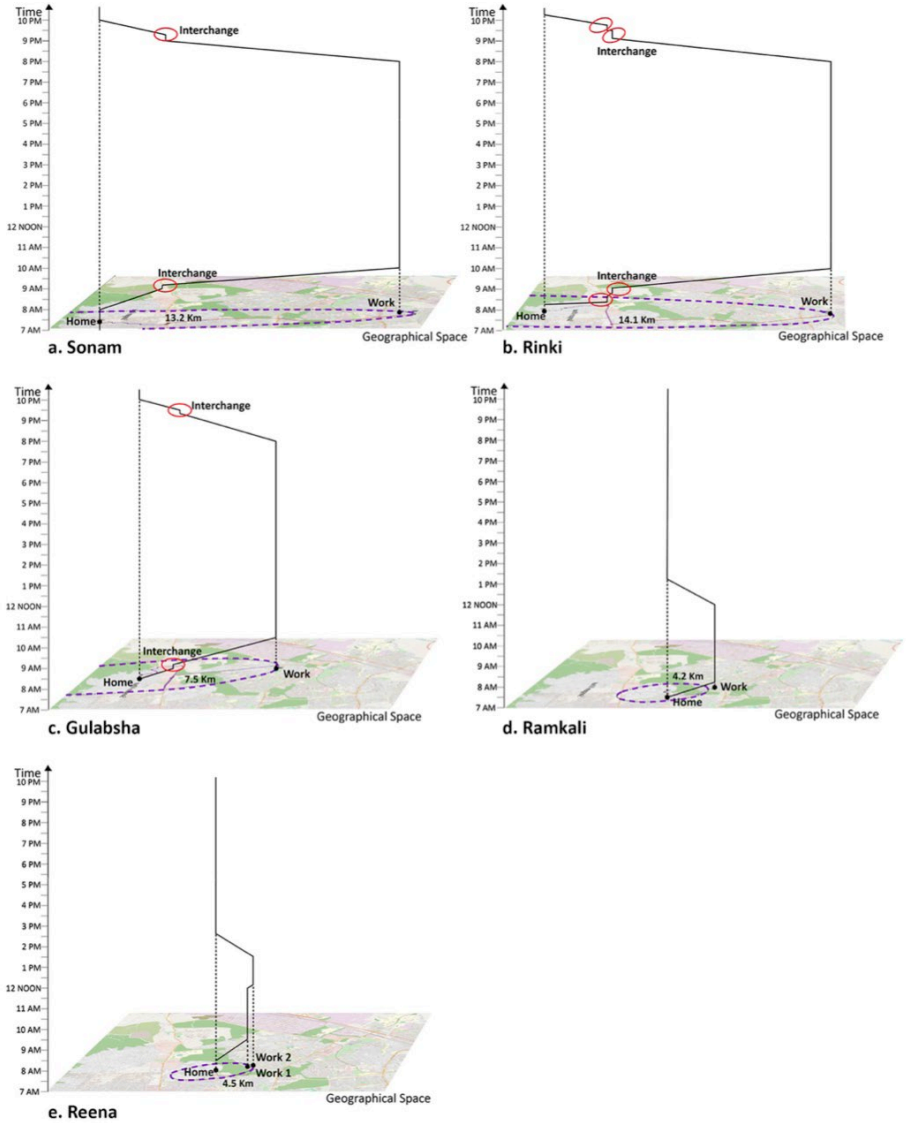

Figure 5 *Time geography – Travel patterns of the five participants exemplified with elementary events. The elementary events displayed are: travel; inter-change; arrive; stay; leave.*

In the diagrams above, the geographical space is demarcated along x-axis and z-axis. Y-axis denotes the time factor. The lines along the geographical space indicate the spatial distance covered and the vertical lines represent the time spent at one particular place. These time-geography diagrams present an overview of the variation in movements performed by participants. It is found that unmarried women travel larger distances consuming more amount of travel time as compared to married women. It is also observed that during their long journeys, unmarried women compromise on factors such as safety and convenience as they perform their travel with 2-3 interchanges, i.e., using multiple transport modes. These journeys also include walking and waiting (during interchange). Married women were seen to be involved in work that did not demand rigid and full day commitments. Contrary to this, unmarried women were employed in semi-informal sector that required them to work long hours.

7.2 Impact of Spatial Mobility

With regard to the use of travel modes, there were several distinguishing factors among the participants. All participants travel between 8 km to 30 km every day and depend fully or partly on informal transport like *gramin sewa, shared auto rickshaws* and *e-rickshaws*. Although the Delhi government authorizes these transport modes, but their characteristics are more inclined towards the informal category, where the culture of 'adjustment' and 'self-organization' is commonly visible. Due to lack of (easy) access to public transport, people of Sangam Vihar depend on these informal modes of transport to meet their travel needs. The routes of these informal modes are proposed and decided together by the vehicle operators and the government (Delhi Government) and are based on the travel requirements of the people using these modes. The study revealed that out of the total number of passengers, around 80% passengers are women belonging to varying age groups. However, it was noticed that there was significant difference in the travel requirements of these women based on their age group and the nature of their employment. Women employed in formal sector were seen using these modes during regular peak travel hours, i.e., between 8:00 am to 10:00 pm. During the afternoon, major users of these modes were either non-working women who were performing various reproductive jobs or those who were working as part-time domestic helpers or were employed in some other informal sector. The informal modes of transport influence the daily mobility (Kaufmann et al., 2004) of passengers through the means of spatial difference and identity. Kaufmann mentions that spatial mobility is also a means for individuals to escape by disengaging from their local societies and creating new identities (Kaufmann, 2017). Based on this theory, the study revealed that with the help of these informal modes of transport, women aspired to move out of their local neighbourhood in search of better employment opportunities and enhanced social status.

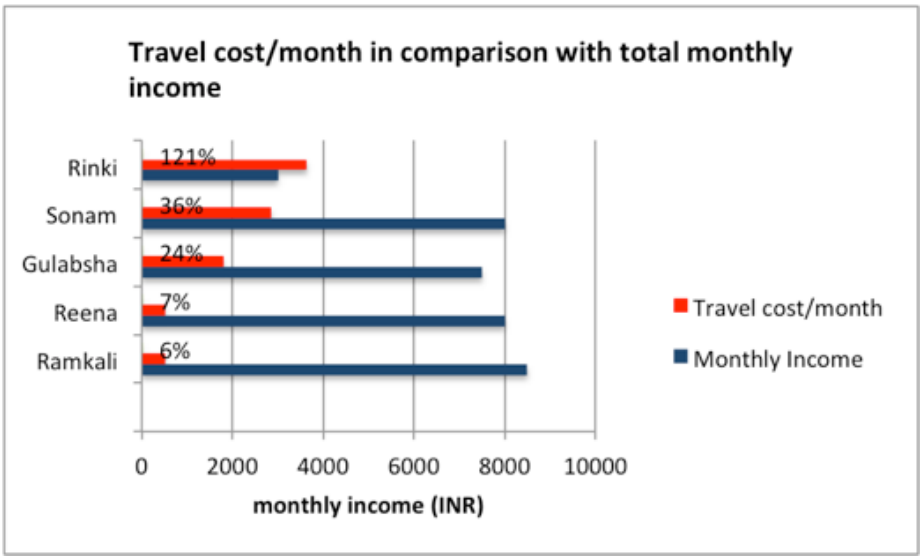

Figure 6 *Monthly expenditure of participants on daily travel. For Rinki, travel cost/month exceeds her monthly income.*

The study highlights a significant difference between the travel patterns of married vs. unmarried women. Because of huge burden of reproductive work, married women (belonging to urban marginalized group) prefer to work in proximity of their homes and with shorter working hours. The concern to run a family allowed them to use little or no money on their travel. Whereas, unmarried women were willing to travel longer distances, spend more money and effort in order to get better opportunities. It was found that the participants spent about 6% to 36% of their monthly income on travel (Figure 6).

During informal interview, one of the participants shared that she prefers working away from her neighbourhood so that she is able to earn more money and establish better social networks. It was found that unmarried women make effort to add on to their skills by attending short-term vocational courses. This enhancement in their skills gives them the ability to access better opportunities through the means of the transport they use, i.e., informal transport. Rinki, an amateur beautician spent more money (and time) on transport than her monthly earnings. According to her, she had moral and economic support from her family, because it was like an investment for better future opportunities. Although there have been changes in the thinking of people towards considering women equality yet based on the understanding of the socio-cultural background of this group, it cannot be denied that these 'better opportunities' refers to finding a good match for the daughters of the house because of their enhanced social and economic value. The study helps to unfold the effect of spatial mobility on the enhanced social status of these women within their society but does not imply towards actual social mobility.

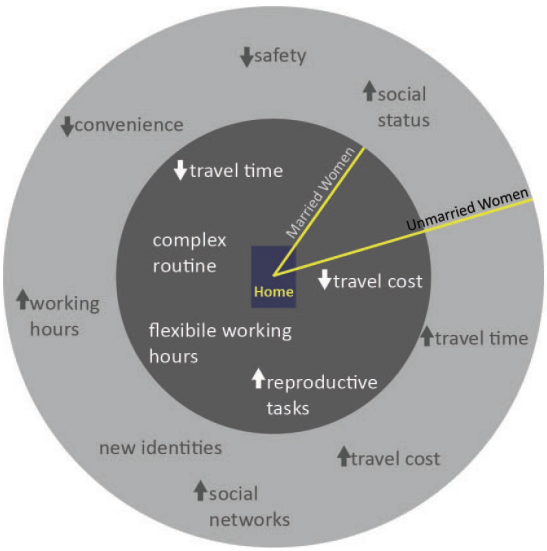

Figure 7 Characteristics of married and unmarried women based on their spatial mobility.

8. Conclusion

The study analyzed the demographic details and mobility patterns of marginalized women living in urban poor area of South Delhi – Sangam Vihar and Dakshin Puri, who are employed

either in an informal or semi-formal sector. In this context, most women had little or no access to assets like a vehicle or a smart phone in their household. This reflects upon the already existing dominance of the patriarchal society.

This study examined the experience of mobility (through informal modes of transport) on the daily lives of these women based on their marital status. In view of the existing relevant literature in the field of mobility, it is clear that accessibility is an important aspect of mobility (Kaufmann et al., 2004). Thus, for unmarried women having access to better employment opportunities by the means of informal transport modes makes them fulfill their desires and create new identities. Besides access, their ability to be able to move away or escape from their local neighbourhood is also found to be an important factor for enhancing their social status. In case of married women, informal modes of transport (because of availability-in the vicinity of their neighbourhood and accessibility-due to low cost) enable them to participate in the productive activities and support their families economically. Because of time-poverty, married women tend to travel in proximity of their houses and generally get involved in part-time jobs.

The ethnographic study and related findings lead the study to a conclusion that highlights mobility as an important component of women's lives as it helps them earn their livelihoods, feel independent, confident and raises their position within their closed social structure. The factors that structure these women's travel patterns are majorly based on 4As, i.e., availability, accessibility, ability and affordability. Unmarried women from this group of the society belong to time-rich and money-poor category and hence do not mind spending more time towards daily commuting for a good salary and desire to climb up the social ladder. Married and older women are occupied with their household duties and/or part-time jobs in the morning and evening and thus tend to move shorter but greater number of journeys as they also need to carry out other obligatory duties in the afternoon. In contrast to this, young unmarried women are less bound by the household chores and therefore tend to spend more time working outdoors to earn a living.

Informal modes of transport (spatial mobility) enable unmarried women to fulfill their own aspirations and to have an enhanced social status but this is largely governed by the prevailing socio-cultural factors that put marriage as the most important aim of the parents of these women (Figure 8). It is understood that this leveling up of social stature is used for an enhanced matrimonial description and does not generate actual social mobility. As supported by literature (Kaufmann, 2017) the study reveals that spatial mobility does not always convert into social mobility.

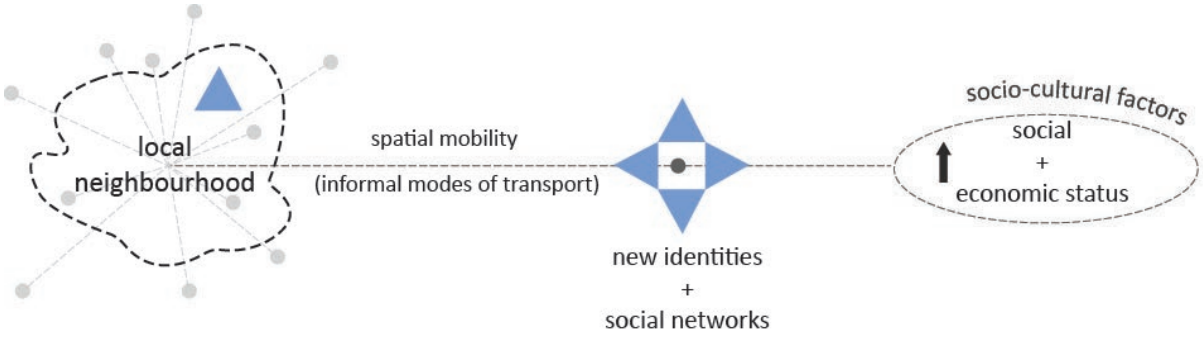

Figure 8 *Spatial mobility enables disengagement from local identities to create new ones for enhanced social status; yet bound by prevailing socio-cultural factors.*

The research is based on a pilot study with a small sample size, which is a limitation of the study. For future research, there is a need to find out the relationship between mobility and social capital (social mobility) of urban marginalized women. To investigate this relationship, it is proposed to conduct an in-depth study of their daily routines, movements and their relationship to the social networks at points of departure, traversal and destination. Other possibilities for future research could be on the lines of a descriptive comparative study and also a quasi-experimental comparative study which arrays marginalized women against non-marginalized women.

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Putting the trans* into design for transition: reflections on gender, technology and natureculture

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Abstract: Over the last five years, design for transition has emerged as a prominent critical paradigm in designing for sustainable futures. Transition design approaches are united in their aim of reorienting design practices to address global environmental catastrophe and societal inequality. Nevertheless, the discussion of gender and sexuality is notable for its absence. One exception is Arturo Escobar's (2018) Designs for the Pluriverse. In this paper, I take Escobar's discussion of gender as my starting point. I suggest that by utilising the concept of "Mother Earth" Escobar risks essentializing gender and biology and limiting the transformative potential of technology. I argue that transition design would benefit from queer feminist and queer indigenous perspectives that advocate for a non-binary approach. I go on to consider what it would mean to put the "trans*" into transition design.

Keywords: transition design; queer feminism; gender; natureculture

1. Introduction

As an emerging field, design for transition encompasses a range of theories, methods and tools aimed at intervening into socio-technical systems to move towards sustainable and equitable futures. The majority of approaches emphasise the interconnectedness of social, economic, political and natural worlds and utilize systems thinking. For example, transition design, devised by Terry Irwin et al. at Carnegie Mellon University, aims to design for complex adaptive systems and draws on living systems theory which focuses on dynamic patterns between organisms and their environments. It advocates "the reconception of entire lifestyles [at the level of the everyday], with the aim of making them more place-based, convivial, participatory, and harmonizing them with the natural environment" (Irwin, Kossoff, Tonkinwise, Scupelli, 2015, p.1). As such, it aims to develop a "cosmopolitan localism" or "pluriversal" approach to design and recognises the value of indigenous ways of living. The transition design movement acknowledges that to create change we must move beyond institutional and disciplinary boundaries. There is also a consensus that environmental

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sustainability cannot be addressed without rectifying social inequality, and that, for the West, ontological reorientation is needed. This includes exploring narratives, mindsets and visions of alternative ways of being outside of possessive individualism. In light of the recent bushfires in Australia and amidst the Covid-19 pandemic, transitional design approaches seem all the more relevant and necessary.

Nevertheless, while there are substantial references to global inequality in design for transition, there has been significantly less discussion of gender and sexuality. Indeed, a number of academics have called for an increased focus on power and politics in the movement, as well as wider methodological engagement with other disciplines including feminism (Boehnert, Lockton and Mulder, 2018; Gaziulusoy and Öztekin, 2019). As a response to this call, in this paper, I consider the theorisation of gender and sexuality in *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds* by Arturo Escobar (2018). I recognise that autonomous design is slightly different from transition design, however, Escobar's work is cited regularly in the field, and is the only text to extensively explore feminist perspectives. While I am largely in agreement with Escobar's arguments about design for transition, I put forward some reservations, specifically around gender and the nature/culture binary. I argue that queer feminist and queer indigenous perspectives should inform transition design and I offer the beginnings of a methodology for putting the trans* in transition design.

2. *Designs for the Pluriverse* and Ontological Design

Designs for the Pluriverse by Arturo Escobar (2018) explores and furthers the work of designers "who have already embarked on the project of design for transitions" (p. xii). Escobar asks "can design's modernist tradition be reoriented from its dependence on the life-stifling dualist ontology of patriarchal capitalist modernity towards relational modes of knowing, being and doing"? He considers whether design approaches can be appropriated by communities to strengthen their autonomy and whether ontologically oriented design can transform the ways we live with each other and the Earth? (2018, p. xiii). In response to these questions, Escobar develops an approach that is collaborative and place-based: an accessible pluriversal approach to world-building where "many worlds fit" (Zapatista quoted in Escobar, 2018, p.16). He describes the transition movement in the design community and explores connections with the work of social movements and indigenous groups in the Global South. *Designs for the Pluriverse* is a wonderfully ambitious book with so much to offer that I cannot go into all its arguments here. The critique of dualist ontologies and the discussion of ontologically oriented design are particularly relevant to the arguments made in this paper, so I discuss them in more detail here.

As Escobar's (2018) introductory question points out, design has been (and arguably still is) heavily reliant on modernist discourse that reproduces dualist ontologies of "mind/body, self/other, subject/object, nature/culture, matter/spirit, reason/emotion" (p.25). Design has contributed to the current environmental crisis and the unequal world that we find ourselves

in today. To move beyond these dualisms, Escobar documents critique from a range of perspectives including feminism. For example, drawing on the work of ecologists and feminists, he writes of how mind/body, culture/nature, and man/woman divides have been "foundational to patriarchal cultures, reductionist forms of science, disembodied ways of being, and today's ecological crisis" (p.121). He argues that it is not the existence of dualisms that is the problem, it is the hierarchies between binaries and their social, ecological and political consequences, that we should take issue with. The critique of dualisms, he suggests, has not only become commonplace in academic discourse, but it is increasingly apparent in intellectual and activist domains. Escobar attributes this both to the challenges of climate change and a "reflection of the fact that nobody really performs as a pure wound-up Cartesian toy" (p.131). Thus, he explores the "ontological turn" that considers how the world can be otherwise: alternative visions and autonomous world-building that fosters inclusion, participation, connection and care.

Design approaches are not excluded from this ontological turn and Escobar (2018) writes about the ways that ontological design, which includes transitional approaches, has the potential to reimagine and reconstruct local worlds. Ontological design recognizes that in designing tools we are designing ways of being (Winograd and Flores 1986, xi as cited in Escobar, 2018, p.134). Escobar gives the example of the way that the Amazonian indigenous maloca (indigenous longhouse) encultures human and non-human relationality through its design, in contrast to a suburban American home that raises "decommunalised individuals" (p.140). He writes "[o]ntologically oriented design is therefore necessarily both reflective and political, looking back to the traditions that have formed us but also forwards to as-yet-uncreated transformations of our lives together" (p.146).

Escobar's arguments regarding the radical possibilities of ontological design are informed by the work of Tony Fry. For example, Escobar suggests that an ontological design approach is formative in Fry's arguments regarding the need for design that is about sustainment rather than sustainability. According to Escobar (2018), Fry argues that humans today are "constituted within a naturalized artificial ecology created through design and technics; this means that nature becomes a "standing reserve" to be appropriated" (p.150). Fry argues that humans have always been prosthetic beings entangled with their tools and with the rise of modernity the artificial has become all the more naturalized. Therefore, the only available option at this time of crisis is to adapt by artificial means and to develop a posthuman notion of the human that critically embraces the possibilities of new technologies. It is here that while in agreement about a need for ontological reorientation, Escobar seems to differ to Fry in terms of his approach to technology. For example, he (2018) writes:

> "[i]t would be pertinent to ask whether Fry succeeds in articulating a view of the future different from that of the techno-fathers of geoengineering, synthetic biology, the great singularity, and the like; in other words, whether his proposal gains sufficient distance from the ontology of appropriation and control that so naturally inhabits the techno-futurist visions related to the artificial"(p.150).

In conclusion, Escobar returns to consider design with/out futures. He considers the

bifurcation taking place regarding "posthuman" futures which he suggests involves two paths: "return to the earth" and "the human beyond biology" (p.40). It is clear which side Escobar is on. He writes that "[r]eturning to Earth implies developing a genuine capacity to live with the profound implications entailed by the seemingly simple principle of radical interdependence" (p.258). Whereas "the human beyond biology" is the "total transcendence of the organic basis of life dreamed up by the techno patriarchs of the moment" (p.258). Escobar leaves us with the question of 'how shall ontologically oriented design face the quandaries of life beyond biology and asks whether design will be seduced by the promise of unlimited growth, novelty, power, adventure, and wealth. I return to consider this below.

3. Gender and Sexuality in Designs for the Pluriverse

In Escobar's (2018) discussion of the wide range of work that critiques life-stifling dualisms, he spends significant time discussing feminist approaches, specifically those from the Global South. He argues that "[f]eminists from the Global South are particularly attuned to the manifold relational politics and ways of being that correspond to multiple axes of power and oppression" (p.90). Feminists, he suggests, have a strong genealogy of thought that emerged from the exploration of situated knowledge, the corporeal and intersectionality which is reflected in a contemporary feminist commitment to other ways of worlding.

Notable for its absence, however, is any mention of queer theory or activism that has been instrumental in challenging the binaries of sex and gender and imagining different sorts of futures. Escobar does refer in passing to the idea that gender maybe something "life-stifling". He (2018) writes:

> "Whether the concept of gender is even applicable to preconquest societies, or even to contemporary non-Western and nonmodern societies, remains a matter of debate, given the relational fabric that, to a greater or lesser extent, continues to characterize such societies, which admits of no strictly separate and preconstituted categories of masculine and feminine" (p.90)

When outlining his philosophy of "strong relationality" without subjects, objects and processes that exist by themselves, he (2018) writes of "the bisexual spider god/goddess Anansi" in the Fanti-Ashanti tradition from the Gulf of Benin (p.250). However, the bisexuality of Anansi is not highlighted as significant.

The omission of queer feminist and queer indigenous perspectives is important not only for its theoretical import but also because it misses the potential for connection with lived experience. Increasingly one of the common ways in which people are questioning and challenging binaries in their everyday lives is through their sexual and gender identities. For example, there have been several popular books exploring non-binary being, thinking and feeling in recent times (see Iantaffi and Barker, 2019; Mandelo, 2012; Ryle 2019). These books contain arguments about relationality, community and care that are remarkably similar to Escobar's. While it can sometimes be a 'cheap shot' to critique authors regarding omission, I believe the lack of discussion of the design of a pluriversal world from a queer

feminist perspective points to a number of issues with Escobar's theorization of gender and technology.

In the introduction to *Designs for the Pluriverse* Escobar outlines the stakes involved in creating "a world where many worlds fit" (Zapatista quoted in Escobar, 2018, p.16). Drawing on Claudia von Welholf, he (2018) argues that is patriarchy that is the "source of the contemporary civilizational model that is wreaking havoc on humans and nature" (p.32). Patriarchy based on hierarchies and domination has prevailed over matriarchal cultures respectful of relational and place-based forms of living. He (2018) suggests that "Matristic cultures were characterised by conversations highlighting inclusion, participation, collaboration, understanding, respect, sacredness and the always-recurrent cyclic renovation of life" (p.32). He is keen to emphasise that matriarchy does not mean the dominance of women over men, rather that life is defined by a different conception of life for everyone. Escobar writes that "in the beginning, there was the mother (in the last instance, Mother Earth)" (p.32) and this is a relationship that continues to be the case for many indigenous people today. For example, he writes of indigenous people in the Americas who are engaged in the "Liberación de la Madre Tierra (the Liberation of Mother Earth)" who argue that it is time to abandon the "superstitious belief in progress and the modern epoch as the best of all worlds"(p.36). He points to the arguments of von Welhof regarding the creation of "new matriarchies" that are "inspired by matriarchal principles of the past" (p.37) adapted to the contemporary moment. At the end of the book, Escobar returns to consider "The liberation of Mother Earth as Design Principle" (p.240). He argues that "a plural sense of civilizational transitions that contemplates—each vision in its own way—the Liberation of Mother Earth as a fundamental transition design principle is the most viable historical project that humanity can undertake at present" (p.241).

In this last sentence, Escobar remembers to add "each vision in its own way", yet one is left with the lasting impression that a progressive future involves new matriarchies liberating Mother Earth. While I agree with the analysis of patriarchy in *Designs for the Pluriverse*, I believe that holding on to the concept of Mother Earth and "new matriarchies" is problematic when adopted outside of relational cultures. The conflation of conditions of inclusion, participation and collaboration with a more "natural" maternal figure essentialises biology and gender when not accompanied by indigenous onto-epistemologies. The association with "woman-nature" reproduces the dualisms of nature/culture, feminine/masculine, male/female that have proved to be so life-stifling. While the mother figure may only be used as a metaphor, as Catriona Sandilands (1997) argues, the constructed "woman-nature" (p.19) relies on a stable notion of identity that is easily assimilated into patriarchal hierarchies of domination. She goes on to suggest, contra to the arguments of ecofeminists such as Val Plumwood, that queer feminism has much to offer ecofeminist politics. Sandilands (1997) does not believe, and I agree, that the "destabilisation of identity as a political construct and the creation of liveable stories for the future are mutually exclusive projects" (p.19). Identity has never been a stable category and it would be a dreadful mistake to require it to be so in the name of a sustainable future. Drawing on the work of

Sandilands, I would suggest that the concepts of "Mother Nature" and matriarchy limit radical possibilities, and that transition design should draw on alternative visions that are not so easily gendered or natured to imagine relational futures. I believe that queer feminist discussions of technology offer possibilities here, and it is to these I now turn.

4. The cyborg, nature/culture and the future

The research of Donna Haraway is fundamentally important to any discussion of feminism, technology and nature. While I do not have the space to do justice to her extensive body of work here, I summarise the points that offer an alternative perspective on gender, sexuality and ecojustice. In the seminal text *Simians, Cyborgs and Women*, Haraway (1991) famously argues that identity is contradictory, partial and strategic. She writes that "there is nothing about being female that naturally binds women" (p.149). With this in mind, she develops the coalition myth of the cyborg, a creature in a "post-gender world" that cannot be contained by the dualisms of mind/body, nature/culture, human/non-human. In fact, as Sandilands (1997) argues, the cyborg "thrives on its lack of closure, on its resistance to any form of categorical symbolisation (except the misinterpretation of the "cyber" part)" (p23). Thus, coalition is made through affinity building "that privileges the inevitable partiality of any position in a chain of alliances" (p23). "In the cyborg view of affinity, the subject position is offered up to others with the express purpose of experiencing its failure; the 'thing that is shared' is […] the experience of radical contingency itself" (Sandilands, 1997, p.23).

Haraway's world is one in where we create "partial connections not universals and particulars", a world where "nature" incorporates people, organisms and technological artefacts. This is not an approach to entanglement that legitimates technofixes and market growth (see Boehnert, 2018), but is a theory of ecological relationality inspired by a feminist ethic of "response-ability" (Haraway, 2016). For example, in *Staying with the Trouble*, Haraway (2016) documents how estrogen links "an aging California dog, pregnant mares on the western Canadian prairies, human women who came to be known as des daughters, lots of menopausal U.S. women, and assorted other players" (p.105). She writes that it is no longer news that corporations, labs, technologies and multispecies lives are entangled but the details matter. The details, she suggests, require us to be responsible for multi-species flourishing. Having eaten Premarin makes Haraway (2016) "more accountable to the well-being of ranchers, northern prairie ecologies, horses, activists, scientists, and women with breast cancer than [she] would otherwise be" (p.116). She concludes, we are all responsible, but not in the same ways. 'The differences matter—in ecologies, economies, species, lives" (p.116).

The Covid-19 pandemic has propelled the ethics of entanglement into global consciousness. As Andreas Philippopoulos-Mihalopoulos (2020) writes:

> "The ethics of withdrawal before Covid is a show of a planetary collectivity, where we finally understand that our bodies are all connected, and that taking precautions in London will mean that more people will survive in the refugee camps or in the less developed world with

> more fragile health systems. It is ultimately a show of removing oneself from the mania of 'progress', with its global pollution, climate change and anthropocenic irreversibility, and allowing the planet to take a breath." (para 8)

Inequality inevitably means the impact of the pandemic will not be equally felt (see Jones 2020), nevertheless, perhaps we can utilise the feeling of interconnection to create more sustainable futures.

To become more sustainable, Haraway (2016) provocatively insights us to "Make Kin Not Babies!" She argues that if there is to be multispecies ecojustice, it is about time that feminists "unravel the ties of both genealogy and kin, and kin and species" (p.102). Thinking about kin beyond ancestry means that all earthly things share common ground. Our ancestors, Haraway argues, turn out to be "very interesting strangers; kin are unfamiliar (outside what we thought was family or gens), uncanny, haunting, active" (p.103). Making kin is about "becoming-with" because our becoming is contingent on the flourishing of a myriad of others. For example, cyborgs are kin made up of historically situated machines, organisms and human beings.

In her approach to technology, Haraway's arguments resonate with Fry's in that they both think that situated technical projects, and the people who take part in their creation, offer possibilities for more positive life and death. As Haraway succinctly puts it, "the task is to make kin in lines of inventive connection as a practice of learning to live and die well with each other in a thick present" (p.1). Being truly present would mean orientation away from narratives of techno-scientific salvation towards cultivating an ethics of care for people, animals, plants, places and things for generations past and for those yet to come (Haraway, 2011). A technoculture with this orientation would have a "familial, generational duty to their failures, as well as their accomplishments" (2007 par 9). Speculation fabulation and speculative feminism in Haraway's (2016) world become propositions and patterns for participants to inhabit, a means of crafting "conditions for finite flourishing on terra, on earth" without attempting to return to Edenic pasts (p.10). Haraway's work questions the bifurcation of the "return to the earth" and "the human beyond biology" that Escobar uses to frame the future of technology, and provides a feminist design ethic for "life beyond biology" (Escobar, 2018, p. 258).

There has been a recent resurgence in feminism that draws on Haraway's *Cyborg Manifesto* and explores the radical possibilities of technology. Xenofeminism, as coined by the collective Laboria Cuboniks, proposes a queer and trans-inclusive feminism with the view to repurposing the tools of capitalist technoscience. Xenofeminism, as Helen Hester (2019) suggests, is an "anti-naturalist endeavour that frames nature and the natural as a space for contestation – that is, as within the purview of politics" (p.19). The "natural" order, Hester writes, has nothing to offer those who have been deemed "unnatural in the face of reigning biological norms", queer and trans people, differently-abled and "those who have suffered discrimination due to pregnancy or duties connected to child-rearing" (p.20). As it states in the Xenofeminist manifesto, "[n]othing should be accepted as fixed, permanent or "given" – neither material conditions nor social forms", and this includes biology (Laboria Cuboniks,

n.b.). This is not to deny that bodies have different biological capacities, rather that "biology is not a synonym for determinism, and sociality is not a synonym for transformation" (Wilson quoted in Hester, 2019, p.21).

The Xenofeminist Manifesto also argues for gender abolitionism built on an anti-naturalist agenda. Abolition, as Laboria Cuboniks argue, does not mean to eradicate gender from the population, rather, like race abolitionism, it aims to abolish gender discrimination. Xenofeminism is a call for "gender post-scarcity" and for the proliferation of genders. "Let a hundred sexes bloom!" insights the manifesto. In this process, Laboria Cuboniks stress the need to render binary gender norms laughable. Xenofeminism is an intersectional project and Laboria Cuboniks are clear that "every emancipatory abolitionism must incline towards the horizon of class abolitionism" (Laboria Cuboniks, n.b.). The call for the proliferation of genders is insightful because it can include a multitude of experiences. As Alyssa Battistoni puts it, there is no problem with people feeling that having a womb makes them close to the earth, as long as "anyone who wanted to could have a womb, and people with wombs could do things other than making babies, and if we recognized that there are a lot of ways to be close to the earth through use of our bodies, whatever parts we might have (and however technologically mediated they might be)" (2018, para 23).

Through the technomaterialism, anti-naturalism and gender abolitionism of Xenofeminism, Laboria Cuboniks are interested in creating an alien future. Hester (2019) further explores the possibilities of a xenofeminist future beyond reproductive futurism. Drawing on Lee Edelman's arguments about the future as a heteronormative construct represented by the cult of the child, Hester (2019) argues that we must be careful not to foster "the supreme value of species survival as a discursive technology of compulsory heterosexuality" (p.54). To look for alternatives she turns to Haraway's concept of "making kin not babies". Hester takes Haraway's slogan in two parts and is critical of the call for a reduction in human numbers because it seems "curiously weightless, floating free of the entanglements and troubles with which [Haraway] usually so doggedly stays" (p.60). This is particularly true to its relevance only to the "privileged, disproportionally resource-demanding classes of the global north" (Hester, 2019, p.57). Hester is also, rightly, dubious of any framing of climate change that lets capitalism off the hook, suggesting that it "might be a more productive move to start from the systemic effects of surplus value extraction" (p.56).

Hester (2019) argues that the call to make kin across species, however, offers possibilities for a future-oriented politics beyond the horizon of the family. She suggests that xenofeminism cannot "form punitive disdain regarding the reproductive choices of others" but must be grounded in "xeno-hospitality". Xeno-hospitality is a mutational politics accommodating new desires and committed to the opening of ideological and material infrastructures. Citing Haraway's speculative fiction she talks of the possibility of a post-gender world where multi-parent genetic engineering is possible. A world where making kin includes making babies.

With this in mind, perhaps, instead of designers resisting the seduction of the powerful imaginary of life beyond biology as Escobar suggests, designers should focus on creating

technologies that make kin and foster multispecies ecojustice. As the work of Haraway and Laboria Cuboniks demonstrates, technology, from synthetic biology, nanotech and geoengineering to the simplest of tools, are not only in patriarchal hands: we are all entangled, albeit in different ways and with significantly different amounts of power. Hester turns to feminist self-help and 'amateur' practices to give an example of Xenofeminist technology. I think that transition design also has the potential to create feminist technologies that would enable earth and all the life on it to flourish.

5. Putting the trans* in transition design

A significant part of transition design, as defined by the Carnegie Mellon Transition Design Framework, aims to reshape the posture and mindset of designers and their communities. As part of the transition design seminar syllabus, student designers are encouraged to develop their critical awareness by exploring theories and practices of diversity and equity including "autonomous design" (Escobar, 2018) and the "matrix of domination" (Hill Collins, 1990). One suggested reading deals with LGBTQ+ issues: Part 1: Traveling While Trans: Design Justice, A.I. and Escape from the Matrix of Domination by Sasha Costanza-Chock (2018). The article begins with Costanza-Chock describing the experience of walking through a security scanner at the airport as a trans person. They powerfully describe the embarrassment and humiliation caused by the cis-normative assumptions built into the A.I. technology. Costanza-Chock goes on to argue for design that is aware of intersectionality and the matrix of domination, and that works to listen to the voices of those who are marginalized, targeted, erased under this matrix. They cite the significance of the work of Escobar, and the importance of designing a "world where many worlds fit" (Zapatista quoted in Escobar, 2018, p.16). I would argue that this is why (in addition to the imperatives of critical pedagogy and authentic participation) it is paramount that the conceptual and methodological frames for design for transition allow for all non-binary identities. We need to make sure that our frames do not reproduce the dualisms that we are trying to dismantle.

The very name, "transition design" could do some of this work. In her discussion of indigenous transgender and transcultural practices, Maddee Clark (2017) suggests that "rather than only articulating trans identity as the categorically imposed colonial assignation, trans can be positioned as a constitutive mode of seeing and relating" (para 5). Drawing on Eva Hayward and Jami Weistein, Clark notes that "trans* is not a thing or being, it is rather the processes through which thingness and beingness are constituted. In its prefixial state, trans* is prepositionally oriented—marking the 'with', 'through', 'of', 'in', and 'across' that make life possible" (para 5). Clark documents how Hayward directly links trans* with Haraway's notion of "becoming-with". The transgender body is produced in a context of "shared vulnerability … open to the planet", reliant on the becoming of others in order to become" (para 6). Clark uses the concept of "becoming-with" to consider how "geopolitical trauma" can open up a space for relationality and mutual dialogue among indigenous trans people (para 6). Trans* illuminates the contingent and non-binary nature of identity and our interdependence on all forms of life. In its radical contingency it offers potential to unite

women, trans, queer, and first nations communities while holding difference within these markers (Allen cited in Clark, 2017, para. 9).

Trans*ition design, then, would acknowledge that to be "one at all, you must be a many" and would appreciate the importance of destabilising the stories built on the dualist ontologies of patriarchal capitalist modernity (Haraway, 2014, para 2.). It would recognise that nothing is fixed including biology and would help us to explore the ethical complexity of our entanglements. For example, when applied to the gendering of domestic life, a wicked problem if ever there was one, a shift to focus on "becoming-with" could be profound. The smart home and its associated technologies usually render the experiences of anyone other than the "straight white man" invisible (Chambers, 2006). However, what if they were reimagined as a site for kin making. How could we configure homes to accommodate a multiplicity of genders and create living arrangements beyond the family and amenable to multi-parenting beyond genetics? Could we normalise gender as choice through the design of the home including integrating technologies for hormone creation and monitoring for example? Instead of the eradication of bacteria, pests, and mould, could we create environments that work with the life we find in our homes, such as utilising schizophyllum and myceliam found in fungus to breakdown toxins and create biodegradable materials?

A "trans*" world-view is not new. Indigenous communities have many ways of expressing "becoming-with". For example, as Elizabeth Kerekere (2015) suggests, in Maori culture "[t]ipua were supernatural creatures who could change form or gender. Tipua can be seen today in takatāpui [Māori who identify with diverse sexes, genders and sexualities] who embody both female and male in remarkable ways" (p.12). Kerekere (2017) tells the story of "the ancestor Tāwhaki who was on a journey when he encountered Tongameha, a tipua (spiritual force who had the ability to change form and gender)" (p.65). Tongameha changed their male form into a beautiful female in an attempt to seduce Tāwhaki. Other tipua included Hine-ngutu, a knot of totara wood, and Pururau, a fish that was easily recognisable because a small tree grew from its' head (Gudgeon, 1906, p28.). Tipua are non-binary entities traversing the human and non-human, the male and the female, the supernatural and the real, the past, present and future. Stories of tipua tell us how to become-with. By hearing these stories we make kin with all sorts of uncanny ancestors.

These lifeforms are not simply rhetorical. The "Blob" a slime mould (Physarum polycephalum) found all over the world under leaves and logs "is neither a plant, an animal or a fungus" (Zaugg, 2019, para 3.). The mould can adapt to its environment, split into different organisms, fuse back together and share what it has learned. It has "spatial memory", "problem-solving prowess", and "over 720 sexes" (Specktor, 2019, para 6.). The "blob" eludes classification and its very existence should cause us to reflect upon how we make sense of the world. As humans, particularly those raised with Western ontologies, we have a lot to learn about "becoming-with", and we have even more to learn about how we utilise technology to do so.

Rather than reaching for technofixes built on salvific narratives of modernity, or attempting to return to an elusive Edenic past, when designing for the transition we should turn our attention to the examples of "becoming-with" that already surround us.

6. Conclusion

One may well ask, how does a trans*ition design that aims to prise technology from the patriarchs proceed? As I hope to have documented in this paper, in the first instance, tran*sition design is about changing our frames so that everyone, including women, queer, trans and indigenous people, can be included while holding onto their difference. I have argued that to address social inequality and to work towards feminist ecojustice we must move beyond "woman-nature". This would mean deconstructing and resisting the binaries of sex and gender that manifest themselves in both design discourse and designed objects as well as creating opportunities for understanding the multiplicity of subject positions. The "becoming-with" of trans*ition design points to our shared vulnerabilities and dependence on others, human and non-human. In being vulnerable we share our failures and as designers we recognise and are made accountable for our actions. Indigenous and scientific stories about remarkable trans* creatures question the dualisms upon which western ontology was built. Indeed, in systems analysis, it may well be the "wild things" that elude classification that tell us the most about our relationships with people, animals, places and environments (Attfield, 2000). Through a detailed examination of these things, we can gain a greater understanding of how to cultivate an ethics of care for our planet that is both critical of the impact of technology, as well as open to its possibilities. Most of all, trans*sition design should be able to adapt to new desires and ways of becoming, making sure that we all live and die well in the trans*ition.

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Whiteness in design practice: the need to prioritize process over artefact.

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Abstract: This article will interrogate the issues associated with non-Indigenous designers working with Indigenous knowledges in commercial design practice. It will analyze the position of 'whiteness' to appreciate the ongoing impact of colonialism on Indigenous representation and identity creation. The article attests there are times when non-Indigenous input into design outcomes is not suitable. However, if non-Indigenous engagement in the design process offers benefit to Indigenous stakeholders, the International Indigenous Design Charter serves as a guiding document on the best practices to follow. There is still a concern that regardless of the extensive consultation, strong industry support and the best intentions informing the development of the Charter document, 'whiteness' may still permeate the design outcomes. This article concludes the only way to mitigate or remove 'whiteness' in commercial design practices is to preface the design process over the artefact to ensure design outcomes are Indigenous led and Indigenous self-determined.

Keywords: indigenous design; charter; process; best practice

1. Introduction

In 2006, Katherine McCoy introduced a new focus when she referred to the nature of changes in the practice of graphic design. McCoy argued for over 150 years designers have worked to satisfy the Industrial Revolution's need for mass communication. Mass production was based on the principle of one product, one communication strategy and all problems solved. "The economies of mass production reduced diversity and individuality but produced lots of affordable goodies" (McCoy 2006, p.201). According to McCoy, we have experienced the end of mass communication, and now we have "narrowcasting instead of broadcasting, subcultures instead of mass culture, and tailored products instead of mass production" (2006, p.201). Diversification, decentralization, downsizing and disunity have led us to a producer centred system with specifically tailored communication processes through specifically tailored channels. This, in turn, has led to a stronger focus on cultures and sub-

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cultures in design outcomes.

Design provides the opportunity for Indigenous communities to actively shape the identity and representation of their culture for a broader audience (St John 2018, p.269, Kennedy 2015, p.112). Cato, prominent Australian non-Indigenous designer, made the statements that as designers "the one thing you're chasing is something different, and yet we ignore thousands of years of history because we feel we've got to fit in while at the same time pretending to stand out" (Kennedy 2015).

There is an emerging perception that drawing on Indigenous knowledges would break down Eurocentric design influences and create a new visual vernacular that is unique and appealing. Findlay (2000, p.316), in a similar vein to Cato, identified an Indigenized vision would have great benefit to everyone, and would serve as a valuable resource as long as it was done through a process of self-representation. Findlay (p.314) argued the necessity to create a new alliance between English literature studies and Indigenous studies, for instance, when he explained Indigenous knowledges are an 'invaluable resource' especially as we seek 'new national imaginaries'. He maintains there is an undervaluing of Indigenous knowledge and acknowledges the challenges of how to proceed (p.311) identifying that it is "not fully allowable when the indigenizing is being undertaken by the non-Indigenous academic collaborator rather than the insurgent Indigene" (p.313). Findlay explains:

> "Outsider essentializing of Indigenous history and cultural practices must be respectfully strategic rather than presumptuously exotic, and driven by the need to benefit Indigenous people according to their rights, needs, and aspirations." (p.313)

The comments of Findlay resonate with the tensions now at play in the design industry. The apprehension of working with Indigenous knowledges in design practice is clearly articulated by Dori Tunstall, Dean of the Faculty of Design at Toronto's OCAD University and design anthropologist, in an interview published by Janna Levitt where she acknowledges the challenges and awkwardness faced by many designers working in this field.

> "I would characterize it more as anxiety. What I mean by that is that it's coming from a place of "I want to be able to do this, but I don't have the knowledge, I don't have the tools, I don't have the resources." (Tunstall cited in Levitt 2017)

Russell-Cook (2017) addresses this tension when he explained after a long history of misrepresentations it is fairly well understood that non-Indigenous designers must only engage with Indigenous knowledges in partnership with Indigenous peoples and with recognition for Indigenous goals and expectations. This might sound logical, however there are challenges when putting these ideals into practice.

Working with Indigenous knowledges in design practice requires returning visual sovereignty to Indigenous groups and empowering self-determination of cultural heritage representation to Indigenous knowledge holders (St John 2018, p.269, Andersen 2017). Understanding this, there is a shift in focus to Indigenous knowledges role in contributing to contemporary design practice (Heike, Nicola, and Edwin 2012, St John 2018), in particular to reposition Indigenous visual culture in creating a nation style (St John 2018, p.225). Indigenous contributions

are not recognized in current historical design frameworks as they are not tied to western tools and technologies commonly aligned to design practice (St John 2018, p.259). St. John encourages a recognition of design history independent of European influences and more inclusive of national expression. However, she also clearly articulated "Indigenous visual culture has been used and abused by western designers" (p.262). The contested and highly political space of misappropriation has been perpetuated by commodification and objectification of Aboriginal art and a history of exploitation "not only by commerce but also by western designers" (p.262). If we take this path, Pedro Oliveira (cited in Schultz et al. 2018, p.94) argues, decolonizing design is less about an opposition of 'decolonized' and 'colonized' and more about a process of un-learning and re-learning how we see the world.

This article will examine the complexity of non-Indigenous engagement with Indigenous representation in design practice through the lens of 'whiteness'. Whiteness is not a categorization based on the colour of one's skin. It is a way to define cultural dominance that is reproduced and maintained; willingly, unwillingly, knowingly or unknowingly according to the privileges associated with a dominant cultural group (Kowal, 2010, p.327). This paper does not imply all non-Indigenous participants in design practice act based on the principles of 'white anti-racism' or 'whiteness'. Instead this paper explores 'whiteness' discourse to inform the complexity, the potential impact and the perception of non-Indigenous engagement with Indigenous knowledges in design practice. 'Whiteness' narratives highlight the need to consider the non-Indigenous designers' position in design practice and the inevitable impact of being non-Indigenous. The article will then present the International Indigenous Design Charter (Kennedy and Kelly, 2018) as a tool to address the need to engage respectfully and ethically with Indigenous knowledge in a blatant attempt to mitigate the impact of 'whiteness'. Yet, it is questionable if 'whiteness' can be fully removed from any engagement leading us to an impasse. The author offers two ways forward; firstly, non-Indigenous designers do not engage with Indigenous knowledges; secondly, if non-Indigenous engagement is to occur, the design industry foregrounds process over the artefact.

2. The influence of 'whiteness'

The International Indigenous Design Charter (Kennedy and Kelly, 2018) is based on the right of Indigenous peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional expressions of their cultures, including designs (United Nations 2007, p.11). Emerging from this is the debate over the level of participation of non-Indigenous people. The argument in a post-colonial environment is that any involvement of non-Indigenous people with Indigenous knowledges is a new attempt at maintaining non-Indigenous dominance. Said (1991) explains that knowledge about the 'other', and the establishing of this knowledge, creates power, while Carnes (2011, p.3) explains that non-Indigenous people naturally frame everything within a western colonial paradigm, and a western way of ordering the world, which means historically the perspective of the Indigenous voice is marginalized. Therefore, it can be argued, that when non-Indigenous

people are involved in the design process, prevailing colonial power relations will always emerge.

Adding to this debate, it is understood that although designers work to formal practices, their own cultural preferences and tastes impact on the production of solutions. Arguably, designers should become self-reflective and acknowledge this influence as part of their professional duty and ethical accountability as a designer and educators should teach the need to understand the impact of personal beliefs, race, religion, socio-economic class and other differences (Buck-Coleman 2010, p.191). Yet it is difficult for a designer to be self-reflective.

> "You cannot escape yourself. You have culture. Not necessarily one of appeal or relevance to your audience, though you may hope so, but the culmination of your evolution. To a large extent, regardless of how you present yourself, this culture will remain visible, a display of self, for better or worse, which cannot easily be distinguished or ignored." (Rowden 2004, p.133)

To interrogate this further, this article draws on the work of Emma Kowal, Professor of Anthropology in the Alfred Deakin Institute for Citizenship and Globalisation at Deakin University. Kowal presents the notion of the 'white anti-racist' to explain there are 'white' people who work with Indigenous peoples with good intentions.

The term 'white anti-racism' is aligned to progressive 'white' people who accept some responsibility for the poor state of many Indigenous communities and with their concern, have sought to help them. Kowal writes "white anti-racists prefer to think of their role as temporarily supporting Aboriginal people to reach their own goals until such time as their help is no longer needed" (2011, p.314). This involves a sacrifice on oneself for the pursuit of a greater goal (Stirrat 2008, p.412) and, as Kowal explains in the Australian context:

> "White anti-racists seek to generate new forms of national identity by exposing the unpalatable aspects of perpetrator history, so persuading White Australians to distinguish themselves from their (biological and social) ancestors." (Kowal 2011, p.320)

'Whites' want to be seen as being good and "it is those most privileged who provide the opportunity and means for voices to be widely heard" (2011, p.4). Carnes believes there is benefit to increasing the volume of those less heard, and this will help to demonstrate respect for Indigenous ideas and to ensure Indigenous ways are at the forefront.

Yet, Leslie Roman (1997, p.274) suggests that white "redemption fantasies," in which the good white "supposedly comes to know and be at one with the 'racialized other'" and his or her struggles against racism, may even be a new form of white privilege. It is based on the principle that at least the white person tried and became a better person in the process. The good-white narrative sees the white guy battle both the bad white guy and their conscious as they deal with their own moral struggles. Audrey Thompson states that notions of ethics look very different from the standpoint of white privilege where fairness and equity, as well as mainstream ideas of morality, are determined by the people who hold the power (2003, p.18). This leads us to a place of paralysis where white people are stricken by guilt rather than placing the situation at the centre of the discussion. White people exist in a tangle

not of their own making as they are born into a racist history of colonialism. As Thompson explains:

> "We do not now wish to choose whiteness or racism, but there they are, part of our world; so we try to distance ourselves from them, to show that we would unchoose them if we could. White guilt mourns genocide, slavery, land theft, lynchings, and broken promises as part of a past that can no longer be changed – and in so doing seeks to return to an imagined innocence. Since the past cannot be changed, we insist on being allowed to feel good about ourselves. Yet this is a solution only if the problem is white helplessness rather than racism. Taking on the alleviation of white guilt as an antiracist project keeps whiteness at the centre of antiracism." (2003, p.24)

According to Kowal (2011), there is always a danger the good 'white anti-racist' will revert to 'white' dominance and utilize status. To do such would ruin the goal (s)he strives to reach. It is argued if self-sufficiency is to be achieved, then 'white' input must be removed and progressively 'white' people must detract their influence. Carnes (2011) likens this to the concept of an apprentice with a master. The intent is the 'white' participant relearns history and reviews their beliefs of the world, creating an opportunity to minimize the 'white' voices in the conversation.

> "The stigma of Whiteness is resolved most completely, and most fantastically, through the figure of the child. The child does not wish to impose their beliefs, nor are they able to. The fascination of the child with the 'other' hides no agenda of self-interest or exploitation, and is not suspect. The epitome of innocence and powerlessness, the figure of the White child realizes the ultimate goal of post-colonial spaces: the inversion of colonial power relations. Through this imaginary inversion, the White anti-racist is cleansed of stigma." (Kowal 2011)

Adding to this debate is the concern of merging cultures. Winschiers-Theophilus, Zaman and Stanely (2017) acknowledge "a transcultural approach to indigenous knowledge preservation and digitization efforts with indigenous communities opens up a controversial debate about protecting versus integrating local epistemologies" (2017, p.419). In their research project created to achieve a community technology development, the authors conclude a recognition of contributions from all participants and a blending of knowledges was critical for success in their project. With deep immersion and full collaboration, cultures enter into a transcultural mode of engagement which reveals the challenging space of preservation versus incorporating cultural knowledges. Winschiers-Theophilus et.al call for a reconsideration of the methods and techniques associated with co-designing to recognize this shift in professional practice.

The idea of blending knowledges is acknowledged in other literary commentary. Marian Sauthoff (2004) refers to Indigenous expressions of South African design and the hybrid nature, or cultural mix, of design practice that underpins the visual representation of Indigenous knowledge in South Africa. She argues design practice in South Africa freely references the diversity of the cultural and ethnic mix drawing on cultural forms and Indigenous creative expressions to recreate meaning. This is representative of a social change, and Sauthoff argues, designers must be more aware of the broader impact of their environment on their design outcomes, critically reflecting not only on the designed object

but the sites and circumstances of how a design outcome was produced and will be used.

3. The International Indigenous Design Charter

Returning to the discussion of non-Indigenous participation with Indigenous knowledges in design practice, it is understandable with such complexity surrounding this issue there is apprehension and concern. Non-Indigenous input may result in an inaccurate representation of Indigenous knowledges due to the colonial constructs in which the engagement has occurred. An extension of this concern is the process under which we can ensure the dominant voice is that of the Indigenous knowledge holder. For this reason, the author identifies two potential ways forward. The first option is to have only Indigenous designers working with Indigenous knowledges. This may present limitations for some projects. The second option is for non-Indigenous engagement to occur, and the design industry foregrounds **process** over the **artefact** which is the central focus of this paper.

West and Akama (2018) refer to process when supporting the idea of designing *with* rather than *for* a community. West and Akama identify some of the challenges are exasperated by the concept of "design-as-problem-solving that places people into categories of a commissioning client or a passive audience" and the focus becomes a 'problem' for a designer to resolve" (2018, p.10). For this reason, West and Akama argue for designers to design appropriately there requires a shift in emphasis where designers do not speak on behalf of the community but act in respectful relation *with* the community through the design process.

The International Indigenous Design Charter (Kennedy and Kelly 2018) is a tool created to guide design practitioners on the process to engage respectfully and ethically with Indigenous knowledge in commercial design practice. It must be noted, the author of this paper is a non-Indigenous academic, researcher, design practitioner and also co-author of the International Indigenous Design Charter. The Charter document positions non-Indigenous people in the discussion and places the designer, not as the arbiter of what is right or wrong, but as a participant working with the custodians of Indigenous knowledge. The document attests this process must be Indigenous led to ensure knowledge remains with the owners and defenders of Indigenous cultural heritage.

The International Indigenous Design Charter (the Charter), conceptualized and developed in Australia, offers ten steps of best practice protocols to guide design educators and practitioners when working with Indigenous knowledge. These include Indigenous led with Indigenous stakeholders overseeing the design process; self-determined with respect for the rights of Indigenous peoples to determine the application and representation of their culture; community specific with respect for the diversity of culture; deep listening and ensuring inclusive and active engagement; ensuring ownership of Indigenous knowledges remains with Indigenous custodians; shared knowledge with courteous interactions and an awareness of Indigenous cultural realities; ensuring Indigenous people share in the benefits from the use of their cultural knowledge including any commercial engagements;

consideration for the impact of design over deep time (past, present and future); legal and moral rights and obtaining permissions as required; and implementing the Charter steps to safeguard design integrity and build cultural awareness in all stakeholders.

Primarily, the Charter was created to lead non-Indigenous people who have the opportunity to work with Indigenous people and engage with Indigenous knowledge in their design practice and outlines how to do this respectfully and ethically in a collaborative manner. The document can be used as a guide for all stakeholders of design practice including design practitioners, design clients and the buyers of design such as governments, corporations, businesses or not-for-profit organizations. The Charter was written with good intention, to empower Indigenous communities, and follows the principles of the United Nations *Declaration on the Rights of Indigenous Peoples* (2008). The declaration describes the right of Indigenous peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional expressions of their cultures, including designs.

The Charter was developed and launched in 2018 at the World Design Summit in Montreal. The document is acknowledged and supported by the International Council of Design (ico-D) and the Indigenous Architecture and Design Victoria (IADV). IADV recognizes the document will help both non-Indigenous designers and Indigenous designers working in or out of country. IADV's Indigenous Architect and advisor to the Charter, Jefa Greenaway (Greenaway Architects, IADV and Melbourne University), highlighted that in 2018 only 13 Indigenous architects can be identified as having graduated from architectural schools in Australia and anyone operating as an Indigenous architect is very much a trailblazer who will encounter aspects of their professional practice which may not have been discussed within the architectural community (cited in Sebag-Montefiore 2016). Similarly, these comments resonate in other areas of design practice where only a small number of Indigenous designers are available for potential Indigenous led design projects around the world.

The Charter document has not been active in industry for a long period of time. Although discussions are emerging, feedback was most apparent at the Australian *Indigenous Design Thinking Conversations* presentation as part of Melbourne Knowledge Week, (City of Melbourne, 2019). Each of the six speakers at the Symposium were Indigenous industry and design professionals who provoked a rigorous discussion; Jefa Greenaway (Greenaway Architects, IADV and Melbourne University), Marcus Lee (Marcus Lee Design), Kyle Vander-kuyp (Schiavello Group), Michael Hromek (WSP), Nimrod Wies (Eness) and Master of Ceremonies, Shelly Ware (presenter on Marngrook television program, Melbourne).

Questions to emerge from the audience, who were design practitioners and purchasers or stakeholders of design, can be summarized as; time, cost and control. Concerns were raised that **time** was needed to engage with deep listening and was not always adequately accounted for in a schedule or a budget. The panel were united in their response to this point saying if there is a project with Indigenous content, organizations need to understanding the project would take some additional time but this would only have a positive outcome on results. An audience member questioned how to determine the **cost** to include Indigenous

knowledges and whether there were intangible benefits by publicly increasing the profile of Indigenous knowledge in the broader community without the need for financial recognition. To this Greenaway made the point that people pay for engineers with many years of university education however, you must consider the cost of engaging with 40,000 years of Indigenous knowledge passed on over many generations. Ware elaborated by explaining there were many requests for Aboriginal people to do things for free because they are Aboriginal and they should want to pass on their culture to 'do the right thing', yet someone was making money out of their knowledge and she suggested it was not Indigenous people. Lastly, concern emerged about managing the design process and the designer's ability to maintain professional design integrity and **control** when working with an Indigenous community. Hromek reminded the audience that designers need to remember the first point of the Charter document, Indigenous led. Greenaway provided the following advice; the starting premise should be to leave all egos behind when working with Indigenous knowledge and remember the designer is often the least knowledgeable in the room.

While the above is only a brief account of the feedback provided in the symposium and further details can be obtained from the live-recording (City of Melbourne, 2019), presenters clearly articulated the challenges of working with Indigenous knowledges and resolved the Charter document's guiding principles were essential to change current practices and enhance engagement methods. They agreed the concepts of community led, self-determined, community specific, deep listening, using community knowledge and shared knowledge with shared benefits are all steps that will positively impact on design practice. The presenters concluded this rich discussion would only improve professional practices in the coming decades however, the changes in the way designers are taught, the expectations of an industry and the shift required in professional practices will continue to present some challenges.

4. Foregrounding process over outcome

This article highlights the complex tensions at play in the discussion of non-Indigenous designers engaging with Indigenous knowledges. For this to occur, there needs to be a shift in design practice where designers appreciate their non-Indigeneity and practice knowing they are the least knowledgeable in the room. This paper draws on the philosophical position of Kowal (2011) and Carnes (2011) framed in the discourse of white sovereignty and colonialization, which emphases that whiteness will always have impact on any engagement. Understanding and applying the concepts of 'white anti-racism', and reducing white noise in discussions when non-Indigenous are working with Indigenous knowledges, is important to change the process of design practices. This paper argues the design industry needs to turn the spotlight to the importance of process over the artefact and celebrate the ethical and appropriate way in which we, as designers, are guided by Indigenous knowledges to a design outcome.

There is a risk the Charter document, endorsing non-Indigenous designers working in

collaboration with Indigenous communities, may be seen as supporting pre-existing colonial power structures and is a new attempt at maintaining power and 'white privilege'. Yet, the intent of the Charter document was to provide guidance on how designers, when privileged with the opportunity to work with custodians of Indigenous knowledges, could change their focus to process over design outcomes. This would provide the landscape for a relearning of history and challenge the non-Indigenous designer's belief of their world to eventually create a space where Indigenous voices are privileged.

5. Conclusion

This article places a spotlight on the ongoing impact of whiteness in commercial design practice. The author agrees there are many times when non-Indigenous designers should not be engaged with Indigenous knowledges. This is particularly pertinent when the role the designer as the knowledge holder of design practice is at tension with the role of the custodian of Indigenous knowledges. The culture of the designer, and their good intention to amend the wrongs of the past, have the potential to reinforce colonial power structures.

If it is deemed suitable by Indigenous knowledge holders for non-Indigenous designers to engage with custodians of Indigenous knowledges, cultural awareness needs to be developed and understood. The decision for participation is an Indigenous choice and an Indigenous community can withdraw their input at any stage when they do not feel their representation is self-determined. However, this article introduces a new consideration; if is decided by stakeholders to be a joint project with Indigenous and non-Indigenous input, the **process** of how the outcomes are achieved should determine the success of the project, and not the **artefact** itself. The International Indigenous Charter Document provides guidance to navigate the process with ten steps of best practice protocols. It is only effective if the ten steps are followed rigorously, are Indigenous led and the benefits are returned to the community. The Charter document, currently an ethical obligation, provides the framework for the design community worldwide to reconsider how they acknowledge impactful design and reward design outcomes. Taking a more central focus on **process** would provide significant steps towards a recognized, rigorous practice whereby the origin of cultural knowledge is protected and celebrated, self-determined and Indigenous led.

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SYNERGY

Anti-Oppression Mindsets for Collaborative Design

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Abstract: There is a growing synergy between design research and social justice. As design moves from commercial contexts into the community, we become advocates for creating more inclusive and equitable systems. But the traditionally nonpolitical posture of design practice leaves us ill-equipped for approaching complex challenges. Learning new approaches to be open to other perspectives improves our insights and fosters deeper collaboration. Without an awareness of historical privilege and oppression, we can unintentionally harm the people with whom we collaborate. Design Research practices are not yet considerate of people at the margins– people we may be working side by side with to unravel wicked problems. Drawing from multi-cultural psychology and design for social justice, I propose ways that collaborative design projects can be more aware of power and equity throughout the process.

Keywords: racism; social justice; decolonising design; collaboration

1. Introduction

"The production of knowledge is a social political process, steeped in history (Torre, 2009, p. 177)."

Until very recently, Design education has centered around business needs, maintaining an apolitical posture. New movements in Design are shifting these creative, holistic tools from business-driven to community-driven settings. Such new work applies the skills for shaping the tangible, everyday experiences of people onto the complex social and ecological challenges that are threatening our futures. However, many Design approaches are ill-equipped to consider and work with difficult, politically involved, social elements like structural oppression that are the foundation of many of our societal issues.

We need new approaches to truly see current systems and work with communities in ways that are just. Most designing for social-good projects involve diverse, multiracial participants, and as our field grows, practitioners will be increasingly diverse. However, our collaborative approaches do not adequately consider the influence of race and racism on the systems we design for and the dynamics between facilitators and participants. An anti-oppression approach for design can build fluency around the role that racism and other historically

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marginalizing identities play in how we structure, facilitate, interpret, and storytell our co-creation work.

The stance of color-blind racism pervades most design approaches, maintaining the belief that we can or should ignore race because it no longer shapes experiences in modern society (Ortiz Guzman, 2017, Ogbonnaya-Ogburu et al, 2020). Yet our design fields remain whiter than the national or global population, and the products created by designers continue to overlook the experiences of users who are not white. “Racism is pervasive and ordinary in our society’s digital platforms and the larger socio-technical systems in which they are embedded,” is how Ogbonnaya-Ogburu and her co-authors reframe a starting point for ethical approaches to design processes (2020, p. 2). Are we equipped with knowledge and methods that would help us incorporate such an awareness into our solutioning? Recent work in Participatory Design describes approaches for working with “marginalized communities,” but this work rarely reflects on how to acknowledge race in that design process (Björgvinsson 2012, Le Dantec 2012). A lack of reflexivity can be problematic. Boehnert, Elzenbaumer & Onafuwa offer the critique that “what may at first glance seem neutral also reveals underlying assumptions and prejudices resulting from social distances between designers and [their] diverse audiences (2016).” Without addressing racial differences more directly, design processes can perpetuate a color-blind approach to work on social issues that, presumably unintentionally, denies structural oppressions.

Such limited design practices miss crucial elements of systems that have historically and deliberately marginalized people based on race, gender, religion, ability, sexuality, and more. The nature of Participatory, Social Innovation, and Transition Design approaches gives voice and decision-making power to traditionally marginalized people. But it also may put typically white designers in positions of power to dominate research processes, ignore important stories, and continue histories of extracting and abandoning different communities.

The work of this paper is to propose ways that researchers from all backgrounds can be more adept at seeing, hearing, understanding, and acting on the effects of race and racism in contemporary society. This consideration is especially crucial for new design practices that value deeper collaboration because these are places where we can empower, and we can harm. Here I will draw on Critical Race and Feminist theories to shift design practice out of color-blind mindsets and into political stances that seek to disrupt oppressive practices at the root. Additionally, this paper will draw on guidance from multicultural psychology to step through the ways that we, as collaborators, should be more mindful when working across difference. This leads to a framework of harm and empowerment, identifying key areas where color-blind research processes can alienate participants or lift up and celebrate alternative experiences. I hope to support ongoing justice-oriented design approaches in establishing a more reflective, self-aware design process that finds inspiration in other ways of knowing.

2. Defining an Anti-Oppression Stance

We need both a political, critical worldview and an ability to listen to stories from alternate places to shape a more resilient path to the future. As Design takes a position as intervener-for-good in socio-political problem spaces, we need mindsets that help us see the full picture. Scholars of color from around the world, particularly from the Global South and the Decolonising Design movement, challenge the dominant paradigms of design. From this critical perspective, these scholars assert that design actively contributes to oppressive practices, and therefore must actively consider ways to undo structural bias in every design project. The Decolonising Design editorial statement from 2016 asserts, "We strongly believe that design, as a field of study, has systematically failed to address the questions of power that have shaped its own practice (Ansari et al., 2016)." As Design breaks new ground in holistic strategies for intervention, we cannot omit the political postures needed to see current systems for what they are: corrupted by historical injustice.

Histories of dominance act as blinders that keep many of us from seeing the full truth of the world. Throughout the history of the United States, people in power built white supremacist thinking into the institutions that inform our worldview: government, education, and media (hooks, 2014; Kendi, 2017; Morales, 2019). These mechanisms shape our perspectives with stories of why some groups of people are not worth respecting. We justify racially biased practices like incarceration, gentrification, and segregated education systems through stories of *undeserving*, rather than *under-served* populations (Bonilla-Silva, 2018; Kendi, 2017).

Yet there are substantial barriers to consciousness-raising. Multicultural counseling experts in Psychology, Derald Wing Sue et al., describe a resistance to learning about and talking about inequity: "Issues of race, gender, sexual orientation, and disability seem to touch hot buttons in all of us because they bring to light issues of oppression and the unpleasantness of personal biases (2015, p. 45)." Robin DiAngelo (2018) has named this "White Fragility," which is particular to white people who can often live life insulated from needing to understand racism. Sue at al. describe how discussions of race are too easily brushed aside because of this discomfort, "As a result, race becomes less salient and allows us to avoid addressing problems of racial prejudice, racial discrimination, and systemic racial oppression (2015, p. 42)." The structural inequality that new design approaches hope to confront cannot fall only on the shoulders of people of color. We all need to become racially fluent.

A core purpose of racist ideology is to teach us to blame individuals rather than structures, which is a particularly dangerous trap for designers who work to understand and intervene at a systems level. Ibram X. Kendi describes white supremacist thinking this way, "This is the consistent function of racist ideas– and of any kind of bigotry more broadly: to manipulate us into seeing *people* as the problem, instead of the policies that ensnare them (2019, Loc. 152.)." Aurora Levins Morales writes about the stories of oppression that have dehumanized people and the unjust structures of society that distort us into "making it look like the reason we're thirsty is not that we're being denied water, but our own lack of initiative in the midst of plenty (2019, p. 55)." When we are blind to the injustice that has happened for

centuries, then we are left to create stories that blame some groups and applaud others for their achievements. If we are to intervene in the right places, it is essential that we develop a critical lens that examines bias within systems and questions their roots.

3. Developing Cultural Competence

Derald Wing Sue's in-depth analysis of interpersonal interactions can help prepare design researchers to work with participants with wisdom and respect. His core textbook in Multicultural Psychology, *Counseling the Culturally Diverse: Theory and Practice* (2015), offers advice for providing therapy to clients from different cultural and identity backgrounds. He outlines the work of developing a cultural competence that is needed to work across cultural boundaries. When we, as design collaborators, look out into the world for new perspectives that we then interpret and materialize, it is worth doing the work of deconstructing our subconscious explanations for the inequities in our societies.

Because the structures of colonial, white supremacy unwittingly teach us to be dismissive of other ways of being, working to undo that will offer a new way of seeing the structures and daily experiences of the people who live different lives than us. It may not be devaluing of a race or ethnicity as a whole, as it was in the past; it is more likely that racist thinking is built into our beliefs about gentrification, public schools, poverty, food, immigration, or access to services. Sue points to the emotional outcomes of multicultural training, as "less intimidation and fear of differences, and an increased compassion for others, a broadening of their horizons, appreciation of people of all colors and cultures, and a greater sense of belonging and connectedness with all groups (2015, p. 34)." Adding to our research techniques to include a more profound openness to the experiences of people who have been marginalized will have a synergistic benefit to our design outcomes while protecting the people we connect with along the way.

We can all benefit from the work of checking on our internal stories of why some groups of people are not doing as well as others. Our cultural interpretations are at work when we engage participants in research and design practices. The norms of our practices are not universal nor neutral: "Many of our standards of professional competence are derived primarily from the values, belief systems, cultural assumptions, and traditions of the larger (Eurocentric) society (Sue et al. 2015)." The authors may be referring to modern psychology here, but we can trust that it applies to our Bauhaus-informed design practices and the Scandinavian heritage of Participatory Design. Those of us who have lived our lives within a EuroAmerican context may have a hard time seeing the boundaries of these norms.

In *Design for the Pluriverse*, Arturo Escobar warns, "Do design practices participate in the sociology of absences by overlooking non-expert subaltern knowledges (2018, loc. 1669)?" If we fail to open up our mindsets through deep reflection on our biases, we run the risk of missing out on hard-won wisdom present in the standpoints of other ways of navigating. Cultural humility and cultural competence are vital in unlocking those subaltern ways of knowing. This greater openness to ideas from different types of people is an essential

posture for design work that is informed by and shapes culture— which is to say, all design work.

4. Anti-Oppression Approaches

Table 1 Anti-oppression approaches for collaborative projects

	Areas for Harm	Opportunities for Empowerment
Interpersonal	Othering and microaggressions	Build trust and accept mistrust
	Trusting meritocracy	Become comfortable with discomfort
	Exerting power	Share power and expertise
Interpretation	Overlooking structural inequity	See the entire system
	Emphasizing weaknesses	Look through the community's lens
	Dismissing individual stories	Value individual stories
Structure	Determining goals externally	Define the problem-space together
	Abandoning projects	Plan to continue

To facilitate successful co-creation sessions that reduce harm and increase insight, I have synthesized recommendations from across socially oriented design and multicultural psychology. I come to this as a white, female, design researcher who practiced in commercial settings for many years and began to transition to community contexts without taking the time to learn community-based or anti-oppression approaches. This set of postures reflects my ongoing, deliberate work to recognize the necessary anti-racist mindsets and techniques that I did not learn in traditional design practice. The framework in Table 1 proposes how designers might prepare to lead projects with racial fluency and attention to anti-oppression strategies.

4.1 Interpersonal Interactions Need Care

Cultural competence is required when working alongside communities who are at the center of complex problems. When we haven't reflected enough on the role that race plays in society, we can reveal ways that we think of some people as "other," non-standard, or exotic. Racial microaggressions are an example of careless actions that disrupt relationship-building. These are slights that non-white people experience nearly every day in the United States. Common racial microaggressions that people face over and over again include: asking to touch a black person's hair (this objectifies their body and signals their appearance as abnormal), complimenting someone's ability to speak English– which happens disappointingly often to American-born people of color, especially Asian Americans. This reveals that the commenter has expected their English to be weak and marks the recipient as non-native. Also, comments such as, "There is only one race, the human race," denies the role that race plays in the experiences of people in a society (Sue et al., 2010. p. 276). In a diverse setting, these actions and comments can signal that the offender has not done the work of reflecting on race and privilege.

Lead designers should be careful to mitigate the automatic power they have as leaders

when working in small and large groups, even in one on one interactions. Participatory and collaborative techniques involve particularly intimate interactions between designers and non-designers. Many forms of power are present when a diverse group of people come together. It is important to learn about and reflect on the way race, sex, gender, ability, education, access, wealth, authority, and many other attributes shape who has priority and who may be left out. As the people in the room with the most expertise in designing, we may unintentionally dominate many discussions about process without giving enough space and attention to those who have questions and concerns. Time should be spent planning ways to care for all people in the conversations and working sessions.

It is likely to take time to build trust between designers and community collaborators. There is an awkwardness to the new relationship for any set of participants. For those who have experienced racism, sexism, classism, and various types of othering, it is natural for them to feel distrustful. We can approach this skepticism with empathy by remembering that much research before us has had, "a legacy of ethnocentric and racist beliefs and practices that had harmed people of color (Sue et al., 2015, p. 8)." When there is resistance to our engagement, we should dis-identify personally with the work and understand that caution is a natural defense to the unknown. Take time to listen to concerns and re-center the work on the needs of the community at that moment.

Christine Marie Ortiz Guzman (2017) offers a poignant critique of design thinking processes as relying too heavily on meritocracy. Jonathan Mijs confirms the problems of meritocracy, describing how, "opportunities for merit are themselves determined by non-meritocratic factors (2016, p. 14)." In status quo thinking we take group voting and sharing ideas aloud in unstructured conversations as a natural way to distribute power, but in practice meritocracy upholds existing unequal power structures. Those with the most power in the room will likely feel comfortable and confident to speak the most and their ideas will be given the most attention by others. Essential voices can be ignored if space if not made to hear from those who are typically at the edges. Without tools to actively redistribute power, we may continue to privilege those who have always been centered in the design process.

In a community-based project a few years ago, my team learned a hard lesson in valuing other forms of expertise. I was part of a team of "design thinking experts" who were hired to bring new thinking and user perspectives into a philanthropic organization. The project focused on understanding poverty and uncovering new opportunities in the local area. Our design team walked into the project as the experts, ready to apply standard tools to a complex project on inequity. Several of the program directors at the organization, with in-depth knowledge of their areas of focus (education, housing, immigration), pushed back against our naïve application of design tools. It was a frustrating lesson in the importance of sharing expertise. After our resistance to being questioned faded and cooled, we learned a great deal from the holistic, systemic perspectives they built into new design approaches. It is essential that we rid ourselves of our need to be the experts. A posture of partnership to share knowledge and leadership is required to respond to the dynamics of complex social challenges.

Designers involved with social issues must overcome the learned discomfort in talking about race and racism, to understand the full context of challenges that most often have a history in structural, purposeful inequality (DiAngelo, 2018). As educator Beverly Tatum advised, it is very difficult to avoid racist thinking when embedded in unjust societies:

> "Because of the prejudice and racism inherent in our environments when we were children, I assume that we cannot be blamed for learning what we were taught (intentionally or unintentionally). Yet as adults, we have a responsibility to try to identify and interrupt the cycle of oppression (1992, p. 4)."

Multicultural Psychology advises developing sensitivity and wisdom as "an active, developmental, and ongoing process that is aspirational rather than achieved (Sue, 2015, chapter 2)." The mindset of anti-oppression is a continuous learning experience.

4.2 Interpretation that Values Marginalized Voices

To wield our power as researchers justly, we must develop an aptitude in issues of structural inequity. Design can learn a great deal from the critical thinking of equity-oriented scholars who can teach us to hold a healthy skepticism about institutions built by the powerful. We need to learn to question the structures that Bonilla-Silva describes as, "the particular social, economic, political, social control, and ideological mechanisms responsible for the reproduction of racial privilege in a society (Bonilla-Silva, 2018, p. 9.)." Similarly, intersectionality author and educator, bell hooks, consistently uses this phrasing, "imperialist white-supremacist capitalist patriarchal values (hooks, 2010, p. 15)," to describe the structures that shape our democracy.

When seeking to understand impoverished or oppressed settings, an unfortunate habit is to amplify the bad and ignore the good, because we are oriented to seek ways to intervene. Ogbonnaya-Ogburu et al. (2020) warn the HCI community, "there is a tendency to assume deficit narratives, in which communities of color are cast as lacking something that can be supplied with technology-based interventions (p. 9)." Grant & Villalobos (2008) warn against defining problems from an external perspective, "The identified issue may only be a symptom of something else altogether; the issue may not actually be a problem in potential users' eyes; or they may have other, more important needs and aspirations to address (p. 30)." These mistakes can bias our analysis and storytelling, missing important opportunities to leverage strengths and address meaningful problems. More importantly they can perpetuate detrimental stereotypes about different types of communities.

When we collect stories, if we are not attuned to the different experiences that people hold, we can overlook or underestimate the importance of anecdotes about oppressive structures and interactions. Sue et al. (2015) have researched instances of such dismissal in counseling, but it is likely to happen in qualitative research as well, where "Many people of color describe how their thoughts and feelings about race and racism are often ignored, dismissed, negated, or seen as having no basis in fact by majority group members (p.11)." Through synthesis and analysis stages it is natural to prioritize ideas that have some sort of energy

around them, and discard ideas that have less potential. We must take caution that we are not giving more attention to problems we understand personally, and placing less value on those we understand less. Ortiz Guzman (2017) offers a new tool for capturing

"not just individual lived experiences but also the role of institutional and systemic forces. We have adjusted the user needs statement to be: (user) needs a way to [user need] because [user insight] but/and [level(s) of oppression at play] (p. 48)."

In this way, we can make space to consider equity throughout the facilitation and creative outputs of a traditionally oppression-agnostic process.

A strength of the design thinking process, and many other forms of design that draw inspiration from qualitative research, is that only a few powerful stories are needed to inspire change. Ortiz Guzman (2017) identifies this as an equitable practice because it "places value on the personal and emotional, the contextual and specific (p. 29)." In feminist practice, the concept of standpoint is powerful. It is the idea that people who are forced to experience systems from the margins will have more insight into how they truly work. They can offer more profound, more accurate, more justice-oriented perspectives (Wylie, 2013). In the United States, this means that people of color are likely to have more insight into social structures than the white majority, and women will have gained a more critical perspective on sexism from navigating traditionally male-dominated institutions. This approach is emphasized by Maria Elena Torre (2009) and in Bagele Chilisa's textbook, *Indigenous Research Methodologies* (2012), in which she proposes that we should "conduct research in such a way that the worldviews of those who have suffered a long history of oppression and marginalization are given space to communicate from their frames of reference." In design, when we are seeking points of inspiration and insight, it is not necessary to focus on the majority and most common experiences. We can value what we determine to be most important or most useful.

4.3 Structuring Equitable Projects

Because the experience of working in a true context is so valuable to designers, we can forget to ask ourselves what the community gains from our participation. Do their goals for the work truly align with our outputs? The way design is typically practiced, it has a shorter timeframe than other community-based practices. We should ask, will needs be satisfied by a series of concept sketches, or insights about their needs? Grant and Villalobos (2008) discuss the concerns for setting expectations carefully, they write, "There are serious ethical implications in setting up a project that promises to help people, which is then unable to fulfill the promises and expectations that it has helped to raise (p. 34)." Practitioners and researchers need to be clear with community groups the timeframe available for the work, or find ways to make longer-term commitments to the project. In academia, leaving when the semester is over, rather than when the community it finished can damage trust between partners. Unfortunately, it often takes a long time to build rapport and trust, and then to build familiarity with design practices, before true collaboration can begin.

Community facilitator Erica Dorn has suggested finding ways to understand and learn from the community on their own terms, if we cannot commit to long-term engagement. We can volunteer or spend time with a group of people to understand their experiences, in a way that is beneficial to them (personal communication, April 15, 2020). When we make time for the ongoing relationships that many projects require, Participatory Action Research and others find ways to structure long term engagements for community-based work.

It is an important task to make a clear and transparent commitment about the project scope, the definition of what issues to tackle, and how leadership will be shared. As Light and Luckin (2008) write, "If tools are designed to make change, but it is only change as decreed by the people in control of the design process, what kind of change is it (p. 10)?" It can be difficult to align our project-based needs to the longer-term work of deep collaboration. Grant & Villalobos (2008) remind us that true engagement and equitable partnerships require a much deeper involvement than simply asking for feedback on ideas: "In this approach, people's only real involvement is to confirm decisions taken by others, and the power to make real decisions rests with the designers and experts (p. 16)." In the best cases, we can find ways to continue the work with partners beyond the first phases of needs identification or concept generation. Helping with implementation and building capacity for self-determination can deliver lasting value from our work.

5. What Anti-Oppression Design Practice Might Look Like

Although it requires a shift in our work processes, it is worth the additional time and effort of building relationships and supporting equitable decision-making. Adapting to the needs of the community is the only way to deliver offerings that are *of* and *for* the people who will ultimately own them. When we are aware of how some voices in our society are oppressed while others have learned to dominate, it becomes clear that additional care must be given to be sure that the contributions of marginalized people are acknowledged and considered.

These approaches can foster deeper, healthier collaborations in socially diverse settings beyond design for social impact projects. In any context where we are seeking to use design to create more desirable futures, we should take care to consider whose experiences are included, and who's are overlooked, in shaping that future. If we continue to ignore the role of race and structural oppression in our projects and their contexts, we may miss critical opportunities for insight. Embracing the self-reflection involved with acknowledging our own privilege and power and seeking to understand the different experiences of others can lead to synergistic practices that fulfill multiple needs. These are crucial steps toward de-centering whiteness in design practice and undoing the structural oppressions that are at the root of so many of the social and ecological challenges we seek to improve. When we incorporate the subjectivity of our perspectives into planning a complex design project, and then deliberately involve people with alternative standpoints, we can ensure more of the problem will be understood and incorporated into the solution.

Developing a more critical lens to see more of the system leads to finding more collaborators and more opportunities to disrupt biased systems from the root.

6. Conclusion

When designing with and for a community, we are taking on more responsibility to intervene in systems that will have a more significant impact than traditional commercial settings. We must ensure we see the entire picture and structure our projects in anti-oppressive, ways. We are now asking for a seat at the table to participate in long-term and deeply involved topics, and we need to do that with equity.

Attention to how we might harm and empower in our collaborations, through the practices outlined here can begin to prepare designers to understand and implement projects in diverse contexts that connect to communities ethically and with wisdom. We must continue to listen to the critique offered by those in the Decolonising Design movement and learn from the healthy skepticism in Critical Race Theory and Feminist practice to increase chances for success and reduce unintentional harm in our projects.

This paper seeks to further Design Research's ability to understand and affect systems-level change. New, more political design practices must recognize the responsibility inherent in deep collaboration and take time to support those we work with. Leaving behind the color-blind processes, an anti-oppression mindset acknowledges that different people have had very different experiences of the same system. Therefore, more care is needed our design approaches. It also creates opportunities to learn from different perspectives, if we can position ourselves as open to listen.

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Coffee Farms as Design Labs: Manifesting Equity x Design Principles in Practice

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Abstract: New forms of co-design, as a mechanism for collaboration with historically marginalized communities, continue to emerge. From short academic experiences to Corporate Social Responsibility (CSR) initiatives, these programs attempt to highlight the value and importance of co-design in reducing equity gaps, producing relevant outcomes, and broadening participation across stakeholders. In doing so, these initiatives run at risk of reproducing a variety of challenges related to power, ethics, and gender among others, therefore requiring continuous examination and experimentation to address such issues. In this paper, we analyze the implementation of an interdisciplinary course in design carried out at two coffee farms in rural Colombia. Using the EquityXDesign framework, we critically analyze how the course approaches these known challenges in community-based design, and discuss modifications to the framework towards more inclusive and equity-driven design.

Keywords: co-design; equity; coffee

1. Introduction

"The only important thing about design is how it relates to people." –Victor Papanek

Recent years have seen a rise in inclusive and participatory principles in design, co-design practices, and community-driven exercises. From "alternative spring breaks" in colleges, to Corporate Social Responsibility (CSR) initiatives at companies, to community development projects led by NGOs, there is growing awareness of the importance of co-design. However, many of these initiatives operate at the expense of communities, inevitability re-creating the power hierarchies they had hoped to level. Gardner, in Discordant Development, articulates the extent to which multinational corporations leverage the narratives of "community engagement" to further disenfranchise the rural poor of Bangladesh (Gardner, 2012). This paper offers a reflection on the role of academics and practitioners during the implementation of a community-based co- design experience at two coffee farms in rural Colombia. It aims to examine an ongoing co-design collaboration across 4 groups:

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i) university students from the United States (MIT Media Lab and Harvard University); ii) university students from South America i.e. Colombia, Peru, Guatemala; iii) Colombia-based development practitioners i.e. the C-Innova Innovation Center for Appropriate Technologies in Colombia; and iv) coffee farmers and farming communities of Fusagasugá.

In 2017, C-Innova began a partnership with coffee farmers in the highlands of the Fusagasugá region with the intention of democratizing access to technology used for coffee production. For decades, coffee farmers have been severely underpaid for their produce by Colombia's National Coffee Federation, partly due to the lack of robust machinery to process the coffee beans after they were harvested. The partnership sought to leverage emerging technologies to improve the means of production for these farmers, using co-design as a methodology. As such, C-Innova began a collaboration with engineers, designers, social scientists, and business students from universities in the United States and South America. Once a year, for the month of January, students and development practitioners would live and work alongside coffee farmers with the main goal of co-designing technologies, practices, and strategies to improve coffee production. Coffee farms soon became design labs.

This paper offers a critical examination and reflection of co-design within the context of coffee farms and farming communities of Colombia. In particular, we reflect on a co-design collaboration designed as a one-month course curriculum called "Technology Design for Coffee Production Course: A Co-Design Experience", conducted in January 2019. Using the EquityXDesign framework as a critical lens, we examine these power dynamics and the nuances of co-design. We ask: *What does co-design across fields, cultures, and geographies look like in practice? To what extent can we mitigate power inequalities in co-design? How can we manifest equity values in each step of the design process?*

EquityXDesign emerged as an alternative framework to design thinking in 2016:

> "[EquityXDesign] is a process for anti-racist and equitable design; it is guided by three central beliefs: innovation's need for inclusion and intentional design, the indistinguishable relationship between the past and the present, and our moral imperative to live in the future we desire to create." (Ortiz, 2017).

We begin by providing context to community-based co-design[1], discuss related work within the coffee industry, and highlight key challenges in co-design. We then articulate the principles behind the design of the one-month co-design course. Next, we introduce the EquityXDesign framework as a critical lens to reflect on the course and offer case-studies of each principle of the framework. Finally, we offer our key reflections, takeaways, and modifications of the EquityXDesign framework. Ultimately, our hope is to provide reflexivity on the role of co-design between academia and local communities, with the aim of offering a new framework for future researchers to assess and design equitable bottom-up collaborations.

1 Throughout this paper, we use the term "co-design" in reference to what Sanders & Stappers (2008) allude to as the 'user as partner model', but different from "co-creation", defined as "any act of collective creativity".

2. Related Work

In the past decades, participatory design has become a highly contested space (Kensing & Bloomberg, 1998; Sanders & Stappers, 2008). Some have detailed how rural communities should be part of design processes i.e. community based (co-) design or co-creation (De Couvreur & Goossens, 2011). Ssozi-Mugarura (2016) for example, reflects on the role of reciprocity when collaborating on water-related projects with rural communities in Uganda. Chamberlain (2013) describes and reflects on different mechanisms for engagement such as using conceptual designs to facilitate conversations or using immersion sessions to surface learnings, later to be used in designing along with rural communities in West Wales. Hussain (2010) proposes a framework for psychological empowerment in the context of PD processes with children in Cambodia. This participatory, community-tailored approach to design contrasts with Universal Design, developed by Steinfield in 2012, which argues for design that optimizes for as large a user group as possible, as opposed to tailored and localized design that PD proposes.

Agriculture has been a recurrent theme in community-based design initiatives (Dubbeling, 2009; Cerf, 2012; Murgue, 2015). Globally, coffee continues to be one of the most common traded agricultural commodities according to the FAO (2018). However, literature around community-based design in collaboration with small coffee farmers, coffee collectives, and coffee farms remains scant. Exceptions include Andreotti's (2019) work on designing agroforestry systems for coffee growing, Souza's (2010) study of participatory mechanisms for coffee tree intercropping, and Ronner (2019) work on co-design methods applied to climbing bean cultivation. Silverstein (2012) work investigating studies on "participatory ergonomics" for coffee harvesting and Leshed (2018) work on collaborative coffee cost calculation, also explore product-driven design in this space. Our study adds to this body of research and advances the discourses around in-field co-design collaborations, with coffee farms as design labs.

Co-design provides has been growing in popularity, given its numerous advantages compared with hierarchical design approaches. Co-design brings the communities into the design process, blurring the lines between the designers and beneficiaries, empowering communities with the tools to design their own futures. This community-oriented approach to design also seeks to re-center user needs in their local context (David, S., Sabiescu, 2013). As articulated by De Laet & Mol (2000), meaningful design needs to take into account the communities' rituals, practices, and value systems. Co-design de-centers the designer, creating an (ideally) horizontal power dynamic between designer and communities (Muashekele, 2019). It aims to make space for the inclusion of a multiplicity of voices (Björgvinsson, 2010).

Despite its clear advantages, participatory and co-design have received their fair share of criticisms. Cooke & Kothari (2001) have pointed out that participation, in many of its current forms, can serve as a mechanism to legitimize and reinforce the interests of the powerful (Cooke & Kothari, 2001). Feminist theorists posit that participatory design can unexpectedly

reinforce toxic leadership as a power vacuum is created due to the horizontal nature of power dynamics in co-design (Freeman, 2013). This is further exacerbated by the fact that mere access to means and resources for technological innovation can signify a position of dominance and privilege (Merritt, S., & Stolterman, 2012). This paper wrestles with these issues of equity in co-design initiatives and provides recommendations on leveling power dynamics.

In the following sections we detail the course: "Technology Design for Coffee Production Course: A Co-Design Experience", conducted in January 2019, as a case study. We discuss the thinking, planning, and designing behind the course and detail the projects and outcomes from the collaboration between university students, C-Innova, and the coffee farming communities of Fusagasugá.

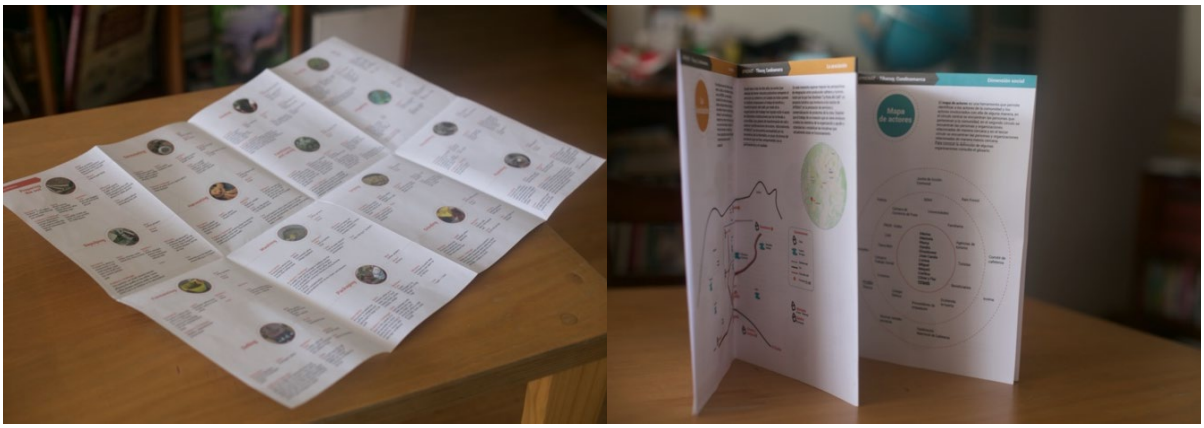
3. Methodology

3.1 Overview

The course presented in this paper is part of a joint research project between universities around the world and small coffee farmers in rural Colombia using coffee farms as their design labs. It included 16 participants from 6 different countries. The key goal of the course was to introduce participants to a co-design methodology, build solutions for coffee farmers, and deliver prototypes in 3 domains: technology, marketing, and social organizing. The course relies on collaborative design methods, as well as methods for design education in the context of development such as the Creative Capacity Building (CCB) framework (Taha, 2011). Utilizing the CCB methodology allows for the recognition of a multiplicity of knowledge, while making design-as-practice accessible to all participants. As Sanders (2008) notes, co-design provides a platform for those who are not formally trained in design to participate in the process. Activities included taking part in agricultural practices around coffee, hands-on sessions on using local technology for coffee processing, and field visits to farms, markets, as well as local and national organizations part of the coffee value chain to gather information and gain a better understanding of the coffee production process. These activities were conducted in tandem with the principles of Participatory Action Research (Borda, 2006) and the design thinking framework i.e. empathizing, defining, problem framing, prototyping, and testing, in collaboration with coffee farmers.

The course was part of a longer engagement with 2 coffee farming collectives: De Finca and APRENAT. De Finca is a local coffee farming organization from the Guavio Alto community in the Sumapaz region "passionate for the production of artisanal, organic, quality and sustainable coffee". APRENAT is a local organization from the Tibacuy region in Central Colombia. Their mission is to "contribute to the conservation of natural resources, ecological diversity, and the ancestral farming culture in the Tibacuy region". In order to better prepare the course participants for the co-design collaboration, we developed a series of documents describing the coffee production process in each farm, the technological infrastructure

involved, as well as the relationships and human networks surrounding the coffee process using Empathy Maps, Stakeholder Maps (Tschimmel, 2012), and Value Canvas (Atasoy et al., 2013) tools among others (Figure 1). The course adopted the notion of *coffee farms as design labs* as a way of de-centering white-coat labs as sites of knowledge production. In the sub-sections below, we further articulate the 3 learning pillars of the course: (1) Background and



Context, (2) Co-Design Immersion, and (3) Co-Production.

Figure 1 *Foldable materials created for participants. Each foldable included cartographic information for each farm, stakeholder analysis, empathy maps, value canvas, and brief overview of the organization (left). The foldable also included a comprehensive visualization of the coffee production process for each farm (right).*

3.2 Context

The coffee course began with a 1-week orientation in Bogotá. The purpose of this section of the course was to provide participants with background and context of coffee production, coffee farming, and working with farmers, at the local, regional, and national scales. Our aspiration was for participants to situate the realities of rural small coffee farmers without losing sight of the larger picture. Figure 2 shows some of these activities. To this end, we held lectures on the historical context of coffee in Colombia, transformations coffee markets in Colombia faced during the past decade, upcoming trends, and social, political and artistic context surrounding coffee. Foundational concepts were further solidified through hands-on activities such as coffee tasting, use of field research and co-design methodologies, drawing as a documentation mechanism, and the use of social cartographies. This week also included an interactive session with members from our two coffee farming partnering collectives, and a field visit to Colombia's National Coffee Federation, the largest conglomerate of coffee farmers in the country.



Figure 2 *Sketch modeling activity between participants and community members (left). Coffee tasting activity as part of the context stage (right).*

3.3 Co-Design Immersion

The goal of this stage of the course was for participants to engage in the practice of co-design directly from coffee farms, and in direct collaboration with community members. The co-design immersion consisted of a 2-week stay with APRENAT and Guavio Alto. The intention was for participants to engage in the practice of co-design in coffee farms whilst living and working along coffee farmers. Figure 3 showcases some of these interactions.

Our aspiration was to center this part of the course around relationships, while providing students and coffee farmers with the space to collectively frame and explore projects. All participants spent 1 ½ days in each of the farms, and at the end of the week the group was split into 2, each of which spent the rest of 2 weeks collaborating with its respective community. During each visit, participants were taken through walks led by the community with the purpose of providing geographic context. These walks also allowed participants to experience first-hand the process of coffee from beginning to end. During this week, participants contributed to community work related to coffee (e.g. sowing, selecting, cleaning or roasting coffee). At the same time, these spaces provided an opportunity for participants to use field methods and kickstart participatory processes in preparation for developing projects. Other more structured activities such as focus groups, community gatherings, brainstorming sessions, social cartographies, and sketch modeling, were implemented by participants in collaboration with community leaders and a group of facilitators. Towards the end of this week, teams of participants and communities agreed on a problem framing, and a path to develop a project. Given that several projects required a manufacturing infrastructure not present in the farms, teams and community members moved to the Jorge Tadeo Lozano University in Bogotá in order to begin the process of co-producing projects.

3.4 Co-Production

The goals for the last stage of the course were to (a) build, test, and implement the result of co-design processes developed in farms, and (b) iterate with feedback from the De Finca and APRENAT communities. Our aspiration was for participants to reflect upon the journey of getting to the prototyping stage, identify challenges throughout the process that could be corrected during the implementation phase, and wrap-up the course with identifying avenues for further work.



Figure 3 *Clockwise from upper left. Ideation session with DeFinca community members. Concept feedback session with DeFinca community members. Coffee seedling planting. Beekeeping as a connected activity to coffee farming.*

For a span of 4 days, participants and community members developed a total of eight projects (described in the next section), followed by a project presentation where participants received feedback from students from local universities and community members. This allowed participants to check their assumptions, and receive ideas for improvement and expansion of the projects. After this presentation, teams returned to farms in order to deploy and test the projects on site. Teams working on coffee production machinery installed prototypes and ran community meetings in order to disseminate knowledge about its design and receive critical feedback. This step was necessary, given that

not all community members were able to actively participate throughout the entire design process, given the harvesting schedules. Teams working on marketing showcased their work, received feedback from farmers, and were able to iterate one more time. They also held training sessions to make sure as many farmers as possible understood design decisions that went into final products. Teams working on social organizing ran, together with community members, examples of the training modules that were developed, and introduced partners to both the content and the documentation built to support it. After projects were implemented, teams created detailed manuals and documentation for community members to manage projects and disseminate if needed. These documents were also given to the C-Innova team with the purpose of integrating the work in upcoming projects.

3.5 Projects

Throughout the course, products for each track were developed at each farm. At the De Finca farm, teams developed: (1) a coffee cooling system and (2) a smoke extractor module for a locally developed coffee roaster; (3) deployment of a marketing strategy in 2 well-established coffee digital marketplaces, along with the development of a website for the cooperative; (4) development and testing of a series of trainings for holding community meetings at the cooperative, tools for improving financial management at farms, and a manual for recruiting new farmers into the cooperative (Figure 5).

In the APRENAT farm, teams developed: (1) an artificial beehive and sensor kit design for beekeeping of angel bees along with a cartography for a touristic “bee route”; (2) honeycomb press for honey extraction; (3) design and prototype of mobile Point of Sale (POS) stations for the farm along with materials for branding and marketing strategy for honey products, and (4) Bamboo-based vertical garden (Figure 4).



Figure 4 *Selection of projects developed with the DeFinca community. Low-cost coffee roaster with smoke extraction and coffee bean cooling systems integrated (left). Guide to onboarding and management of association members (right).*



Figure 4 *Selection of projects developed with the APRENAT community. From left to right, manual honeycomb press, beehive-inspired mobile POS booth, vertical mobile POS booth, bamboo-based vertical garden, sensorized angel bee beehive.*

4. Theoretical framework

EquityXDesign is a design framework developed by Christine Ortiz, Caroline Hill, and Michelle Molitor in 2016. As design practitioners, they saw a gap between design methodologies and societal inequalities. Rather than addressing these inequalities, design methodologies tended to overlook participatory and inclusive design:

> "EquityXDesign: an additional layer of checks, tools, and activities that, when laid on top of traditional design thinking methodologies, will illuminate racism and inequity — individual, structural, and institutional — that exists in the individuals involved in the design team and potentially shapes the way problems are framed and solutions are proposed."

It is an attempt at retrofitting design thinking with an equity-centered framework to enable designers to question their subjectivity while keeping beneficiaries at the center of the design process. It is a practice that merges the consciousness of equity design with the methodology of design thinking. It is framed by 3 core philosophies; i) Learning to see: Historical context matters; ii) Be seen: Radical inclusion; iii) Foresee: Process as product; and 5 design principles; i) Design at the margins; ii) Start with yourself; iii) Cede power; iv) Make the invisible visible; v) Speak to the future (equityXdesign, 2019).

The 3 core philosophies lay out the ethos for the framework. They argue that design needs to be framed within the historical context of the people, place, and community we are designing in. Further, inclusive design requires eliminating barriers of entry for all participants and beyond a designed product, the process needs to be done right - raising voices of the marginalized and strengthening relationships across differences. The 5 design principles provide a guide for this equitable design process. Designing at the margins highlights the importance of designing with and for people outside the dominant culture.

This begins by critical awareness on the part of the designer, acknowledging their biases and being conscious of not re-creating those biases in their designers. Equity design also requires an inversion of legacy power structures and a blurring of the lines between designers and the end-user. As seen in the coffee course, coffee farmers were as much designers as there were researchers. However, many of these power structures are invisible and thus, the fourth design principle is to make visible these dynamics with the aim of breaking them down. Finally, equitable design needs to be long-sighted, for new discourses and frameworks are needed to replace current design methodologies to ensure that design, as a field, is moving forward collectively, inclusively, and equitably.

The co-design coffee course was designed independent of the EquityXDesign framework as the coffee course came out of prior work that one of the key authors had carried out in Colombia. However, we decided on using it as a framework to analyze our work for several reasons addressed below. In our process, we also considered several other frameworks, two of which were the Design Justice (Costanza-Chock, 2020) and Consentful Tech (Lee & Toliver, 2017) frameworks. We ended up going with the EquityXDesign framework as i) Both authors of the paper attended a workshop led by the team behind the EquityXDesign framework and were inspired by the thoughtfulness behind the framework; ii) Each design principle was well-defined and action-oriented which is helpful for analyzing fieldwork; iii) The framework is still in its early days of its inception and we wanted to build it up through using our work as a case study, to suggest modifications, edits, recommendations for a more robust framework. Our hope is that the EquityXDesign framework and our recommendations below provide a new pathway for horizontal co-design initiatives between future researchers and collaborators. In the next section, we offer reflections on the course through the lens of the EquityXDesign framework.

5. Analysis using the EquityXDesign Framework

In this section, we present our analysis of the course using the EquityXDesign framework. An overall view of its beliefs and values is shown in Figure 5. We navigate through each principle reflecting and driving insights based on the work done through the course.

5.1 Design at the Margins

"Our current innovation conversation is exclusive, accessible only to the powerful and privileged." (equityXdesign, 2019)

This was one of the most prominent aspects of the course. Although coffee is one of the defining features of Colombia's economy and culture, due to the decentralized nature of the agricultural practice of coffee, coffee farmers have not been centered by the industry. By living and working alongside coffee farmer collectives, the course sought to convey the wealth of knowledge and experience these groups hold, even when living far from urban centers.

Inverting the equation of the privileged being an educator, and the underprivileged the learner, is fundamental to dismantle this notion of power, particularly within higher education.

From a design studies perspective, our framing of *"coffee farms as design labs"* is an instantiation of ideas present in scholar research around the decolonization of design. By stressing the significant value of knowledge until now considered invisible, by recognizing the centrality of the self-determination project of these farmers associations, and their imminent participation in imagining, designing and building their own future, we answer to the call of Schultz et al. (2018) for turning design education to focus on "techno-mediations" as they relate to designing autonomy and plurality and to futuring".

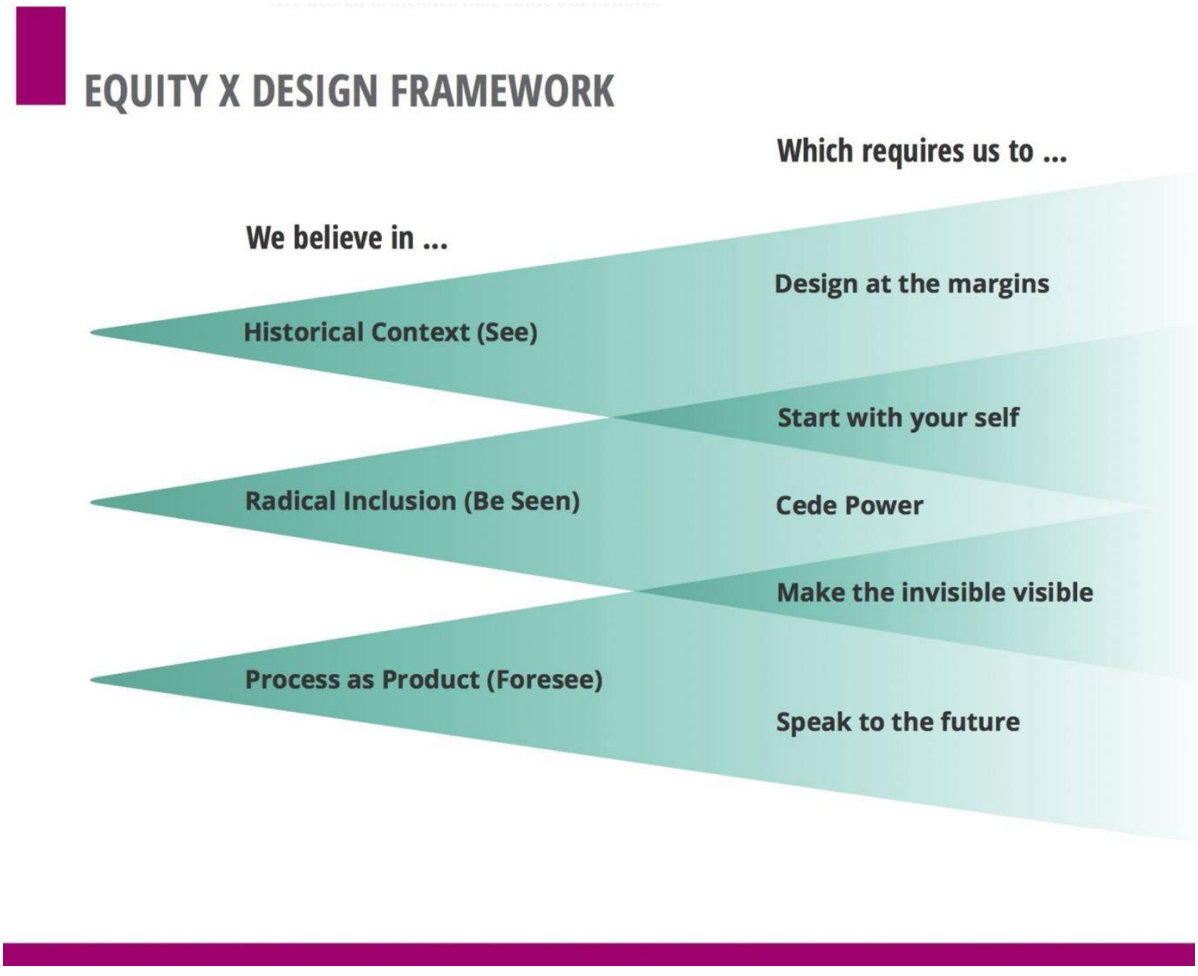


Figure 5 Equity by Design framework. Diagram taken from equityXdesign (2019).

5.2 Start with Yourself

> "Our identities (race, gender, upbringing, social status, home language, etc.) create our lens for the world and how we make sense of it." (equityXdesign, 2019)

This is one of the aspects where the course fell short. The curriculum did consider spaces

for participants to reflect both individually and collectively about their work and presence in a historically marginalized community. Additional informal spaces were provided for students to voice concerns or ask questions about the history of the relationship with partnering communities, trust, continuity and power dynamics among others. Although healthy relationships with communities, the building of deep, organic trust, concerted plans for continuity, and acknowledgement and defuse or diminishment of power relations were all key directives in designing and implementing the course, we did not intentionally acknowledge or deconstruct these processes. As we mentioned in our introduction, the course is part of a larger process and arc for change built in partnership with communities. During this process, measures were taken to address power imbalances brought by the presence of external agents in coffee growing communities. For example, we engage in local communal activities such as sowing and harvesting, and collaborate on smaller projects driven entirely by local communities. However, in the design and implementation of the course, we failed to include content geared towards deconstructing what those measures were, how we used them to frame the presence of participants in communities, and how participants can integrate these principles into their professional practice. In summary, we failed to translate these decisions into potential participant learning. This lack of surfacing prior work also holds true to gender dynamics, even though the EquityXDesign framework accounts for the importance of highlighting this aspect. Gender imbalance is common in rural Colombia, and one of the objectives of the work done prior to the course was to intentionally dismantle the imbalance thus, 10 out of the 16 participants and 4 out of the 6 course organizers were women and women-identifying. Part of our reflection in this section is a call to further researchers to build this dimensionality in their future work.

5.3 Cede power

> "Equity requires a nonviolent, action-oriented spirit of co-creation and co-invention, necessitating an inversion of legacy power structures." (equityXdesign, 2019)

From its very title, "a co-design experience", the course sought to make clear that the act of designing will lean towards horizontal relationships. As discussed before, initiative, branding, and resources to set change into action already manifest dominance. Through a continuous emphasis on the need of collaboration, and the centrality of local knowledge over academic knowledge for example, the course actively attempts to diminish these dynamics. The most basic expression of this was a focus on asking questions, rather than on providing answers or "solutions"; on listening rather than on speaking. Further, the research materials we provided, alongside deep engagement with De Finca and APRENAT, emphasized the importance of local knowledge(s) as opposed to colonial approaches to co-design. The decision to run the course in Spanish was another expression of ceding power. Through translation and facilitation, the legitimacy of local language over efficiency or pragmatism was established.

Another potential source of power differential were institutional brands, more specifically from educational institutions. Coming from a strong institutional brand such as the

Massachusetts Institute of Technology (MIT) involved many contradictions and several opportunities. Where appropriate, De Finca and APRENAT used the institutional branding to further relationships with coffee distributors and build on their marketing efforts. Further, they used the institutional branding in securing new grants and relationships, strengthening their supply and value chain of coffee production.

5.4 Make the invisible visible

> "The relationships between people and problems are often governed by sets of heuristics — techniques that allow problems to be solved with speed, agility, and economy." (equityXdesign, 2019)

Two salient "invisible" dynamics were made visible for all stakeholders throughout the course. First, the complex relationship between some coffee farmers' associations and Colombia's National Coffee Federation. Though we did not hear this directly from our partnering communities, countless interactions with farmers in the region, and many others that attended the course as speakers and spectators, revealed a hegemonic, dominant, and sometimes coercive relationship between small coffee farmers and the Federation. Although this circumstance might be common knowledge to farmers across the region, it does not match the perception of the federation at the national and international scale. Conversations with De Finca and APRENAT community members made starkly visible the anatomy of this relationship, bringing to light the marginalization and power dynamics at play.

The second, less surprising dynamic that was made evident through the course was the divide between the rural and the urban. By virtue of oscillating with the city (Bogotá) and rural farms, it was evident to participants the challenges rural farmers face not only in connecting their economies to mainstream consumers, but also the disconnection between urban citizens and the struggles of their rural counterparts. These challenges go beyond the economic, transcending to the cultural, political and even environmental stages. Some of these complex connections were deconstructed along the course, others were made evident to participants through personal interactions with farmers.

5.5 Speak to the future

This was an area where we could have been more intentional as designers and organizers of the course. The entire design of the course was present-oriented and made little acknowledgement of the future, in terms of the longevity and sustainability of the projects, and also in terms of acknowledging the differing understandings of "the future". While the course recognizes the importance of self-determination and autonomy as key pillars of co-design, we should have anchored these within the framework and understandings of the coffee communities. In fact, most of the language surrounding the design of the course continued to be heavily influenced by "western" academic fields of thought. Here, we are presented with the opportunity for the decolonization of design. We discuss this further in our modifications in the next section.

6. Discussion

As seen in the section above, the EquityXDesign framework provided a lens to critically reflect on the design and implementation of the co-design coffee course. However, several dimensions of our work did not fit neatly within the definitions of the 5 principles. We came to realize that we both fell short in embodying the principles proposed by the framework, but also that the framework was an incomplete lens to assess the multi-dimensions of the coffee course, cutting across geographic, industry, and cultural lines. In this section, we offer modifications to the 5 principles in hopes of providing a more robust framework for future researchers to design and evaluate their co-design initiatives with communities.

*6.1 Design at the margins **without over-glorifying design***

As designers, we have a strong bias towards the power of design, both as a process and a tool. In many ways, this bias has served as well in helping to break down complex problems whilst developing innovative solutions. We worked with the De Finca community to co-innovate solutions in the categories of the production of coffee, marketing and branding of the business, and developing an association for coffee farmers in the Guavio Alto region. Despite the usefulness of design thinking, however, it is not a panacea to society's problems. Many of such problems are complex and multi-faceted and as such, require multi-faceted approaches. While design as a problem-solving framework aims to plug many of these gaps, it is more effective when used complementary with other skill-sets. In the case of De Finca, design thinking gave us a framework to conceptualize the problem we were trying to solve, along with potential solutions. One of the problems we chose to work on involved improving the quality of coffee beans. Design thinking helped us define the key problem: we needed to build a cooling system for the coffee roaster so that the beans can cool down at a consistent rate. Whilst design thinking is a useful framework in framing the problem and solution(s), we also needed technical engineering skills to build a cooling system for the coffee roaster. Thus, as much as design is a powerful tool, it cannot exist in a vacuum and needs to work hand-in-hand with other disciplines.

*6.2 Start with yourself **and build relationships***

Building relationships and fostering trust with the local communities are at the core of co-design. These relationships cannot be fostered overnight and require years of engagement. The success of the coffee course was a result of years of deep relationship-building that the group of Colombian practitioners cultivated with the De Finca community. While self-reflection is an important part of the fieldwork process, researchers also need to be able to step-out of themselves in order to build authentic, long-term relationships with their community collaborators. De Finca's community was extremely welcoming and open to collaborating with foreign researchers because of the trust fostered over the years.

*6.3 Cede **and redirect** power*

Ceding power is merely step one of the process of leveling power dynamics when working with communities. Beyond ceding power, we needed to redirect power to these communities by craving spaces for their voices to be amplified. As much as we were intentional about ensuring equal representation of local vs. foreign participation at all co-design exercises, we failed to account for the language barrier between English and Spanish speakers. English was frequently the dominant language in many co-design exercises; especially as participants grew tired and impatient from long co-design exercises, they reverted to their native tongue. These are the covert ways in which power manifests and language excludes and includes. Given that many of the Colombian participants, the coffee farmers and Colombian university students, felt more comfortable in Spanish, speaking in English excluded them from these exercises. More than serving as a communication barrier, language reinforced power structures of the global "north-south" divide and muted the voices of the communities we were working with. In order to mitigate future power inequality, we will be accepting MIT and Harvard participants/researchers with Spanish-speaking experience. Thus, it is not enough for researchers to cede power to local communities but to take it a step further by redirecting and re-centering the roles and voices of communities in co-design.

*6.4 Make the invisible visible **by listening to community wisdom***

The importance of listening to community wisdom was another learning point for us. As researchers from the "global north", we brought our personal biases and institutionalized forms of knowledge into the field. As we encountered technical challenges, our immediate response was to resort to hi-tech solutions. However, our work with the De Finca community re-centered the value of local forms of knowledge and working within the local ecology and landscape. As an example, Franklin showed us a broken Arduino project built by researchers a year before. The researchers had built a device to monitor the temperature of the cooked coffee beans. While the researchers had good intentions, they did not account for the long-term unintended consequences of their solutions. Unfortunately, the device stopped working a few weeks after the researchers had left and Franklin did not have the tools nor knowledge to repair it. This example highlighted the importance of working within the knowledge framework of the local communities. Further, we sought to seek feedback from the De Finca community during each step of the design process. Instead of working with hi-tech tools, we worked with materials that Franklin had available, redesigning a roastery cooling system made out of an old pot and a fan. This modification enabled a consistent cooling speed and temperature of the coffee beans, improving the quality of coffee produced. The cooling system was co-built with Franklin and the De Finca community and within local frameworks of manufacturing and production.

*6.5. Speak to the **near and far** future*

In the EquityXDesign framework, design principle #5: Speak to the Future addressed the importance of discourse in shaping the narrative of the future. However, it does not account

for the differences in the meaning of "future" for the researchers vs. coffee farmers. Time and temporality are felt and experienced differently in different contexts. For researchers on an academic calendar, taking 3 weeks to a month to work on a project *feels* like a long commitment. However, from the perspective of the local communities, these collaborations are seen as limited and short-term. Further, these short-term collaborations are disruptive to their workflow, especially if there are no plans for future engagements. Local communities have to take time from their daily harvesting schedule to spend time with researchers, introduce them to their tools and technologies, and educate them on the local context. Thus, it is important that we clarify what it means to "Speak to the Future" and further, what that means in the context of "near and far future(s)".

One of the pitfalls of co-design is the short-sightedness of these collaborations. Many co-collaborations are one-off projects with no plans for future engagements. Such collaborations reinforce extractive and exploitative frameworks while co-opting the narratives of co-design. We, therefore, propose a framework of near to far futures to get researchers to consider the time and temporality of their engagements and mitigate exploitative relationships. Communities need to see the value in investing time with researchers and tangible outcomes from each co-design collaboration. As opposed to using vague terms like "future", researchers need to define the "nearness" and "farness" of these collaborations by coming up with explicit roadmaps for current, short, and long-term engagements. These engagement plans are critical to equitable co-design.

7. Conclusion

In this paper we present the EquityXDesign framework as a lens to analyze and study community-based co-design initiatives. We introduce a case study of a course around technology design for coffee production in close collaboration with two coffee farmers' collectives. By juxtaposing the framework over the design and implementation of the course, we reveal gaps in the design of the course, as well as opportunities for expanding the EquityXDesign framework in the particular context we apply it. This leaves a window of opportunity to apply this framework in other areas of design (e.g. health, education, etc), as well as in other areas where co-design can prove relevant (e.g. governance, infrastructure). We present our analysis of the course using the five principles of the aforementioned framework, discussing gaps and potential retrofits to both the framework and the course.

This examination reveals the enormous difficulty inherent in planning and practicing co-design that is informed by principles of equity, justice and decolonization of knowledge. Such practice, as we learned through this analysis, requires significant amounts of intentionality, trust over time, and plurality. In that sense, this work is in many ways a criticism to the quite common comfort of cashing in corporate design and design thinking. Through toolkit-ing, and concept-boxing, these approaches to exploring solution spaces for wicked, complex problems, over-simplify community-based design.

By studying co-design initiatives through an equity lens, we propose new ways to practice

and study these projects. Avoiding the glorification of design in any of its versions, leaning towards relationships, redirect power embedded in relationships and dynamics, center local knowledge, and envision near and far futures, are some of our key calls to action. A more comprehensive approach to community-based co-design that considers these factors, can potentially provide a more robust blueprint for designing and implementing initiatives in this space.

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Inclusive Design SIG

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SYNERGY

Editorial: Inclusive design SIG. A wider context and reflections on theory and education

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Inclusive design is centred around people; this is well reflected in the papers featured in the InclusiveSIG section of DRS2020. People are not only users of products or services, but also actors of decision making, sense making, change making and future creation. Their physical, sensory, cognitive, affective, and environmental factors need to be considered in the design process, together with a wider technological, social, political, economic, legal and cultural context in which they interact with things, other people, and the world. Individuals can be excluded/included from the society culturally, socially, economically or politically, and these aspects have been illustrated in the papers with topics ranging from personal mobility aids and public transport systems to museums and smart cities.

The review of the paediatric mobility product design in the last 50 years written by Cara O'Sullivan and Farnaz Nickpour (paper 275), has highlighted that paediatric mobility design "embodies and reflects not only the state of technology and healthcare, but also social, political, economic, legal and environmental states."

The public transportation system study (paper 239) by Jing-Ting Yu et al. has taken a service design perspective to involve various stakeholders, aiming to improve the service users' riding experience, providers' service quality and the administrators' efficiency.

Qi Wen and Sandy NG (paper 268) point out the shifts of the museum paradigm from the "isolated, elitism and collection-centered tradition" to a "more diverse, inclusive, communicating, educational and visitor-orientated institution". They see inclusive museums as "a synergist of design since it is an open platform that connects design and the public."

The role of participatory design activities in the appropriation of urban technology is explored by Julieta Matos-Castaño, Anouk Geenen and Mascha van der Voort (paper 133), and they find that 'visibilizing', 'reframing', and 'imagining' are key characteristics of participatory design in supporting sense-making of future smart cities.

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In addition to the discussion on the wider context of inclusive design, reflections were made on the relevant theory and practice.

The theoretical paper by Prithi Yadav (paper 340) proposes 'perception' as an alternative construct for understanding users in human-centred design, recognising the limitations of empathy. The proposed 'perceptive design' has integrated three predominant approaches of social cognition, i.e. Theory Theory, Simulation Theory and Interaction Theory. Perception allows "the designer to retain their consciousness, while considering the user's consciousness, allowing for a plurality of consciousness to better inform design processes" which would facilitate "mutual creative understanding" and "balance in power". The taxonomy of the four degrees of perception were proposed: 'recognize', 'resonate', 'relate' and 'realise', and the commonly used user-centred design methods were mapped to the four levels of perception, which has turned the taxonomy into a useful analytical tool.

The educational paper by Daniel Charny et al. (paper 325) is focused on 'Fixperts', a learner-centred, creative-problem-solving and project-based learning programme. It serves as an experiential hands-on introduction to "human-centred design, maker culture, and design-based thinking". Many elements from established design methods and approaches have been incorporated into 'Fixperts', for example, "user-centred design, universal design, design ethnography, participatory design, design thinking, action research, co-design, design activism". Different universities have adopted the 'Fixperts' learning framework, and developed a variety of models, i.e. Primary Model, Partnership Model, Community Model, and Public Model, representing the evolution of the Fixperts framework to better enable the development of students as confident and empathetic socially-led designers. The 'Fixperts' framework is currently being adapted to facilitate the Newton Fund sponsored UK-Turkey research link project on 'sustaining inclusive design through co-design platforms".

The wider context of inclusive design requires a holistic approach involving many stakeholders, utilising appropriate methods, and addressing various factors of exclusion, while reflections will help consolidate learning and development.

With rapid advances in technology and the increasing awareness of equality, diversity and inclusion issues in society, inclusive design researchers are facing new challenges and opportunities. A people-centred, context-aware approach with critical reflection will help move the field forward.

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For more information on the Inclusive Design SIG, please visit the SIG's webpage at http://drs.silkstart.com/cpages/inclusive-sig. To find out whether the SIG is organising a satellite event to the DRS2020 conference, or just to get in touch with members and see news on the SIG, please visit the SIG webpage.

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50 Years of Inclusive Design for Childhood Mobility; Insights from an Illustrative Mapping Review

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Abstract: In recent years, the field of Inclusive Paediatric Mobility (IPM) has gained increasing interest from a variety of disciplines and stakeholders, including designers and engineers, healthcare professionals, policymakers, children and families. This has led to increased visibility and understanding, as well as the development of new products and services. However, knowledge around IPM design remains fragmented and with many issues around the desirability, feasibility, and viability of interventions. This is the first illustrative mapping review of the IPM design field to capture, classify, and analyse IPM design contributions chronologically over the past five decades. The review explores relationships between contributions, their context, and their significance in the landscape of IPM at the time. This paper outlines insights from the mapping review and highlights key trends, gaps, and issues in the IPM design field since 1970. Key themes and considerations are proposed for a framework to improve the future of IPM design.

Keywords: inclusive design; childhood; mobility; disability

1. Introduction to Inclusive Paediatric Mobility

The contemporary landscape of Inclusive Paediatric Mobility (IPM) design saw negligible change until the introduction of the first paediatric power wheelchair in the United Kingdom in 1983. It was around this time that the widely accepted narrative used to address paediatric mobility disabilities began to evolve. Conventionally, the acknowledged goal was to 'normalise' children's movement, with walking being the ultimate achievement. The stark lack of independence-promoting IPM interventions other than walking aids at this time, was simply a reflection of society's thinking (Wiart & Darrah, 2009). This mentality shifted in the late 1970s, to a narrative of encouraging children to use their most efficient mobility approach to optimise their experience of childhood (Butler, 2009). Interest in the field has since continued to grow from designers, engineers, healthcare professionals and families. This has led to increased knowledge and understanding of the need for IPM

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interventions from an early age (Rosen et al., 2017), as well as evolutions in narrative and the development of new IPM products and services (Logan et al., 2017). From walking aids and prosthetics to wheelchairs and exoskeletons, there remains a myriad of challenges around the desirability, feasibility and viability of existing paediatric mobility products, in addition to poor documentation of design processes, principles, accomplishments and failures within the field.

This paper maps and synthesises findings from the perspective of Inclusive Design, in order to highlight gaps, issues and patterns and translate these into constructive points for consideration in future IPM design processes. The aim is to learn from IPM history and to question its present, in order to capture core elements of a design framework to guide the future of IPM. Such a framework will need to be adaptable in order to operate in a multitude of evolving social and technological future contexts. This highlights the fact that IPM design embodies and reflects not only the state of technology and healthcare, but also social, political, economic, legal and environmental states. Subsequently, each design contribution is entwined with context-specific projections which need to be captured and acknowledged.

2. Understanding IPM Design; What, Why, Who?

2.1 What is Inclusive Paediatric Mobility Design?

IPM design is the application of an inclusive design approach to create mobility interventions such as wheelchairs, walking aids and exoskeletons, with the fundamental goal of optimising the experience of childhood. Inclusive Design centres on the diversity of users' physical and psychosocial needs (Lim et al., 2016) and often starts with considering 'extreme' or 'extra-ordinary' users (Newell & Gregor, 1997). In the context of commercially available mobility interventions, young children are the most underserved and excluded age group of users (Feldner et al., 2016); hence becoming the 'extreme' of an already 'extreme' user group. Designs which cater for the particular needs of people with disabilities are conventional examples of Inclusive Design (Nayak et al., 2016). There are three predominant approaches to the application of inclusive design (Clarkson & Coleman, 2015), and it is important to consider all three in order to build a comprehensive, accurate and critical picture of the IPM design landscape. Table 1 provides examples of IPM interventions categorised by their most commonly used inclusive design approach.

Table 1 Inclusive design approaches commonly used for paediatric mobility interventions.

User-Aware Design Approach	Customizable or Modular Design Approach	Special Purpose Design Approach
Tricycles	Ride-On Scooters	Wheelchairs (Power/Manual)
Go-karts	Ride-on toy vehicles	Splints and Casting (to support or stretch muscles/bones)

Pushchairs, Strollers, Buggies	Tailored therapy and physical training equipment	Walking aids (i.e. crutches, canes, gait trainers, walkers, exoskeletons, prosthetics)

2.2 Why IPM Design Matters; Issues and Opportunities

Significance

Mobility, as well as being a human right, is a necessary and significant part of life which, amongst children in particular, impacts multiple health outcomes. Independent mobility facilitates children's physical, emotional, psychosocial, perceptual and cognitive development (Nilsson et al., 2011), as well as providing opportunities to make social interactions (Guerette et al., 2013) and increase confidence and participation with peers in everyday activities (Casey et al., 2013). For infants and children with mobility disabilities, opportunities to develop in these areas are greatly reduced and the likelihood of developing passive, dependent behaviour increases significantly (Durkin, 2002). Hence, IPM interventions are instrumental in enabling independent mobility and helping children to develop to their full potential. The early years of childhood are characterised by rapid and critical developments of the brain which provide the essential building blocks for future growth, development and progress. Around 90% of brain development happens during the first five years of life (Brown & Jernigan, 2012), making early intervention and provision of IPM an urgent priority to avoid irreversible developmental delays. Provision of powered mobility to those who lack it, has been shown to facilitate childhood development from as young as 11 months old (Rosen et al., 2017).

Issues

There are a myriad of unresolved issues around the design of IPM products currently available in the market. Many of these act as barriers for incorporating IPM into a child's life. Many IPM interventions are as restrictive as they are enabling and often exclude children with complex needs. Furthermore, they lack up-to-date integrated and assistive technologies, let alone desirability and childhood appeal which has long been the norm in other sectors. Hence, issues around IPM designs can be classified under three meta-levels:

- Desirability (i.e. acceptability, pleasurability, emotional durability and personal meaning (Desmet & Dijkhuis, 2003)).
- Feasibility (i.e. usability, technicalities, functionality/features (Livingstone & Paleg, 2014))
- Viability (i.e. economies of scale, affordability, sustainability (Rushton et al., 2015))

While each issue has been separately investigated and addressed within adult services (Leaman & La, 2017), there is a considerable lack of holistic, convergent and innovative thinking within paediatric services (Feldner et al., 2016).

Opportunities

IPM is a global need, as well as a worldwide market (Casey et al., 2015). Recent initiatives in the wider area of disability and inclusive technologies have aimed to reduce the gap between the current state of design, development, manufacture and adoption of IPM products, with innovations in design, technology, materials and manufacturing processes as seen in other sectors (Nesta, 2014; Google Impact Challenge, 2015; Toyota Mobility Foundation, 2018). Moreover, there are emerging scholarly attempts at converging disability, design and innovation through new postgraduate courses (Global Disability Innovation Hub, 2019). Thus, there exists a timely opportunity to develop a framework to inform and equip the next generation of IPM designers with foundational knowledge, processes and tools to better steer progress and accelerate learning in the field globally.

Advanced manufacturing technologies such as 3D printing, combined with the advent of social product development, crowdfunding and open source movements (providing platforms to share and build upon designs and), provide a significant opportunity for continued development, full customisation and viable route to market for IPM products (Lunsford et al., 2016). Furthermore, open source design platforms welcome new players to the industry by saving time and money on research and development, and unleashing creativity and tools to drive rapid innovation for IPM at a global scale (Manero et al., 2019).

Alongside such engineering and socio-technological advancements, there is an imperative to advance IPM design knowledge base and critical discourse around narratives and experiences of disability, childhood and mobility. The narratives and philosophies adopted by Childhood Studies, Mobility Design, and Critical Disability Studies are evolving at a rapid pace and would be instrumental in progressing the field of IPM design if integrated in an interdisciplinary and holistic manner. Such opportunity needs a transdisciplinary, human centred and participatory approach in order to ensure various disciplines and stakeholders are engaged. The ability to facilitate inclusive and interdisciplinary participation is known to: enable a more holistic perspective on problems and potential solutions, offer co-creation opportunities, give choice and agency to end-users, and result in products which better match the individual needs of users (Thorsen et al., 2019).

From the perspective of health economics, there lies an opportunity to build a case for state provision of early IPM interventions and potential funding for further research and development in the field of IPM design. Children who receive adequate developmental opportunities during early childhood, have a better chance of becoming healthy and productive adults, which can reduce future costs of education, medical care and other social spending (Bray et al., 2017).

Looking to the future of childhood mobility, there are opportunities for the wider use of user-aware and customisable design approaches. These could facilitate the move towards a truly inclusive experience of childhood, by optimising mobility-related participation for all children.

2.3 IPM Design Stakeholders; Expert Fields and Missing Voices

The narratives, definitions, and priorities of IPM design evolve and vary across different cultures and stakeholder groups: to provide functional, timely and energy-efficient mobility (Butler 2009); to meet developmental and gross motor milestones (Kenyon et al., 2018); to provide a safe means of mobility that can track a child's progress and enhance their mobility experience (Soh & Demiris, 2012); or to enable independence and meaningful participation in life (Pituch et al., 2018). Each of these priorities reflects a single disciplinary perspective (i.e. Occupational Therapy, Psychology, Parents, Design and Engineering). The importance of taking a multifaceted approach to IPM has been long established (Field 1999), as well as the need for holistic stakeholder input to take into account a range of views and lived experiences (Livingstone, 2010). However, this is not fully reflected in the IPM design field and the actual design and development of IPM interventions. There remain numerous scholarly fields, disciplines, experts and stakeholders whose voices are currently missing, and could bring significant value, as well as complexity, to the IPM design process. The subject areas most commonly drawn upon for knowledge during the IPM design process include Childhood, Disability, Mobility, and Design. These areas could be viewed as the foundations of the IPM design field, with other subject areas surrounding and overlapping them at different stages of the design process. Considering the diversity of narratives from different stakeholder groups, it would be valuable to explore and capture stakeholder knowledge and voices from within and between these four overarching spheres. This could be a good starting point for incorporating more thorough interdisciplinarity into the IPM design process.

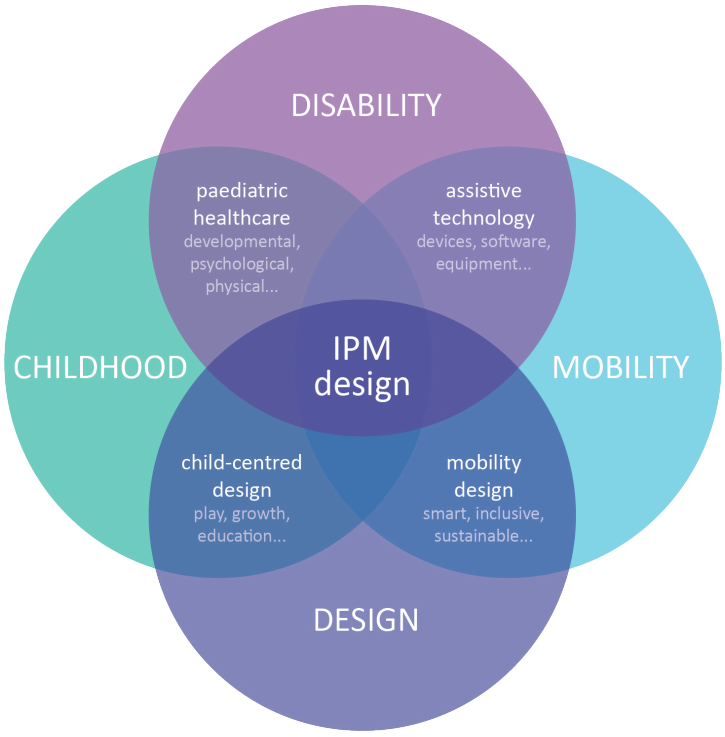

Figure 1 *The four foundational disciplinary fields of IPM design.*

3. Aims of the Designerly Mapping Review

The purpose of conducting this designerly mapping review is twofold: to thoroughly capture and to clearly illustrate the changing landscape of IPM. Such review is pivotal in informing the direction and dimensions of an IPM design framework aimed to impact and improve the way IPM interventions of the future are designed. Hence, it is essential that this review comprehensively captures the core elements to be included in such a framework (O'Sullivan and Nickpour, 2020). An examination of the field needs to encompass past and present perspectives, in order to identify failing, successful, missing, or complicated elements within the past and present landscape. Additionally, such a map should enable moving beyond the present by providing insights on how an ideal IPM future could look, and what should be considered to move towards this. Three distinct aims of conducting a mapping review of the IPM design field include learning from history, questioning the present and road mapping the future.

4. Methodology & Methods

4.1 Methodology

A comprehensive list of various types of literature review (Grant & Booth, 2009) was carefully reviewed. As a result, a representative evidence mapping review was chosen, in order to objectively categorise contributions by their key features. This type of review enables the identification of gaps in knowledge or need for future research, and presents results in a clear visual format (Miake-Lye et al., 2016). The mapping review data is presented chronologically to allow for identification of trends, clusters and deserts across all types of designerly contributions through history. Mapped contributions are then critically analysed to evaluate quality and significance, as well as their relationship to other contributions on the map. This methodology was selected as it allows many different types of designerly contributions to be plotted at a high level of granularity using the same categories, thus enabling a holistic visualisation and analysis of the field (Jahan et al., 2016), which is currently missing, and much needed. Data for the review is classified under one of four types of designerly contributions. Four levels were chosen as they encapsulate all types of designerly contributions to the field of IPM (Wobbrock, 2016). Table 2 outlines the contribution classification system.

Table 2 Classification of IPM Design Contributions.

Interventional	Theoretical	Methodological	Empirical
New or improved products, services, systems, or artifacts. **I.1 -** Interventions made it to market or are commercialised. **I.2 -** Interventions remained as a concept or prototype.	**T -** Conceptual models, frameworks, policies, principles or important variations on those that already exist (e.g. disability studies).	**M -** Novel or refined methodologies, methods, processes, or techniques with sufficient detail to be replicated by others.	**E -** Data sets, surveys, arguments or findings based on empirical research which reveal formerly unknown insight and analysis of behaviours, capabilities, or interactions with interventions, etc.

Table 3 translates mapping review objectives into high level mapping questions. These will guide the collection of data and help achieve the aims i.e. to learn from history, to question the present and to roadmap the future.

Table 3 Mapping Review Objectives and Questions.

Objective	ID	Mapping Question (MQ)
Identify levels and types of design contributions.	MQ1	What is the type of design contribution? i.e. I.1, I.2, T, M, E (CLASSIFICATION)
Identify if design contributions have increased/decreased/fluctuated/remained constant throughout history.	MQ2	When have designerly contributions been made to the field of IPM? (YEAR)
Identify the balance of contributions from stakeholder groups and explore diversity of perspectives and types of contribution.	MQ3	Which discipline or stakeholder group does the contribution come from? (CONTRIBUTOR)
Identify where in the world IPM contributions have come from and why.	MQ4	Where have designerly contributions been made to the field of IPM? (GEOGRAPHY)
Understand the design approach and how this influences the success of the contribution.	MQ5	Which Inclusive Design approach has been used to develop it? i.e. 'User Aware', 'Customisable/modular', or 'Special Purpose' (DESIGN APPROACH)

4.2 Methods

The data collection search protocol centred on electronic database searches to identify evidence of contributions made between 1970 and 2020. Search databases included: Compendex, Scopus, PubMed, Web of Science, Science Direct, Google Scholar, Google Images, and Open Grey. Each result was reviewed according to the criteria outlined in Table 4. To capture grey literature, unpublished fieldwork and artefacts, IPM experts (each with a minimum of 15 years of experience in their field) were shown the results and asked to share any further known contributions.

This included four paediatric therapists and four paediatric mobility designers.

Table 4 Inclusion and Exclusion Criteria.

Inclusion Criteria	**Exclusion Criteria**
Contributions post 1970 *(IPM design field emerges around this time).*	Interventions which do not provide a means of *independent* mobility (e.g. passive mobility via attendant).
Novel or significant designerly contributions (i.e. excluding incremental updates and copycat products)	Contributions which lack record of the context of their creation.
Contributions that relate to at least one child aged ≤18 years with a mobility disability.	Studies involving only non-disabled/fully mobile children or adults.
The development of technologies and gadgets specifically for the IPM field.	Non-English language publications (with no English translation available).

Search strings were a combination of keywords relating to childhood, mobility, and design categories as follows: “childhood” OR “child” OR “children” OR “early years” OR “infants” OR “paediatric” OR “pediatric” AND “mobility” OR “assistive mobility” OR “power mobility” OR “powered mobility” OR “power chair” OR “power wheelchair(s)” OR “power wheelchair(s)” OR “wheelchair(s)” OR “walking aid” OR “exoskeleton” AND “design” OR “designing” OR “development” OR “implementation” AND “disability” OR “impairment”.

4.3 Limitations

Searches were carried out in English language. The likelihood of excluding eligible contributions documented in languages other than English may significantly skew geographic observations, in the context of this illustrative review. The majority of contributions were collected from grey literature searches which are typically less thorough than traditional systematic searches of academic literature (Turner et al., 2005). This could be seen as a finding in itself, reflecting the nature of IPM contributions and their documentation. The decision-making process around novelty and/or significance of a contribution could be a limitation as it was judged based on other existing designerly contributions in the IPM landscape at the time, and whether the differences were distinct enough to describe and record.

5. Results and Key Findings

5.1 Data Collection Results

The identified IPM design contributions from between 1970 and 2020 are presented in Appendix A. Contributions are categorised under four types including Interventional, Theoretical, Methodological, and Empirical (see Table 2). Interventional contributions are presented under two separate tables depending on whether they were successfully

commercialised (Table 6) or remained as a concept (Table 7). All contributions are referenced numerically in the order they appear in the tables, with their sources referenced in Appendix B; these numbers are used to refer to specific contributions in the following discussion.

5.2 Illustrative Mapping of Data

The data collection results were translated into a visual map (Figure 2) to illustrate designerly contributions to the field of IPM between 1970 and 2020, based on type of contribution and contributors' stakeholder group(s).

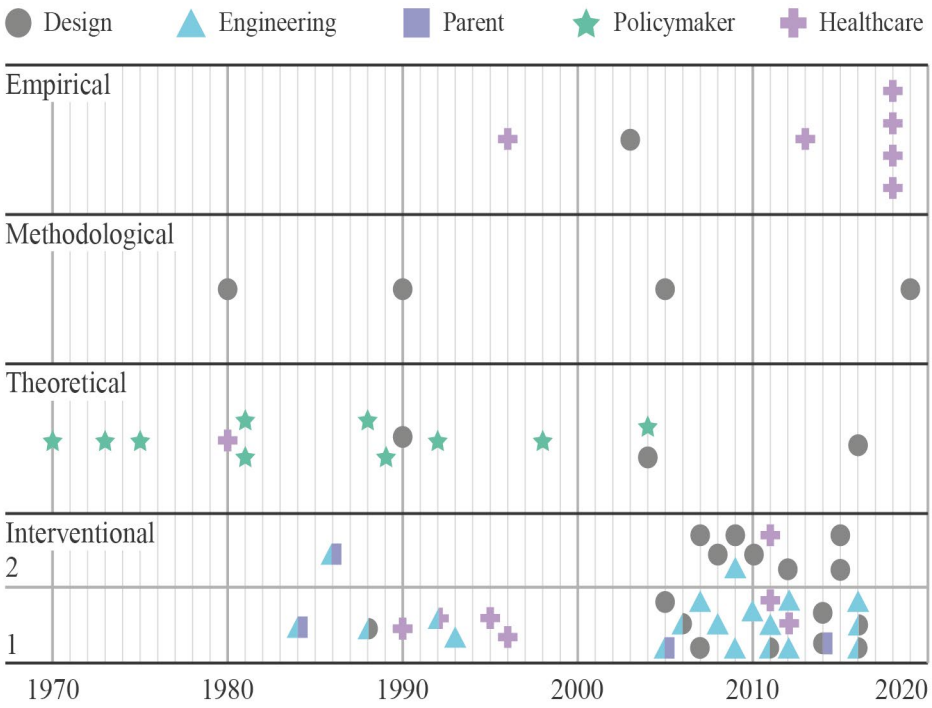

Figure 2 *Illustrative map of designerly contributions in IPM between 1970 and 2020, based on type of contribution and contributor's stakeholder group(s).*

5.3 Key Findings from the Mapping Review

In total, 1417 results were found in the electronic database searches, of which 503 duplicates were removed. After screening titles and abstracts, 76 of the 914 contributions remained. The authors independently screened full-texts to determine if they met all inclusion criteria, after which a further 20 were excluded. In total, 56 results were deemed eligible for inclusion from electronic database searches. The initial findings were shared with a total of eight experts for review and input. Accordingly, a further five contributions were included, bringing the total number of contributions deemed eligible for inclusion to 61. Of these, 36 were classified as interventional, 14 were classified as theoretical, four were classified as methodological, and seven were classified as empirical. Top reasons

for excluding contributions were: focus on adult mobility only, focus on passive mobility only, interventional designs with no evidence of intention to commercialise or implement, contributions lack novelty and classed as 'copycat', or contributions which demonstrate only incremental updates or improvements to existing contributions. Key findings about the context and nature of contributions, and their collective significance in the landscape of IPM, are discussed under the themes of chronology and typology.

Chronology

Following the shift in narratives of mobility rehabilitation in the late 1970s from 'normalising' to 'optimising' mobility (Butler, 2009), interventional IPM contributions begin to emerge in the form of beginner paediatric power chairs [1][4][5][6][7]. This continues to be the most prominent type of IPM design contribution until 2020. This is later accompanied by empirical contributions in the form of therapist-led studies mentioning design features and/or stakeholder perspectives [55][56][57], which appears to reflect a realisation of the benefits, and thus urgency, to build a case around providing better designed IPM at the earliest possible age.

Typology

The majority of the recorded contributions came from North America, the United Kingdom, and Scandinavia. Of the 36 recorded interventional design contributions, 26 reached commercialisation and 10 remained at concept or prototype stage. Of the 26 that reached commercialisation, at least 6 were discontinued in less than 15 years. Seven out of the 10 interventional contributions which remained as concepts, were created by design or engineering university students with limited industry experience. Although many of the interventional contributions involved stakeholders from other disciplines throughout the design process, the majority were led by stakeholders from Design or Engineering disciplines, with the exception of four contributions led by Occupational Therapists, one led by a Kinesiologist, and one founded by a philanthropist. None of the interventional contributions were approached with the definition of 'user aware approach' (see section 2.1), whilst seven were approached with a 'modular/customisable approach' and the remaining 29 were designed with a 'specialist assistive approach'. Of the 36 interventional contributions, 21 were designs of power chairs, 7 were walking aids or exoskeletons, and 8 were other products e.g. self-powered mobility devices and pieces of technology. The strongest trend across all classification types is the steady increase in the number of new contributions per decade since the 1970's, and a spike in contributions in the 2010's.

6. Discussion

6.1 Learning from History and Questioning the Present

Contributions captured by the mapping review were investigated by gathering background information about them, including their year of creation, geographic location, discipline

of contributors and design approach. All contributions captured by the mapping review were then further analysed by investigating the contributor's experience, motivations, methodologies, narratives, and terminology used. Analysing the map in this way enabled the data to grow into a story about the history of IPM design, and helped to identify a number of key insights which have been summarised and discussed under the following five themes.

Documentation & Representation

The review revealed a somewhat disjointed and heavily unbalanced landscape of IPM design efforts. Moreover, these efforts were poorly recorded, making it difficult to locate and capture grey literature and unpublished fieldwork or artefacts, especially for discontinued interventional contributions. In most cases, once located, the documentation itself was not thorough and rigorous. A total lack of theoretical, methodological, or empirical contributions relating specifically to the process of designing IPM interventions, may reflect knowledge-sharing barriers (Riege, 2005) or an 'end-result-oriented' mentality; considering only certain polished aspects of a final solution valuable or worthy of being recorded, communicated, and represented (Wong & Radcliffe, 2000).

Short-term measures such as aspirational design awards and media coverage (mainly under narratives of invention or innovation) are represented as indicators of success (Norman, 2010) and were the threads of grey literature which uncovered many of the I.2 interventional contributions. These are mainly focused on well-presented inspirational prototypes, videos, or illustrations of final products. At the same time, design processes, failures, long-term measures of success and empirical knowledge are typically kept in-house, if documented at all, and as a result have little or no representation. Adding to this, the overall representation of empirical contributions appears skewed towards stakeholders with an academic background, with all of them being published by therapists or designers affiliated with an academic institution and/or holding a postgraduate degree. This is likely due to documentation and dissemination of knowledge being encouraged and allocated more time in academic settings in comparison to industry.

Design Approach & Knowledge

One prominent gap in the field of IPM design is the lack of contributions taking a 'user-aware' design approach. Instead, the majority of contributions employ a 'special purpose' design approach to create 'assistive technology' (Newell, 2003), which tends to be targeted at smaller markets and typically results in higher costs. Funding issues are reported as a major barrier to acquisition through private purchasing or satisfying health service commissioning budgets, and has wider health economics implications (Guerette et al., 2005).

Apart from one contribution in 2004, relating to design principles specifically for IPM [49], there remains a total lack of contributions relating to frameworks, processes, or methods relating to the IPM design process. The limited number of theoretical and methodological contributions, specific to the IPM field, leaves little foundation for new interventional contributions to learn from and build upon. This also means there are no rigorous principles

or measures to assess quality, steer and define success in IPM design. Hence, the short-term spotlight approach to defining and measuring success.

Literature around new developments in exoskeleton technologies for children has grown increasingly throughout the 2010s yet only 2 interventional records [25][26] are captured. This could reflect the timely process of pushing a new product through to market, or it could be seen as an experimental and exploratory time of future-thinking; a habitual characteristic of designers.

Stakeholder Collaboration & Interdisciplinary

A pattern in the development of interventional contributions is that they have been mainly led by an individual or small team of engineers and/or designers. Most collaborated with occupational therapists and parents at some point during the definition and delivery stage. However, there is little evidence or trend of continued involvement from other disciplines or stakeholders throughout the process. It is worth noting that a few of the interventional contributions were developed by designers/engineers who also had lived experience of another stakeholder group (e.g. also being a parent to a child with mobility disability). Only six interventional contributions were recorded where research and development was *led* by someone with a healthcare related background [3][6][7][18][20][33].

A number of empirical contributions involved children, parents and therapists, but limited overlap is seen between stakeholders in the IPM design process. This suggests that multidisciplinary and co-design approaches to interventional contributions have either not been adopted, or are simply not recorded. Either way, it is clear that no contribution to the field of IPM design has taken a holistic approach to involve all key stakeholders, and potentially beneficial expert disciplines. Doing this could bring new perspectives and narratives to the field, stimulating and altering the way interventions are imagined, and subsequently designed.

Currently, designers and engineers appear to get the final say on which features are appropriate and significant enough to be included or excluded in an intervention, but evidence shows that therapists and parents are not always satisfied with this (Livingstone & Paleg, 2014). It is important to acknowledge and balance healthy tensions in terms of narratives and requirements across disciplines and set a transdisciplinary criteria for IPM progress in order to encourage stakeholders to step out of their silos and start collaborating more closely together. It is essential to look beyond the field of IPM to better consider, involve, and understand current thinking in broader subject spheres such as childhood, disability and mobility, as well as involve the stakeholders and disciplines currently excluded. This could be facilitated through a values and requirements framework (Harries et al., 2015) and would require a transdisciplinary, co-creative and child-centred approach.

It could be argued that the recorded methodological contributions do not belong specifically to the field of IPM design, but rather to the broader discipline of design, despite the direct influence they have on the field. This raises the question: what have we been missing from within the other overarching disciplines that make up IPM design?

Geopgraphics & Regionality

There is a significant lack of novel IPM design contributions recorded from developing regions of the world. This could be due to limitations of the search strategy, poor documentation of possible contributions, or general lack of contributions to the field of IPM from these regions. Whatever the case, there remains insufficient data available to gain reliable understanding of IPM design in developing contexts. Focusing the scope of further research on developing regions of the world, could be one future direction. Using design principles to redesign or adapt interventions is one way to extend the reach of IPM design to also suit developing regions of the world (Nickpour and O'Sullivan, 2016).

The rise of IPM design contributions in developing countries is predicted to accelerate in the coming decade as research and policy push to enforce access to IPM as a human right. This is echoed by the introduction of new organisations and programmes steered towards the design of interventions for such regions, more sustainable and local infrastructure around design and development, and more affordable and inclusive technologies (AT2030 Programme, 2019).

Operational & Market Characteristics

A primary consideration in the development of IPM interventions is the way in which they will achieve impact; this appears to vary based on the contributor's position on a spectrum of identified operational profiles. On one end of the spectrum exist projects which are instigated by those with a vested personal interest or social and corporate responsibility, such as third sector charities and family members. These are typically small-scale organisations, cottage industries, or startups which lack budget, investment, and a clearly defined business strategy from the outset. On the other end of the spectrum, there are large-scale commercial organisations who already mass-manufacture adult mobility equipment and have well established routes to market. The former is an agile entity with the ability to adapt and change designs as and when needed to allow for greater impact for individuals, but struggles with economies of scale and financial sustainability; some tend to involve a social aspect in their business model such as a subsidised loan schemes (Wizzybug Loan Scheme, 2011; Bugzi Loan Scheme, 2013). The latter is able to achieve greater impact through reaching larger markets, hence more end-users. However, they are profit-driven and thus can be slow to introduce new products unless financially motivated; they struggle most with desirability and affordability issues.

There also appears to be a disparity between design application and successful intervention, where a considerable number of interventional concepts or prototypes, never make it to being used or commercialised. This could reflect on a myriad of issues with navigating complex and highly regulated healthcare systems, inadequate manufacturing plans, or lack of commercialisation or commissioning strategy from the outset of a project. It could also reflect sparse project funding opportunities and investment activity in the IPM sector. It would be interesting to closely examine the relationship between the short and long term success of IPM interventions in relation to viability, feasibility, and desirability, and how their

features address the hierarchy of user experience (Anderson, 2011). Equally, it would be interesting to investigate the reason for IPM interventions being discontinued having reached the market, to answer if this relates to the nature of the market or to the quality of the interventions.

6.2 Towards a Design Framework for the Future of IPM

The mapping review rendered the field of IPM design as currently lacking a holistic and rigorous reference point to define, measure, assess and improve the value and impact of contributions. Thus, distinguishing between change and progress becomes difficult, and there is little scope to help facilitate future contributions. Incorporating this into a design framework for IPM will enable progress to be monitored and help move towards a well-defined, ideal situation in IPM design.

Mapping past and present contributions helped uncover some major gaps and insights in the IPM design field and highlighted the possibility for paradigm shifts to take place on the level of product, service, and system design. Shifting from the traditional limited choice of designs to fully customisable designs, from rigid functionality to adaptable smart technology, from purchasing a mobility product to purchasing mobility as a service, or from niche to mass markets. Practical considerations to help visualise and steer the future of IPM design have been outlined in table 5, to be embodied through the development of an IPM design framework which ultimately intends to optimise the experience of childhood.

Table 5 Considerations for the future of IPM design.

Documentation & Representation	• Consider IPM impact measurement criteria from the outset, to build in means of evidencing long-term results or benefits of interventions. • Record and share theoretical and methodological contributions from Designers and Engineers as well as just ‘end product’ interventional contributions. • Reflect on and document failed or discontinued interventional contributions.

Design Approach & Knowledge	• Identify the narrative being used to frame the problem before starting the design process. Question how alternative narratives could reframe the design goal and design approach. • Take a radical product-service system (PSS) innovation approach to IPM design to move beyond incremental changes. • Adopt a user-aware approach in the design of your IPM interventions where possible. • Consider commercial viability, business strategy and sustainability before developing concepts.
Stakeholder collaboration & Interdisciplinarity	• Make the documentation and circulation of Designers' and Engineers' empirical and tacit knowledge part of the design process. • Give IPM healthcare stakeholders and end-users a major role in the development of interventional contributions. • Use design principles and frameworks to assist with decision making in interdisciplinary teams with conflicting opinions or requirements. • Capture not only knowledge and requirements, but also higher level narratives and principles across contributing disciplines and stakeholders. • Build transdisciplinarity into the design process through: exploring foundational and ancillary IPM subject areas, acknowledging their complex and sometimes conflicting narratives and requirements, and capturing the diversity across disciplines and stakeholders.
Geographics & Regionality	• Support global development of IPM interventions through knowledge sharing and making designs open source. • Consider what it would take to make IPM interventions for developed regions of the world suitable and appropriate also for developing regions of the world, and if these choices and justifications can be embodied by design principles.

Operational & Market Characteristics	• Small organisations should consider and define their route to market early on, and calculate the budget runway required to get there. • Large established organisations should encourage exploration and development of new ideas based on emerging IPM needs and/or wants. • IPM healthcare stakeholders should conduct larger scale empirical case studies to better reflect and measure impact of interventions. • IPM designers should focus efforts on the development of novel mobility interventions rather than incremental changes to power wheelchairs.

7. Conclusion and Future Research Direction

This study reviewed 61 contributions to the field of IPM design between 1970 and 2020. Design contributions were classified and discussed under Theoretical, Methodological, Empirical, and Interventional categories. The review synthesises the evolution of the IPM design field, showing how it has progressively grown from a technical and low volume product-centric cottage industry, towards a larger scale commercialised industry producing IPM interventions without fully considering social, economic, environmental, political and legal states.

Key insights from the mapping review are categorised into five themes: Documentation and Representation, Design Approach and Knowledge, Collaboration and Interdisciplinarity, Geographics and Regionality, and Operational and Market Characteristics. A table of considerations for future IPM design outlines initial suggestions going forward. These will inform a framework for future IPM designs to help steer, improve, and facilitate future product and service interventions.

Further research is needed to enhance thoroughness of the mapping review and to further investigate and analyse the identified contributions and themes. In parallel, real-world observation of an IPM design project from the outset, as well as capturing IPM stakeholders' narratives and requirements, would establish research triangulation needed for outlining the IPM design framework.

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Appendix A

Appendix A presents five tables containing the identified IPM design contributions from between 1970 and 2020. A numerical referencing style has been adopted to make it easier to look up sources for each contribution in the order they are listed in the tables. Source references for each contribution are listed in Appendix B.

Table 6 Interventional Contributions (I.1) which made it to market or were commercialised

MQ1 - **I.1**					
	CONTRIBUTION NAME	MQ2 **YEAR**	MQ3 **CONTRIBUTOR**	MQ4 **GEOGRAPHY**	MQ5 **DESIGN APPROACH**
1980s	Turbo / BobcatDX power chair - Everaids [1]	1984 - 1990	Engineer/Parent	UK	Special Purpose
	Aug-mentative mobility aid 'Smart Wheelchair' - CALL Centre [2]	1988	Designer/Engineer	UK	Special Purpose
1990s	Mobility equipment Service - WhizzKidz [3]	1990	Healthcare/ Philanthropist	UK	Special Purpose
	The CooperCar -RJ Cooper & Associates [4]	1992 - 2000	Psychologist/ Engineer	North America	Customisable or Modular
	BIME infant & junior bugs - Designability [5]	1993 - 2006	Engineer	UK	Special Purpose
	GoBot - Lucile Packard Hospital Stanford [6]	1995	Healthcare	North America	Special Purpose
	Tiro training chair- Lisbeth Nilsson and Permobil [7]	1996 - 2005	Healthcare	Sweden	Special Purpose
2000s	Bugzi beginners power chair - MERU charity [8]	2005	Designer	UK	Special Purpose
	Dragon power chair - Dragon Mobility [9]	2005	Engineer/Parent	UK	Special Purpose
	Permobil Koala power chair [10]	2006	Designer/Engineer	Sweden	Special Purpose
	Wizzybug power chair - Designability (BIME) [11]	2007	Designer	UK	Special Purpose
	Balder Junior power chair - Etac [12]	2007 - 2015	Engineer	Sweden	Special Purpose
	Zippie Salsa M2 mini - Sunrise Medical [13]	2008	Engineer	North America	Special Purpose
	Skippi power chair - Ottobock [14]	2009	Engineer	Germany	Special Purpose

2010s	Self-initiated prone progressive crawler - Virginia c University [15]	2010	Engineer	North America	Customisable or Modular
	TinyTrax power chair - Imaginable Ltd [16]	2011	Designer/Engineer	UK	Special Purpose
	Drive Deck wheelchair platform - Smile Smart Technology [17]	2011	Engineer	UK	Special Purpose
	AKKA Mobility Platform JCM Helsingborg [18]	2011	Healthcare	Sweden	Customisable or Modular
	Systems Collision Avoidance Device (SCAD) - Chailey Heritage [19]	2012	Engineer	UK	Special Purpose
	Go-Baby-Go toy car adaption Service [20]	2012	Healthcare	UK	Customisable or Modular
	Spectra Blitz power chair - Invacare [21]	2012-2018	Engineer	North America	Special Purpose
	Firefly Scoot seat - Leckey [22]	2014	Designer	Ireland	Customisable or Modular
	Upsee Walking with adult support harness [23]	2014	Designer/Parent	Israel	Special Purpose
	Piccolino power chair - Paravan [24]	2016	Engineer	Germany	Special Purpose
	TrexoPlus exoskeleton gait trainer -Trexo Robotics [25]	2016	Designer/Engineer	North America	Special Purpose
	Atlas2030 exoskeleton - Marsi Care & CSIC [26]	2016	Designer/Engineer	Spain	Special Purpose

Table 7 Interventional Contributions (I.2) which remained as concepts or prototypes

MQ1 - **I.2**					
	CONTRIBUTION NAME	MQ2 **YEAR**	MQ3 **CONTRIBUTOR**	MQ4 **GEOGRAPHY**	MQ5 **DESIGN APPROACH**
2000s	Hanna's Upright powered walker [27]	1986-1995	Engineer/Parent	Sweden	Special Purpose
	UD1 Robot - University of Delaware [28]	2007-2007	Design Student	North America	Special Purpose
	A2B Tricycle - Hadassa College [29]	2008-2008	Design Student	Israel	Customisable or Modular
	CPLEGIA - Mimar Sinan Fine Art University [30]	2009-2009	Design Student	Turkey	Special Purpose
	UD2 - University of Delaware [31]	2009-2011	Engineering Student	North America	Special Purpose

2010s	Ugo supportive wheeled seat Aalborg University [32]	2010-2010	Design Student	Denmark	Customisable or Modular
	WeeBot - Ithaca College [33]	2011-2011	Healthcare	North America	Special Purpose
	Chair 4 Life power chair - Renfrew [34]	2012-2014	Design Consultancy	UK	Special Purpose
	The Play & Mobility Device - Grand Valley State University [35]	2015-2015	Engineering student	North America	Special Purpose
	Evolvable Walking Aid Brunel University London [36]	2015-2017	Design Student	UK, Peru	Special Purpose

Table 8 Theoretical Contributions (T)

MQ1 - **T**

	CONTRIBUTION NAME	MQ2 **YEAR**	MQ3 **CONTRIBUTOR**	MQ4 **GEOGRAPHY**	MQ5 **DESIGN APPROACH**
1970s	The Chronically Sick and Disabled Persons Act, the first in the world to give rights to people with disabilities. [37]	1970	Policymakers	UK	User Aware
	Section 504 of the Rehabilitation Act - Prohibits discrimination and exclusion based on physical barriers. [38]	1973	Policymakers	North America	User Aware
	Education for all Handicapped Children Act (EHA) guarantees free education and supports services to enact it. [39]	1975	Policymakers	North America	Customisable or Modular
1980s	Social Model of Disability [40]	1980	Healthcare	Globally	User Aware
	The UN designates 'The International Year of Disabled People' [41]	1981	Policymakers	Globally	Customisable or Modular
	Education Act laid down that children should be educated in mainstream schools or classes wherever possible [42]	1981	Policymakers	UK	User Aware
	The Assistive Technology Act mandates the right to appropriate IPM devices [43]	1988	Policymakers	North America	Special Purpose
	The Children Act, section 17 to provide advice, services and support to children with disabilities [44]	1989	Policymakers	UK	User Aware

1990s	Inclusive Design Principles [45]	1990	Designer	UK	User Aware
	Disability living Allowance is introduced [46]	1992	Policymakers	UK	Customisable or Modular
	Reauthorization of the 1988 Tech Act to improve access to AT devices [47]	1998	Policymakers	North America	Special Purpose
2000s	Improving Access to AT for Individuals with Disabilities Act provides *legal* right to AT from birth to death [48]	2004	Policymakers	North America	Special Purpose
	Childhood Mobility Design Principles - Dragon Mobility [49]	2004	Designer/ Engineer	UK	Customisable or Modular
	Inclusive Healthcare Product Design Principles - F. Nickpour, C.O'Sullivan [50]	2016	Designer	UK	Customisable or Modular

Table 9 Methodological Contributions (M)

MQ1 - **M**				
CONTRIBUTION NAME	MQ2 **YEAR**	MQ3 **CONTRIBUTOR**	MQ4 **GEOGRAPHY**	MQ5 **DESIGN APPROACH**
Human-centred Design Process [51]	1980	Designer	North America	User Aware
Inclusive Design Process [52]	1990	Designer	UK	User Aware
Double Diamond Design process - Design Council [53]	2005	Designer	UK	User Aware
MSc in Disability, Design and Innovation (processes and techniques) - GDI Hub [54]	2019	Designer	UK	Customisable or Modular

Table 10 Empirical Contributions (E)

MQ1 - **E**				
CONTRIBUTION NAME & BRIEF DESCRIPTION	MQ2 **YEAR**	MQ3 **CONTRIBUTOR**	MQ4 **GEOGRAPHY**	MQ5 **DESIGN APPROACH**
Parent/Caregiver Perspectives on power wheelchair [55]	1996	Healthcare	North America	N/A
A wheelchair can be fun: a case of emotion-driven design [56]	2003	Design	Netherlands	Customisable or Modular
Practice considerations for the introduction and use of power mobility for children [57]	2013	Healthcare	North America	N/A

Power mobility for children: a survey study of American and Canadian therapists' perspectives and practices [58]	2018	Healthcare	North America	N/A
Children's, Parents', and Occupational Therapists' Perceptions of Powered Mobility [59]	2018	Healthcare	North America	N/A
Participatory photovoice narrative study exploring powered mobility provision for children and families [60]	2018	Healthcare	North America	N/A
Impacts of early powered mobility provision on disability identity case study [61]	2018	Healthcare	North America	N/A

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Designing an Integrated Public Transportation System for the Accessible Needs of Long-Term Care in Taiwan Using Service Design

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Abstract: In Taiwan, the numbers of the elderly population and people with disabilities are rising. Accordingly, addressing the accessible transportation needs of these groups is an important issue. Currently, long-term care bus services in Taiwan provide on-demand point-to-point shuttle services for people with disabilities and the elderly. However, these services are currently unable to meet the increasing market demand, resulting in lower administrative efficiency and unsatisfactory service quality. In response, the present study approaches the challenge of providing accessible transportation from a service design perspective, exploring the needs of various stakeholders, establishing a cooperative rapport between designers and core stakeholders, and ultimately delivering improvements to the long-term care shuttle system design. The designers first prioritize design concepts, then follow up with service improvement recommendations, and finally collaborate with service operators to implement the new system.

Keywords: service design; accessible transportation service; long-term care shuttle bus

1. Introduction

As the numbers of people with disabilities and the elderly population continue to increase, so too does the demand for accessible transportation. According to a 2016 report entitled, “Analysis on the Living Conditions and Needs of People with Disabilities,” published by the Ministry of the Interior of Taiwan, the most common reason for people with disabilities to leave their homes is to attend “hospital visits,” accounting for 51.86 percent of trips made using accessible transport. In their answers identifying the greatest challenges of a hospital visit, the three most common responses are related to transportation factors — 33.73 percent reported that hospitals are “too far away,” 32.23 percent reported that they do not have access to “convenient transportation,” and 22.85 percent reported that “they have no one to drive them to the hospital.” In response to the report’s findings, a nationwide long-term care shuttle service began its operations in 2017. However, due to a lack of standard

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operating procedures, passengers are unable to obtain immediate feedback when booking a ride, drivers do not receive up-to-date information about passengers, and administrators are faced with managing and interpreting large volumes of service data; all of these contribute to lower administrative efficiency and unsatisfactory service quality. This also creates an opportunity to improve the service. Service design is an emerging field of study that seeks to innovate and improve existing services from a holistic, interdisciplinary, and integrative perspective. The aims of service design are to increase service efficiency and feasibility while simultaneously addressing consumer needs and increasing organizational efficiency (Stefan Moritz, 2005). The purpose of this study is to approach accessible transportation from a service design perspective and to develop a cooperative rapport with various stakeholders by offering a new long-term care shuttle system with an improved riding experience, service quality, and administrative efficiency. The specific objectives of this study are threefold: (1) identify major issues with the current long-term care shuttle services using service design methodology and develop design recommendations based on the results; (2) assess the existing system with a heuristic evaluation and usability test to propose an alternative long-term care shuttle system; and (3) trial the new service concept with users based on the Kano model to determine the implementation priority of improvement concepts, which will serve as a useful reference for relevant organizations.

2. Background of the Research

2.1 An overview of the demand for accessible transportation in Taiwan

According to an estimate by the Ministry of Health and Welfare of Taiwan in 2018, the number of people with disabilities had reached 1,173,978 (5 percent of the population), of which more than 60 percent considered transportation to be the greatest challenge that they faced (The Ministry of Health and Welfare, 2016). While transportation has long been an issue for people with disabilities, accessible transportation is an important service for the elderly population as well. Zhang and Shih claimed that “fixed-schedule and fixed-route mass transportation services are unable to meet market demand. Instead, services featuring flexible schedules and routes must be developed as an alternative to serve the elderly and people with disabilities” (Zhang and Shih, 2015, p. 2). Table 1 is a comparison of existing accessible transportation services in Taiwan.

Table 1 *This table shows that long-term care shuttle and rehabilitative bus services are not only cheaper than accessible taxi rides but also more flexible alternatives than traditional bus services and the Mass Rapid Transit (MRT).*

Type	**Service Coverage**	**Costs**	**Issues**
Long-term care shuttle	~1,896 vehicles	Variation in eligibility for government subsidies (maximum of eight free trips per month)	No Standard Operation Procedure (SOP), low service quality
Rehabilitative bus	~1,912 vehicles	Half to one-third of the price of a normal taxi ride	Service shortage, high complaint rate
Accessible taxi	~700 vehicles	Expensive	Underprivileged individuals cannot afford taxi rides
Low-floor bus	40% of traditional bus services	Inexpensive	Fixed route, lack of flexibility
Railway/MRT	Varies by train types	Inexpensive	Fixed route, lack of flexibility

2.2 An overview of current long-term care shuttle services in Taiwan

In 2017, the Taiwanese government launched the "10-Year Long-Term Care Plan" as an initiative to implement a wide range of preventive measures to mitigate the challenges experienced by people with disabilities, including at-home hospice care and an on-demand point-to-point shuttle service, otherwise known as "long-term care buses." To serve the large number of people in wheelchairs, every long-term care shuttle vehicle is equipped with a wheelchair lift, a ramp, and side walls, as shown in Figure 1. These vehicles can be utilized by elderly citizens with disabilities including those without a government-issued disability card, provided that they register with local long-term care management centers beforehand. Once approved, rides can be scheduled 1–3 days in advance (reservation periods vary by administrative district). As of the first half of 2018, there were 1,896 long-term care shuttle vehicles in service, offering upwards of 170,000 rides to those in need, according to statistics published by the Ministry of Health and Welfare.



Figure 1 *A driver of the long-term care shuttle vehicle helping an elderly citizen on board with the wheelchair lift (photo provided by the authors).*

2.3 Service design

Service design is an emerging field of study that seeks to innovate and improve existing services from a holistic, interdisciplinary, and integrative perspective. The aims of service design are to increase service efficiency and feasibility while simultaneously addressing consumer needs and increasing organizational efficiency (Stefan Moritz, 2005). Service design creates high-quality service environments, toolsets, and procedures for employees that can be tailored to a brand (Continuum, 2010). Addressing the lack of a unified definition for service design, Stickdorn and Schneider (2011) proposed the following five fundamental qualities: (1) user-centered, (2) co-creative, (3) sequencing, (4) evidencing, and (5) holistic.

3. Methodology

3.1 Research framework

The framework of this study is based on the Design Council's (2005) "Double Diamond" design process model that incorporates user experience research, design, and testing. The study was conducted in three stages, which include exploring and defining service designs, developing and implementing service design concepts, and evaluating the design concepts.

3.2 Research procedure

To meet the accessibility needs of long-term care stakeholders in Taiwan effectively, the integrated system is designed in three stages.

1. **Stage I: Exploring and defining current service design:** A pilot study was conducted to develop a preliminary understanding of current long-term care shuttle services, followed by field visits and interviews designed to identify the specific demands and challenges faced by various service stakeholders. In addition, quantitative results on long-term care shuttle services and service

design tools, such as stakeholder and customer journey maps, were produced as a reference for design improvements.

2. **Stage II: Developing and implementing service design concepts:** Based on the results of Stage I, the designers proposed design concepts and recommendations to partner organizations, who developed a system prototype. The design team conducted a heuristic evaluation and a usability test on the prototype. A long-term care shuttle service platform that meets the needs of all stakeholders is designed.
3. **Stage III: Evaluating service design concepts:** Based on the analysis of Kano model, the design team evaluated the feasibility and user preferences of the new service concepts in the long-term care shuttle service platform to determine the implementation priority of the design concepts, which will serve as a useful reference for relevant organizations in developing future accessible transportation services.

4. Problem Definition

4.1 Field observation

Based on the results and observations of the pilot study, we classified stakeholder profiles into three layers: people, places, and competent authorities, as shown in the stakeholder diagram in Figure 2.

- **Service users:** The core users of long-term care shuttle services are people with disabilities and the elderly, among which the patients requiring rehabilitative care or dialysis form the majority. A companion is usually onboard with the patient (usually a foreign caretaker), while a family member is often responsible for making reservations.
- **Service providers and administrators:** Providers are front-line staff members who work in direct contact with passengers, including drivers and customer service representatives. Administrators, on the other hand, refer to managers and executives who oversee operations within the organization.
- **Service regulators:** The Ministry of Health and Welfare and local governments are responsible for supervising long-term care services, establishing long-term care management centers and serving as the regulator of long-term care organizations.

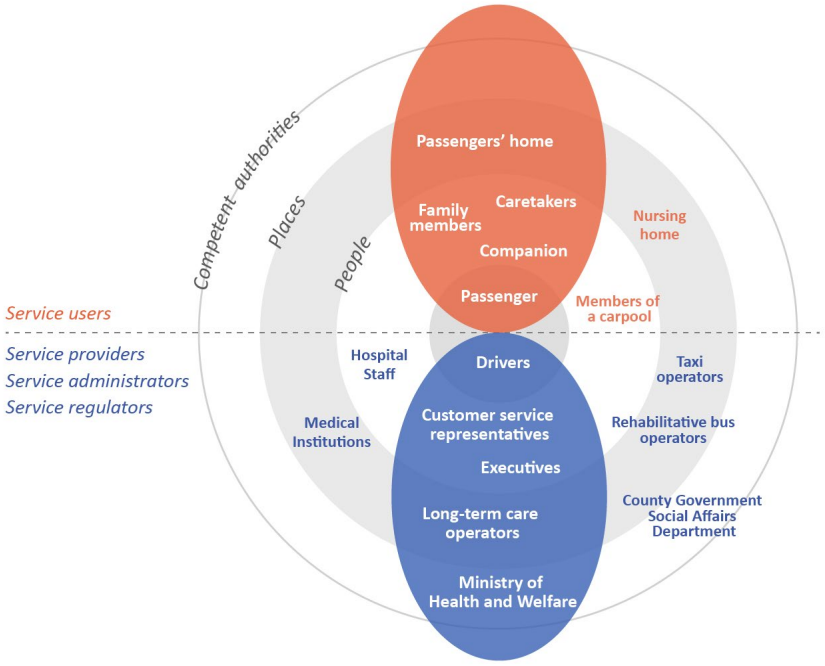

Figure 2 *The stakeholder diagram includes an upper part (service users) and a lower part (service providers, administrators, and regulators). Blue and orange areas indicate core stakeholders.*

4.2 In-depth interview

As mentioned in the previous section, there are three target groups in this study: service users (passengers, companions, family members, and caretakers), service providers (drivers), and service administrators (customer service representatives and executives). To obtain a fuller understanding of the challenges and issues presented by service situations, interviews were conducted with 31 stakeholders in total, comprised of eight long-term care shuttle service organizations, four executives, seven administrators, eight drivers, and four passengers as well as family members. The interviews were subsequently analyzed through a work activity affinity diagram (WAAD).

4.3 Customer journey analysis

To identify the key areas in which problems arise, the designers sought to understand the passenger experience better, envisioning a customer journey map consisting of three phases – "before the ride," "during the ride," and "after the ride" – as depicted in Figure 3. Through interviews and journey analysis, the designers were able to summarize the challenges faced by each stakeholder group.

- **Service users:** (1) Unable to book a ride, forget to book a ride, or forget the time of a ride; (2) no immediate feedback after booking and no subsequent ride reminders prevent passengers from staying updated on a ride booking.
- **Service providers:** (1) Unable to access passenger information, special needs,

and the optimal route immediately; (2) passenger signatures and payments are recorded on pen and paper, making record-keeping difficult.

- **Service administrators:** Vehicle dispatching procedures are complicated and large amounts of data must be sorted and processed by hand.

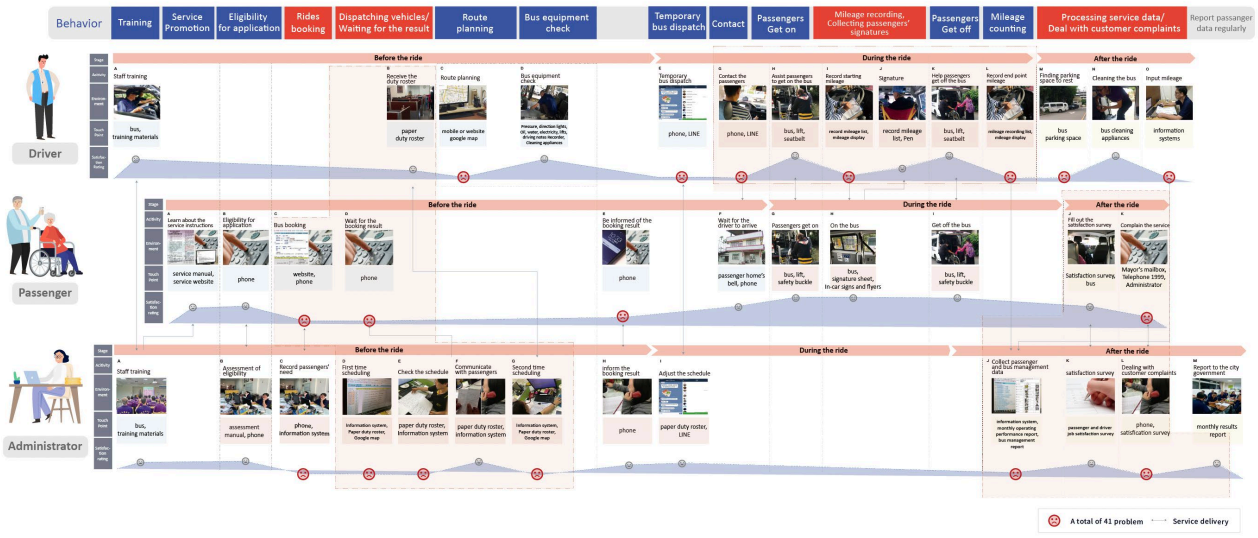

Figure 3 *Areas shaded in red are the key areas in which issues arise. These include booking rides, dispatching vehicles (before the ride), recording mileage, collecting passenger signatures (during the ride), and processing service data (after the ride).*

4.4 Quantitative survey on current services

To paint a fuller picture of current services, this study used a customer satisfaction (CSAT) survey and a Net Promoter Score (NPS) to gauge the opinions of the three stakeholder groups on existing long-term care shuttle buses. The satisfaction questionnaire includes a seven-point Likert scale. In total, the numbers of valid responses obtained are 15 from service users, 14 from service providers, and seven from service administrators. The results are summarized below:

- **Service users:** Figure 4 shows that passengers noted relatively lower satisfaction in service promotion, service eligibility, customer service, booking, and successful booking rate for long-term care shuttle services. This reflects several pre-ride issues behind: customer service representatives are required to process large amounts of information and are unable to provide immediate information regarding a reservation. To compound this issue, some passengers noted that they did not understand the service's promotional materials. Nevertheless, customer loyalty remains high (NPS = 73), suggesting that long-term care shuttle services are truly an integral part of the accessible transportation system.
- **Service providers:** Figure 4 shows that drivers were most dissatisfied with the workload, after which the issues of collecting signatures/payments and on-the-

spot assignments are highlighted. This reflects several issues identified in the pilot study, including the traditional method of collecting passenger signatures/ payments and a cumbersome record-keeping process. Furthermore, passengers often book or cancel trips on short notice, resulting in frequent on-the-spot assignments and an unstable workload for drivers.

- **Service administrators:** Figure 4 shows that similar to drivers, administrators were most dissatisfied with the workload, followed by regulations, lack of flexibility in dispatching vehicles and arranging shifts, and the large amounts of time devoted to processing large amounts of service data. In response to an open-ended question, a few participants suggested that a comprehensive system of regulations should be devised and that the introduction of an assistive technology (such as an automatic record-keeping system) would alleviate certain issues.

Results of the customer satisfaction (CSAT) survey

Service Users (N = 15)

	Overall service	Promotion	Eligibility	Booking	Driver's attitude	Vehicle cleanliness	Vehicle exterior	Booking success rate	Customer service
M	6	4.1	4.8	5	6.4	6.3	6.5	5	4.8

Service Providers (N = 14)

	Overall service	Training	Scheduling	On-the-spot assignments	Record-keeping	Signature/ payment	Regulations	Job division	Workload
M	5.7	5.4	5.1	5	5	4.7	6.5	5.5	4.4

Service Administrators(N = 7)

	Overall service	Training	Promotion	Reservation	Shifts	On-the-spot dispatch	Regulations	Job division	Customer complaints
M	5.4	4.5	5.2	4.8	4.8	4.2	3.5	4.8	4.8

	Workload	Case management	Reporting
M	3.6	5	4.7

Figure 4 Results of the customer satisfaction (CSAT) survey completed by service users, providers, and administrators.

5. Results

Through the pilot study, the designers identified four major issues in existing long-term care shuttle services:

1. **Incomplete management system:** Deficiencies were found in trip reservation and shift arrangement; completing paperwork is difficult in light of the growing demand for shuttle services.
2. **Poor communication:** Discrepancies were found in the information communicated to frontstage and backstage staff as well as customers.
3. **Human resource challenges:** Insufficient training and unclear job allocation to frontstage and backstage employees, particularly those working in remote areas.
4. **Incompatible regulations:** Standardized operating procedures and regulation were unclear of long-term care transportation services – resource distribution is incongruent with operational needs, and shuttle operators struggle to coordinate markedly divergent models of operation.

The design team met with people from partner organizations, various stakeholder groups, and three designers well versed in service design (who have first-hand experience of the shuttle service) to discuss potential design concepts. The ultimate goal is to build a "safe, convenient, and accessible shuttle service" with a focus on designing a digital tool. As shown in Figure 5, the framework of design incorporates the actual needs of the three stakeholder groups:

- **Service users:** Three major needs are identified: (1) immediate and clear information on reservations and ride reminders, (2) a channel to submit and receive information on rides for family members**,** and (3) a safe riding experience.
- **Service providers:** Three major needs are identified: (1) a smooth channel of communication with administrators, (2) clear information for passenger pick up**,** and (3) a more comprehensive training program.
- **Service administrators:** Two major needs are identified: (1) a set of congruent regulations governing long-term care shuttle services and (2) prevention of financial loss.

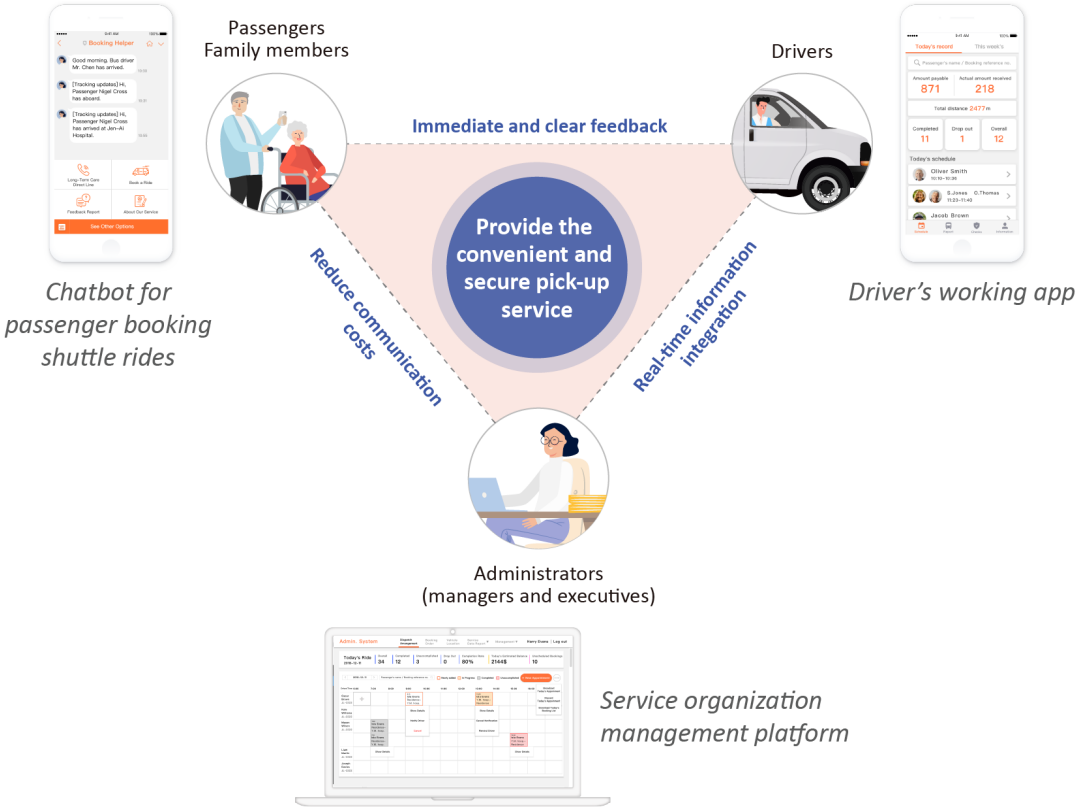

Figure 5 *As shown in the design framework, the researchers hope to approach the task from a service design perspective and establish a safe, convenient, and accessible shuttle service by connecting the three stakeholder groups through a digital platform.*

6. Design and Evaluation

6.1 Heuristic evaluation and usability test on existing platforms

Based on the results of the pilot study, our research partner *A* produced the first prototype of the management platform for service providers and administrators, a system that is already in use by a number of service organizations. To enhance the user experience and communication channel aspect of the platform, the design team invited seven UI/UX designers to conduct a heuristic evaluation and usability test on the platform in six major areas – information architecture (IA) content, IA, flow, layout, interaction, and user interface. The experts were asked to examine whether the system complies with generally accepted usability principles. Finally, the design team compiled a list of 50 usability issues based on suggestions made by the seven experts.

6.2 Designing a new long-term care shuttle system

The prototype was revised based on the evaluation results to create a more holistic long-term care shuttle service system. The specific design concepts for each of the stakeholder

groups are described below:

- **Service users:** A chatbot was developed for booking long-term care shuttle rides on the popular instant messaging app**,** "LINE**.**" In the pilot study**,** we found that more than 80 percent of passengers have a LINE account, making it the most suitable platform for booking rides and receiving ride reminders. The remaining 20 percent who are unfamiliar with digital products will be redirected to customer service to maintain a smooth and efficient user experience when booking a transport service. As shown in Figure 6, the current functions of the chatbot include a service introduction, simple reservation feature, clear contact information, ride reminders, ride tracking, payment notifications, and service feedback. These functions are designed to help passengers and their family members stay updated on information regarding upcoming rides.

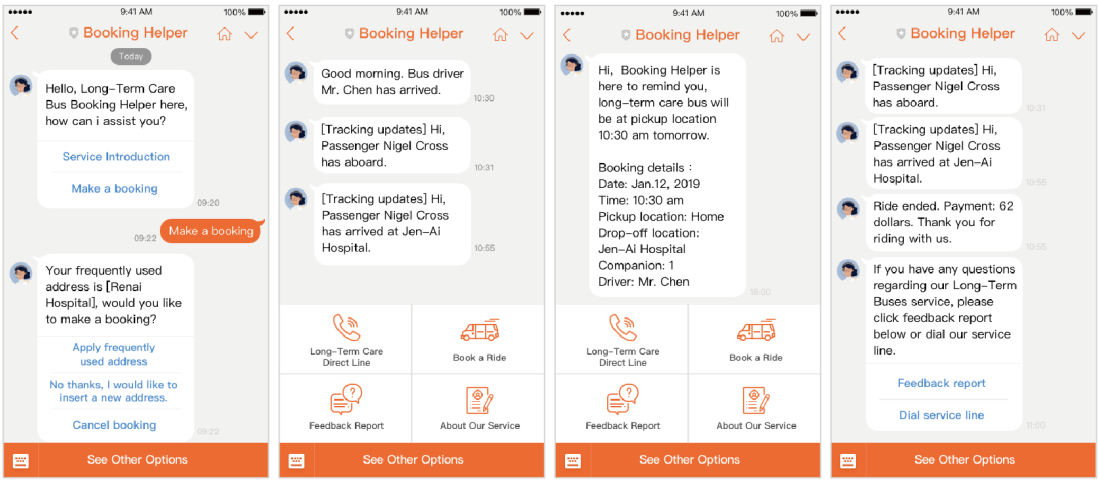

Figure 6 The app interface for the "Long-Term Care Shuttle Booking Helper" LINE Chatbot

- **Service providers:** A long-term care service provider app was tailor-made for the drivers, which aims to provide real-time information and reminders while drivers are working. Figure 7 shows the main functionality of the app, which includes ride reminders, route and schedule view, daily vehicle maintenance, tracking/navigation, arrival alerts, payment reminders, e-signatures, task lists, passenger notes, and mileage reports. The goal is to increase the effectiveness of communication among drivers, passengers, and administrators, digitize the record-keeping process, and avoid human errors as much as possible.

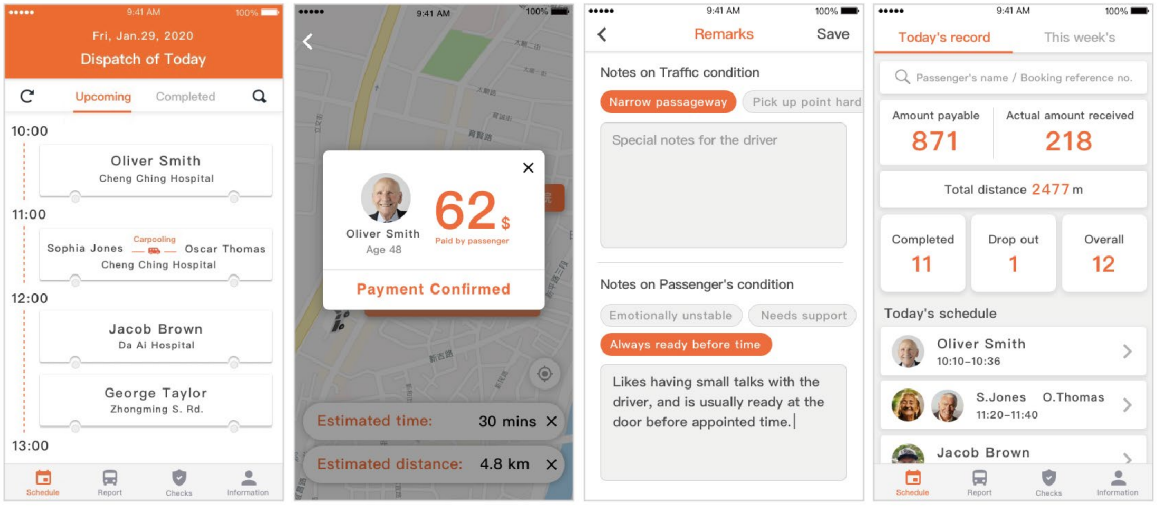

Figure 7 The app interface for long-term care shuttle drivers

- **Service administrators:** For long-term care shuttle service organizations and administrators, the "Long-Term Care Shuttle Bus Service Organization Management Platform" was developed with the goal of boosting work efficiency and service quality. As shown in Figure 8, the platform handles enterprise resource management, case management, reservation management, vehicle dispatching, real-time monitoring, smart reports, service feedback, and order history. It is expected that the platform will help administrators to arrange shifts, obtain driver locations, and process the large amounts of data generated.

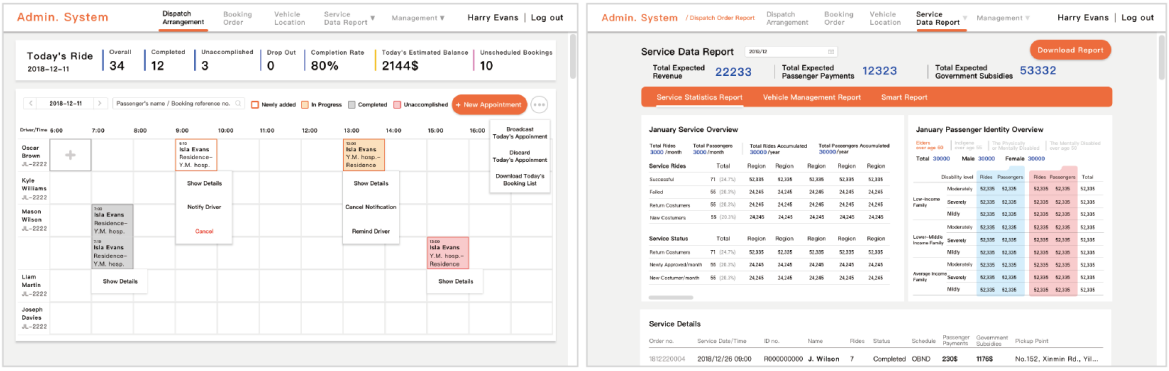

Figure 8 The platform interface for long-term care shuttle service administrators

6.3 Priority of design concepts

The framework of this study is based on the Kano model proposed by Noriaki Kano and other Japanese scholars in 1984. Through visual presentations of design concepts in various service scenarios (see Figure 9), service users, service providers, and service administrators were asked to evaluate each functional module in the newly designed system. The Kano model categorizes customer satisfaction characteristics and helps corporations to decide

which customer needs should be prioritized (Matzler & Hinterhuber, 1998). There are six quality categories in the Kano model: *must-be requirement* (M), *one-dimensional requirement* (O), *attractive requirement* (A), *indifferent requirement* (I), *reverse requirement* (R), and *questionable requirement* (Q). Meanwhile, we used the NPS to construct a holistic understanding of user loyalty to the product and the Customer Effect Score (CES) to gauge how much the product simplifies and accelerates the workflow of service providers and administrators. In total, 31 valid questionnaires were collected from service users, 23 from service providers, and 16 from service administrators, the results of which are summarized below:

- **Service users:** Given that a large portion of passengers are intubated and unable to respond to the survey themselves, a majority of participants (58 percent) in this stakeholder group are family members. Based on the aforementioned Kano model, respondents were asked to rate the seven major functions of the "Long-Term Care Shuttle Booking Helper" LINE Chatbot. Statistics show that "simple booking," "ride reminders," and "ride tracking" are attractive requirements (A) and should be prioritized accordingly, as shown in Figure 10. The NPS is 55. In the follow-up interview, we found that participants with moderate to advanced computer skills consider booking a ride via the LINE app to be far more convenient than booking over the phone. In the pilot study, we found that long-term care shuttle users are loyal to the service, and we believe that the LINE chatbot provides a useful alternative to scheduling a ride every week.

"My husband needs a ride every week, meaning that I have to regularly call to book a ride. It's a lot of hassle and I sometimes forget to do it. The LINE Chatbot offers a convenient alternative, and I am more than willing to recommend this service to my tech-savvy friends." — C11

- **Service providers:** As illustrated in Figure 10, the 10 functions in the long-term care shuttle driver app were all scored as indifferent requirements (I), meaning that neither good or bad, it may have no effect, positive or negative, on customer satisfaction. The CES, on the other hand, is only 17. Through in-depth interviews, we learned that drivers do not have time to use their smartphones when they are between rides and that many older, more experienced drivers feel comfortable with the status quo and may even be averse to digital assistive tools. Some drivers told us that they are indifferent to using a pen-and-paper system or digital software, as long as it is fully integrated and does not increase the workload. With this, we conclude that providing sufficient training, establishing a standard operating procedure, and building the professionalism of drivers are more important than introducing a digital platform.

"Our job is to take passengers to their destinations in a safe and timely manner. I am not against mobile apps, but they must be easy to operate for them to be useful. To put it frankly, it doesn't really matter that much whether we have or don't have a software system in place." — D3

- **Service administrators:** Participants in the service administrators group generally identify themselves as moderate to advanced users of digital tools. Among the nine functions of the "Long-Term Care Shuttle Bus Service Organization Management Platform," only "smart report" is classified as a *one-dimensional requirement* (O), meaning that the implementation of this design concept is positively correlated with user satisfaction and vice versa. By contrast, "real-time monitoring" and "booking history" are classified as *attractive requirements* (A), as shown in Figure 10. The CES is 63. The follow-up interview revealed that participants hold favorable opinions towards the platform as it consolidates large amounts of data, minimizes manual labor, and increases service efficiency and quality. However, in terms of shift arrangement, participants still prefer the traditional pen-and-paper system as it offers more flexibility than the digital platform, which did not include the "smart scheduling" function at the time.

"The strength of the platform is its robust data processing power, which dramatically reduces my workload. However, in terms of flexibility, I still prefer using pen and paper. At the end of the day, both systems have their benefits and drawbacks." — A1



Figure 9 *Following visual presentations of our design, based on various service scenarios, participants are asked to express an opinion on the new platform. On the left-hand side is an illustration of the scenario; on the right-hand side is a partial screenshot of the interface; at the bottom, a photo of the actual service scenario is included.*

Kano analysis results										
Long-Term Care Shuttle Booking Helper LINE Chatbot										
Concept	**Service agreement**	**Simple booking**	**Clear contact info**	**Ride reminders**	**Ride tracking**	**Payment notification**	**Service feedback**			
Classification	**I**	**A**	**I**	**A**	**A**	**I**	**I**			
Long-Term Care Shuttle Drivers App										
Concept	**View schedule**	**Daily vehicle inspection**	**Tracking & navigating**	**Ride reminders**	**Arrival notification**	**Payment reminder**	**E-signature**	**Task list**	**Passenger notes**	**Mileage report**
Classification	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
Long-Term Care Shuttle Bus Service Organization Management Platform										
Concept	**Promotion website**	**Resource management**	**Appointment management**	**Reservations management**	**Dispatch management**	**Real-time monitoring**	**Smart reports**	**Service feedback**	**Booking history**	
Classification	**I**	**I**	**I**	**I**	**I**	**A**	**O**	**I**	**A**	

Figure 10 Results of the KANO analysis among Long-Term Care Shuttle Bus Chatbot, App, and platform.

7. Conclusions and Recommendations

7.1 Conclusions

The purpose of this study is to analyze accessible service scenarios in transportation from a service design perspective. By collaborating and co-creating solutions with designers and various social stakeholders, the present study seeks to improve the riding experience, service efficiency, and quality of long-term care shuttle bus services. Based on the research and design of this process, this study draws the following two conclusions:

1. **The service design perspective is effective in redesigning public transportation:** Public transportation services involve a wide range of stakeholders. A service design perspective can create a cross-channel system that integrates the resources of various stakeholders, allowing the reinvention of a public transit system with better efficiency. The present study provides a prime case study on the application of service design in a public transportation system.
2. **The service design methodology helps designers resolve transportation issues faced by the underprivileged:** The stakeholder diagram and the customer journey map highlight the intricate issues of public transportation services, which involve complicated concepts and high infrastructure costs. To address this, the designers prioritize effective service design concepts by evaluating them according to the results from Kano model using visual presentations of service scenarios, which assists the designers in preliminary planning prior to the implementation of the new system.

We will continuously collaborate with two long-term care shuttle organizations in Taiwan, Taichung and Yilan, to implement the service design project in local communities. In the near future, we expect that the potential results of the study could provide significant value both socially and economically. In terms of social value, the study could enable local governments to consolidate resources and build a network based on "the disadvantaged taking care of the disadvantaged," addressing the often-neglected social needs of the elderly and people with disabilities. For economic value, this study could enable coordination between government, taxi dispatchers, and long-term care shuttle service organizations to achieve an accessible transportation service model that is efficient and sustainable.

Apart from applying service design to public transportation services, this research corresponds with the points of Inclusive Design as stated by Clarkson, Coleman, Keates, and Lebbon: "A key aspect of the inclusive approach is to expand the target group of a product or service to include as many users as possible, without compromising the business goals of profit and customer satisfaction" (Clarkson, Coleman, Keates & Lebbon, 2013, p. 10). Additionally, apart from designing for the physically disabled, we have expanded our field of design to include passenger associates, such as family members, drivers, and administrators. We also consider user habits and behaviors throughout the design process so that users are able to achieve their goals with greater flexibility. Ultimately, "design for all" is the core value of this research.

7.2 Recommendations for future research

In light of its research findings, the present study would like to make the following three recommendations concerning the direction of future research and application:

1. The core issue of long-term care shuttle services is that government policies are incongruent with actual market needs. However, the present study does not address the process of communication and coordination with the government. It is recommended that in the future, designers working with public services should establish a channel of communication with the government so that user feedback and user needs are relayed to the responsible authority, thereby increasing the impact of the design.
2. The present study identifies the lack of standardized operating procedure and regulations as the cause of inconsistent service quality and the rising number of customer complaints. We suggest that future designers draft a standardized service agreement with relevant stakeholders to influence policymakers to establish standard operating procedures that can be easily duplicated in other locations.
3. Future designers interested in constructing similar multi-channel service platforms are advised to approach their designs from an all-inclusive perspective with individual consideration given to various touchpoints in actual service scenarios to elicit genuine feedback from participants.

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Inclusive Design Museums and Social Design

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Abstract: The design museum was a rising genre of museums in the late 1980s during a golden age of museums on an international scale. Along with the building boom of museums, with the advent of new museology and the notion of socially inclusive museums, museums become more visitor-oriented and inclusive. Based on Richard Sandell's theory, this thesis argues that design museums can be seen as a form of social design to deal with social exclusion. It chooses two Asian design museums founded in recent years and explores how they use design as an assistive approach to achieve the goal of social inclusiveness and to what extent they achieve their objectives.

Keywords: social inclusion; design museums; social design

1. Introduction

The design museum was a new genre of museums that emerged in the late 1980s along with the building boom of museums on a global scale. It is a specialty museum dedicates itself to collecting, researching, conserving and displaying design or design-related issues. Having its roots in the early industrial and decorative arts museums, the design museum has taken an educational responsibility to promote design and educate the public with its collections(Bayley, 1983). In the past decades, design museums were built internationally. They played an important role in the design industry and society and were conducive to connect design and the public.

However, questions about the significance and reasons for museums in documenting and displaying design have been raised(Farrelly & Weddell, 2016). They are related to the functionality and commercial implication of design as well as the nature of museums, because design becomes "an object of contemplation" when it is displayed in a museum setting(Taylor, 2016). The thesis thus serves to be one of the many answers to the questions. On the one hand, as design evolves constantly, many derivative concepts such as critical design and social design emerged and challenge its utilitarian association. On the other hand, museums used to be a place for admiring art and a place of social exclusion that only served the royalties and elites, while museums have been increasingly visitor-oriented under

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the guidance of experience-based new museology since the 1980s(McCall & Gray, 2014). In the late 1990s, Richard Sandell(1998) proposed the idea of socially inclusive museums that should be an open, diverse, inclusive, educational and visitor-orientated institution. The foci of the idea are the social roles and functions of the museums, especially when addressing marginalized groups. This idea overlaps the concept of social design and museums becomes an experimental platform that employed design to deal with social exclusiveness.

The thesis will briefly contextualize design museums and their transformation under the influence of new museology. Then it traces how the idea of socially inclusive museums came into vogue and explores what the social roles of design museums should be. At last, the thesis discusses two museums in Asia that use design as an assistive approach to achieve the goal of social inclusiveness and to what extent they achieve their objectives. These two museums were founded in recent years and both do not have collections. Their focus thereby places on the engagement of their local communities. The thesis argues that design museums could be considered as a form of social design to represent and engage with the public, and further, improve individuals' well beings.

2. Musealization of Design

The emergence of design museums has intertwined with industrial fairs and expositions which traced back to the middle of the nineteenth century(Williams, 2016). Many industrial exhibitions were held to showcase national manufacturing progress. The most distinguish event was the *Great Exhibition of the Works of Industry of All Nations* opened in London in 1851. After the exhibition, many products on display were collected and formed the Victoria and Albert Museum(V&A), which became a model of industrial and decorative arts museums that were flourished in Europe. The authorities believed the exhibitions were cultural diplomats as well as manifestations of national power(Williams, 2016), and the museums were established for the commercial purpose—to promote design industry and economy—and for educational and aesthetic purposes with the endeavor to shape the public's "good taste" (Weddell, 2012).

The latest upsurge of design museums has been identified in the new century. Design museums were lavishly built in Asian countries, such as Singapore, Japan and China. In this period, ideologies and paradigms shift from a Eurocentric model to dynamic and diversified ways of operations among these new museums and those well-established.

3. Socially Inclusive Design Museums

3.1 The Social Role of Design Museums

Museums were regarded as the ivory tower for elites and the privileged and denied access from the general public. Since the twentieth century, the social functions and roles of museums have been discussed and debated by the academia and practitioners. With the advent of new museology in the 1980s, visitors became the central concern

of museums(McCall & Gray, 2014). The new museology introduces a new philosophy regarding the social and political roles and functions of museums and their relationship with their communities and societies(McCall & Gray, 2014). It shifts the museum paradigm from the isolated, elitism and collection-centered tradition to a more diverse, inclusive, communicating, educational and visitor-orientated institution.

As defined by the International Council of Museums (ICOM) Statutes, a museum is a non-profit research and exhibition organization that collects, conserves, researches, communicates and displays the tangible and intangible heritage with an intention of education and entertainment(ICOM, n.d.). Museums today are cultural organizations with multiple functions and purposes. Design museums in an era of change are no longer a static warehouse but a living and interactive space driven by multiple purposes of education, social innovation and "national salvation" (Twemlow, 2017, p. 139). They can also "chart the history of design movements and influence design principles and contemporary taste" with the aid of curation and exhibitions(Erlhoff et al., 2008, p. 122), at the same time, create a futuristic scenario and open debate for the public, academia and industries through exhibitions and conferences. They can be considered as a synergist of design since it is an open platform that connects design and the public.

Whereas the most important role that museums play in society are in education (Hooper-Greenhill, 1992; Sandell, 1998). In the nineteenth century, museums were regarded as an "instrument for positive social change" that can be achieved by education(Sandell, 1998, p. 408). The establishments of the V&A and Design Museum in the UK, for instance, were also out of an educational purpose. The former was part of the education reformation in the 1850s(Pevsner, 2014), while the Design Museum plays a pivotal role in providing educational programs for school children and college students from its inception (Usherwood, 1991). Design museums are crucial in promoting design and social innovation by educating the public. As Sandell puts it, as an educational institution, the museum must now present "its justification in terms which demonstrate its ability to promote social inclusion, tackle issues of deprivation and disadvantage, and reach the widest possible audience"(Sandell, 1998, p. 403).

3.2 The Inclusive Museum and Social Design

Social inclusion, or social integration, has often been discussed in comparison with social exclusion, which has been increasingly important discourse in European and British academia and governmental policy-making in the 1990s. In the article *Museums as Agents of Social Inclusion*, Sandell(1998) boldly raises the questions of social exclusiveness of museums, when museums of that time overemphasized their economic values rather than their social influences due to the political agenda. He elucidates the social responsibility and roles of museums and proposes a typology of socially inclusive museums in light of "an increasing desire to make clear the museum's social purpose and the value it provides in relation to addressing contemporary social issues"(1998, p. 415).

Social exclusion used to be associated with poverty and deprivation, referring to those handicapped or disadvantage people that have been marginalized by society. But social exclusion has a broader meaning and is more multidimensional than poverty. There are four interconnected dimensions of exclusion from cultural, social, economic and political aspects that would have a negative impact on individuals and society(Sandell, 1998). For example, an excluded person can be excluded from education service, employment market, cultural organizations and some social or political communities.

As Sandell discerns, there are three roles of museums that should play in the multidimensional social inclusion. They are "the inclusive museum", "the museum as agent of social regeneration", and "the museum as vehicle for broad social change", all of which have different backgrounds, goals and achieved methods. The first one aims to embrace cultural inclusion through representing and engaging the marginalized groups (open access); the second to improve personal life by encouraging personal development or working within small communities that have been marginalized; while the last plays "a campaigning or advocacy role" for social betterment "by exploiting their potential to communicate, educate and influence public opinion"(Sandell, 1998, p. 412). Graham Black(2010) explores five principles that support museums to engage communities. Although he adopts urban history museums as an example, the principles are universal and applicable for varied kinds of museums. Among the principles, the advocation of museums being social and democratic institutions echo the appeal of Sandel that museums should act as agent of social inclusion.

In the realm of design, inclusive design is a similar concept, whereas it primarily addresses issues on accessibilities(Imrie & Hall, 2001), transdisciplinary research and user-engagement(Langdon et al., 2018). Imrie and Hall's publication concerns the inclusive design in creating an accessible architectural space for the disadvantaged. This is particularly crucial in public space such as shopping malls, hospitals, schools, public libraries, theaters and museums.

However, the employment of inclusive design in museums could make the space more friendly and accessible, but that cannot help museums to achieve the goals as Sandell defines above. Compare with inclusive design, the concept of "social design" deals with a broader scope and people. In 2013, the British Arts and Humanities Research Council conducted a research project on social design in the UK. As the research team defined:

> "Social design highlights design-based practices towards collective and social ends, rather than predominantly commercial or consumer-oriented objectives... It is associated with professional designers, students, staff and researchers in Higher Education Institutions (HEIs) and also promoted and practised by some public sector bodies, funders, activists and non-profit and commercial service providers."(Armstrong et al., 2014, p. 6)

The research team makes the point clear that social design reaches towards "collective and social ends" and it is distinguished from commercial design and executed by public sectors. Similarly, Ezio Manzini asserts that social design is:

> "a design activity that deals with problems that are not dealt with by the market or by the

> state, and in which the people involved do not normally have a voice (for the simple reason that they do not have the economic or political means to generate a formal demand)... Thus social design is intrinsically a complementary activity: a design that, to exist, asks for someone else who can and will generously pay for it."(Manzini, 2015, p. 65)

Manzini elucidates the ethical and charitable nature of social design since the people do not have a voice normally are excluded from economic, cultural or political agenda due to their disadvantages or poverty. While this exclusion can hardly be solved by commercial or public services because these people cannot "sustain the cost of design" (Manzini, 2015, p. 65). Social design hence is urgently needed to tackle social inequalities and exclusion.

In this regard, an inclusive design museum can be considered as a form of social design that represents and engages the minority and improve the life of the marginalized individuals. A difference is that museums should not only serve the minority and the poor, but also for all economic and social levels of society.

However, limitations exist in institutional settings. Many museums simply consider social inclusion as "audience development and access" (Sandell, 2003, p. 47) which is reluctant to fulfill any of the three roles mentioned above. The notion of visitor-oriented museology has been put forward for several decades, it is not extensively accepted by all museums, or the changing role of museums has been underestimated by society(Black, 2010; GLLAM, 2000; McCall & Gray, 2014). To deal with change inhibitors, regulatory, financial and policymaking assistance from different external bodies, as well as attitudinal and structural shifts of museums themselves, are required(GLLAM, 2000; Sandell, 2003).

In 2000, the Group for Large Local Authority Museums (GLLAM) commissioned a research project into museums and social inclusion. Despite the limitations and difficulties, as the GLLAM Report affirms, "museums are natural engines for social inclusion work as long as we choose to adopt this role"(2000, p. 5). The thesis hereby discusses two museums that use design as an assistive approach to achieve the goal of social inclusiveness.

4. Design Museums as Social Design

4.1 Design Museum as a project



Figure 1 Design Museum Dharavi, Mumbai, India. Source: http://designmuseumdharavi.org/

Design Museum Dharavi was a cultural platform opened in 2016 by Jorge Mañes Rubio and Amanda Pinatih, an artist and a curator based in Amsterdam. The museum has been sponsored by two Dutch cultural organizations, the Creative Industries Fund and The Art of Impact. Located in Dharavi, Mumbai, India, this place is the largest informal settlement in Mumbai and one of the largest "slums" in Asia that has been featured in the film "Slumdog Millionaire". A high density of population which consists of one million immigrant workers and their family rests in a 3 square kilometers' space. Many belong to the poor, low-caste groups that are historically marginalized (Srivastava & Echanove, 2016). The living condition is hazardous: the area is lack of basic civil infrastructure as well as well-equipped health and hygiene systems such as toilets(West, 2018). The working condition is hazardous as well. Dharavi has many factories for export business, most of which are "illegal, untaxed and unregulated" (West, 2018, p. 136).

Despite the above, creativity is an invisible wave in Dharavi. Hindu, Muslim and Christian are three main communities that are strong and united, and the major industries in Dharavi are leather, textile, pottery and jewelry and so on(West, 2018). As the area is developing slum tourism recently, visitors are increasing. In 2013, the Alley Galli Biennale began inaugurated

at Dharavi to connect and revive the area with themes of art, health, recycling and community.

The situation of Dharavi inspired Rubio and Pinatih to make nomadic exhibitions for cultural exchange and innovation(Pinatih et al., 2016). The design museum project was thereby launched and aimed to connect this impoverished place with the rest of the city, "to employ design as a tool to promote social change and innovation, and to challenge the negative perception of informal settlements around the world"(Rubio & Pinatih, n.d.). It is not usual to open a museum in an informal settlement like Dharavi. Design Museum Dharavi called itself "a museum on wheels", because it was not a traditional museum with a stack of collection and a static house. Rather, it was a temporary museum project with exhibitions and workshops traveling around this area.

Representation, participation and access are three elements for an inclusive museum in cultural dimension(Sandell, 1998). The Design Museum Dharavi was open to all and engaged local makers and represented the once marginalized groups. Besides, the museum encouraged the makers and showcases their design around this region. Rubio and Pinatih collaborated with local makers and craftsmen and encourage them to create for the exhibitions. Inspired by local customs and industries, the created objects ranged from pottery, broom, embroidery, leather works and carpentry and so on. Among the objects, Chai, for example, is an important local beverage which is associated with their identity, therefore more than fifty different tea containers were designed and featured in exhibitions; while brooms and fans making are normally regarded as low-value production, the makers were then encouraged to use different material and techniques in this project(Pinatih et al., 2016). The museum team also worked with *urbz*, a design and architecture collective founded in Mumbai, as well as local construction contractors and artisans, to co-design ideal tool-houses,[1] a pre-industrial multi-story building in Dharavi that combines the living and working space like a home factory. The team and *urbz* recognized the energy within the spontaneous design, assisted them to improve the building and made the dynamism visible to local media and the public.

Local artisans and makers were often required to make repetitive manual works based on production order which stereotyped the community as low-valued and uncreative. But when enough freedom was given, they were more confident and able to create interesting works. The museum thus served as a platform that helped to represent the marginalized groups as a creative community and the works in exhibitions helped to reverse the identity of the community with their dynamism and creativity(Pinatih et al., 2016). After their collaboration with local artisans, the museum team found more attractive works were designed and

1 As Srivastava and Echanove(2016) examine, the tool-house is a multifunctional and flexible building that is unintentionally "designed" by local families according to their sheltering needs and modes of production. The chaotic neighbourhood induces the authorities to do a wholesale makeover and relocate people to high-rises, however, this is a misplacement that would destroy the dynamism of these communities.

displayed in their family shop.[2] This is exactly what Sandel calls a socially inclusive museum and "the museum as agent of social regeneration".

However, the flexibility of the mobile museum hinders its sustainability at the same time—the museum only functioned for a short period. The objective of the museum team was not to create a permanent site of design objects, but to create a scenario and to explore the possibility of boosting local development with design with this model, which can be applied to other settlements in similar situations(Pinatih et al., 2016). At the end of November 2016, the Design Museum Dharavi was nominated the Beazley Designs of the Year and exhibited at the Design Museum, London. In the same year, the museum received the Leading Culture Destinations Awards in the category of 'Best New Museum of the Year - Asia Pacific'.

4.2 Design Society: Design to Love

Design Society is another museal institution open in December 2017 in China. It is organized by the state-owned company China Merchants Shekou Holdings (CMSK) in cooperation with the V&A Museum and located in the Shekou Industrial Zone, at the southwest side of Shenzhen city, Guangdong Province. The industrial zone was established during the Reform and Opening period around 1978 when Shenzhen was set up as a special economic zone. The area was full of factories and warehouses. Along the coastal line, there were docks, containers and vessels. In recent years, as many manufacturing industries were updated and transformed, many factories gradually moved out of the city and left many empty buildings.

Design has been featured and promoted lavishly in Shenzhen at the beginning of the century. The city believes design can innovate society, transform the industrial structure and stimulate the economy. Since Shenzhen has been part of the Creative Cities Network and entitled "City of Design" by the UNESCO, design-related cultural events were prevalent.

Design Society was born in this context, while slightly closer to the commercial center of Shekou. It aims to serve the society and function as a cultural hub to 'combine, connect, cross-fertilize and, by doing so, transcend cultural territories and boundaries'(*Design Society - New Culture Hub*, n.d.) and revive the forty years old industrial region with design and creativity. The institution believes design is 'a key factor for societal, ecological and economic renewal in China', hence intends to be a bridge connecting the public, industries, business and other cultural institutions with design and creativity. The institution's Chinese name 'Sheji Hulian' makes its point very clear—the Chinese characters literally mean connection by/with design. Since it is the first overseas program of the V&A, it connotes both organizations' anticipation of building international networks as well as the aspiration of developing cultural diplomacy for both nations(Reeve, 2019). In addition, as coined by the Bilbao effect, Design Society hopes to rejuvenate this post-industrial region with an innovative identity and cultural tourism.

The founder initially wanted to build a Shekou Design Museum, but Design Society turns

2 According to the report provided by Jorge Mañes Rubio and Amanda Pinatih.

out to be very different from a traditional museum. It is part of the Sea World Culture and Arts Centre (SWCAC), which is a cultural complex, designed by Fumihiko Maki's studio. The SWCAC consists of the Design Society and V&A galleries, several commercial art galleries, a theatre, an art training school and several restaurants. The operation model to some extent guarantees that the non-profit cultural activities can be sustained by the profits from enterprises.

As a museal organization, Design Society has dedicated itself to connecting with the public. It holds design exhibitions as well as many interesting educational events, ranging from maker fairs, design workshops, lectures and communities' activities. Besides inviting students and teachers to come to the museum, Design Society also goes into local schools' classrooms and gives lectures about design thinking.



Figure 2 *"People's Canopy", displayed at the exhibition "Social Design, Learning at Play" in 2019, Design Society, Shekou, Shenzhen, China. Photography by Author.*

In 2016, Design Society launched the Design Community Festival to connect with the local communities. The first Design Community Festival selected its location on the Shekou Square and invited designers and artists to share their ideas and works in an open-air environment zoned by a foldable and mobile "People's Canopy" designed by the People's Architecture Office (Figure 2). The canopy was a large and conspicuous object that attracted audiences and created a friendly environment for public engagement.

Chinese museums used to be propaganda tools to serve the political and ideological needs of the authorities, a "visitor-oriented" direction has been identified in Chinese museums in this century (Varutti, 2014). Government policies such as the free-admission policy were issued to encourage accessibility and promote museum development(An, 2019). Whereas museums are immobilized buildings that await visitors to come; people who are not interested in

museums are less likely to visit them. The Design Community Festival hence is an approach that brings museums' activities and staff out of the museum space to reach to the local communities.

The festival is held in different communities for two days yearly. Activities are ranging from talks, open markets, workshops, live shows and film screenings which allow different levels of community members to come to learn and play. For instance, open markets display and sell design products from local makers; workshops teach people how to make objects; while design talks invite renowned designers, design educators or researchers to share their practices or ideas. The communities are thereby livened up by the festive activities.



Figure 3 *2019 Design Community Festival Exhibition, Design Society, Shekou, Shenzhen, China. Photography by Author.*

In 2019, the festival chose four communities and organized workshops to re-design public chairs for their communities. Similar to the practices of Design Museum Dharavi, hundreds of residents participated and teamed up to create forty-five chairs, which were later exhibited in the exhibition. The chairs were made with waste or reclaimed objects and the outcomes were interesting and innovative. The participation in design-making workshops and exhibitions have a value of empowerment that fosters confidence and competence, provides opportunities, and enables co-operation towards success for the engaged groups(GLLAM, 2000). As the program organizer puts it, the goal of the festival is to go into the communities

and connect the public through design.[3]

Partnerships are imperative for museums to develop socially inclusive programs(GLLAM, 2000). Design Society has collaborated with various organizations such as design companies, non-governmental organizations as well as local government offices. The latest community festival collaborated with Shekou Community Foundation and the governing bodies of the communities.[4] In 2019, China began reinforcing garbage sorting in major cities, and this became the main focus in communities. Re-designing public chairs with recycled materials thus met the communities' need to raise public awareness of the environmental issue.

When the organization is managing to be inclusive to varied kinds of audiences, it is not, or cannot be, open to all since it charges for its two main galleries and some workshops are reserved for museum members only. Funding is an important issue that hinders the management and sustainability of many museums, and the requirement for entrance fee excludes people who cannot afford it. Although a free-admission policy was issued in 2008(An, 2019), the subsidy from the government was mostly granted for public museums. As a young organization with limited public funding, it is a challenge to balance the incomes and expenses of managing the organization, at the same time, to be more inclusive.

5. Conclusion

Musealization of design has been a popular phenomenon since the middle of the nineteenth century. Among the three periods of development, changes in museum focus have been witnessed. The rich design collections formed the core of Western design organizations. The introduction of new museology changes the relation between museums and their communities and society(McCall & Gray, 2014). Sandell(1998) also advocates a more inclusive typology of museums. Under the influence of the social inclusive theory, museums should pay more attention to their social roles and functions in society. Design museums today thereby should not only focus on how good or authentic their design collections are, but think about how to be more open, inclusive and diverse.

Design museums as non-profit cultural organizations are a good platform for social design. They play a vital role as "catalysts and resources" in society(GLLAM, 2000, p. 54). Design Museum Dharavi in Mumbai, India and Design Society in Shenzhen, China are two Asian museums founded in recent years. Different from the well-established design museums that feature design collections made by famous designers, the former lasted less than a year and showcased works by marginalized groups in nomadic exhibitions; while the latter does not have collection and performs as a new museum practice that engages with communities with reverse thinking of going out of the organization. Both follow a socially inclusive philosophy and goal to engage their communities with design as a vehicle. Although the two organizations have to confine to a limitation of open access and sustainability, they, as

3 In a conservation with the program organizer.

4 The governing bodies received governmental funding to address civil livelihood issues such as providing professional training, establishing community libraries, and improving public facilities.

a creative museum practice as well as a form of social design, create a scenario and explore the possibility of boosting local social development with design practices and ideas.

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The role of participatory design activities in supporting sense-making in the smart city

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Abstract: We examine the role of participatory design activities in supporting sense-making while anticipating technological effects in smart cities. The effects of technology are not univocal. Therefore, creating smart city visions that enclose multiple meanings requires providing environments where stakeholders make the often-implicit processes of meaning attribution to technology explicit. We develop and test three participatory design activities to anticipate value changes and controversies in smart cities, and analyze how these activities supported seven sense-making properties. Our results show that visibilizing, reframing, and imagining are key characteristics of participatory design activities in supporting sense-making. Visibilizing technological impacts 'makes things public,' revealing existing perspectives and fostering new ones. Reframing technological impacts enhances empathy for diverse interests instead of treating smart cities as technical problems. Imagining supports understanding connections between technology and society to anticipate impacts. Our insights contribute to the provision of participatory design activities to articulate multiple meanings around smart cities.

Keywords: sense-making; smart cities; participatory design; technological appropriation

1. Introduction

Smart cities rely on the notion that using technology to collect, analyze, and apply data of city processes improves urban life (Vanolo, 2016). Fueled by enthusiasm about the opportunities of technology, public and private organizations launch multi-million programs for smart city development, leading to a pervasive 'smart city fever'. Although these programs help to capitalize on the technological benefits around efficiency and sustainability (Angelidou, 2015), the extent to which these initiatives fulfill the wishes of citizens and other sectors of society is under debate (Van Zoonen, 2016). Often, smart city strategies assume technology is universally beneficial, providing a vision that represents an ideal with clear objectives and imaginaries (Vanolo, 2016). In practice, as with any other socio-technological development, the impact of technology is not univocal.

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On the contrary, technology changes the way we are in the world and act, and its effects are often uncertain and subject to multiple interpretations. While anticipating the impacts of technology in smart cities, people allocate meaning to form assumptions as predictions about future events. Assigning meaning is an ongoing process in which people make sense of reality around them and how it changes. 'Sense-making' is the process by which people attribute meaning to the world around them (Weick, 1995). In particular, attributing meaning to technology relates to the concept of 'technological appropriation'. This is a 'sense-making activity that involves the interaction of people, with their existing knowledge and beliefs; technologies, representing a phenomenon that requires the attribution of meaning and its integration into the existing frameworks of understanding; and the world, as an active context against which the human–technology encounter occurs' (Kudina, 2019; p.87).

In smart cities, stakeholders collectively allocate meaning to technological impacts, anticipating a future that has not happened yet. Since the effects of technology are broad, ambiguous, and uncertain; partaking in activities that make the often-implicit processes of meaning attribution of technology explicit can support the development of inclusive smart city visions. Here, design can play a crucial role. Design contributes to making sense of complex problems, giving them meaning, and synthesizing them in a coherent product or service (Kolko, 2010a; 2010b). It helps to allocate meaning to otherwise fuzzy and incomprehensible events, being supportive of people's exploratory needs when trying to make sense of the world. In this study, we focus on participatory design approaches because they bring together heterogeneous groups of stakeholders in activities that elicit issues of interest, and manifest the existence of different meanings relevant to the urban context (Tironi, 2018).

Based on this premise, this paper explores the role of participatory design activities in supporting sense-making in the appropriation of urban technology. We reflect on how they open spaces to discuss and confront a diversity of meanings of technology in the city, essential for the development of inclusive smart city visions. To this end, we elaborate on how three making and telling participatory design activities supported sense-making in different collaborative settings. To operationalize the concept of sense-making, we examine how the participatory design activities supported each of the seven sense-making properties previously introduced in literature (Weick, 1995). Our results show that making and telling activities support sense-making in three different ways, namely: making technological impacts public ('visibilizing'), helping people to frame technology from multiple perspectives (reframing) and triggering participants' imagination to anticipate technological effects (imagining).

This article is structured as follows. We first introduce the relevance of sense-making processes in smart cities. Second, we refer to the connection between design and sense-making, as previously debated in the existing literature. Then, we narrow down to participatory design and describe three making and telling activities we developed and used in participatory settings to support sense-making. Furthermore, we present our results and discuss our learnings in the context of technological appropriation in smart cities. We finish

reflecting on how this could translate into insights for the development of approaches to develop inclusive smart city visions.

2. Sense-making in smart cities

In organization studies, sense-making is a process in which individuals or groups interpret novel, uncertain and ambiguous events to give meaning to the world around them (Weick, 1995; Colville et al., 2012; Maitlis, 2005). The process starts when people experience situations they cannot immediately interpret using their current mental structures (Kiesler and Sproull, 1982). People perceive them as surprises, triggering the need for explanations in a process through which interpretations flourish (Weick, 1995). It is the process by which actors (individual or collective) build situations they attempt to comprehend, involving the creation of frameworks for understanding (Maitlis and Christianson, 2014). Through collaborative processes of sense-making, people create a collective understanding of the world and a foundation of collective action (Matilis, 2005; Weick et al., 2005; Meyer, 2019).

In smart cities, different sectors of society (companies, government, citizens, knowledge institutions) allocate meaning to how urban life changes because of technology, and what these changes entail for our ways of being and acting. Technology influences societal values (Forlano & Mathew, 2014; Royakkers et al., 2018), the lives of citizens (Vanolo, 2016) and often leads to tensions resulting from value diversity or conflicting agendas (Kitchin, 2014; Van Zoonen, 2016; De Waal and Dignum, 2017; Valdez et al., 2018).

Smart technology, in essence, interrupts a usual flow of urban experience, leading to changes that are difficult to explain. Technology is, therefore, a cue in a sense-making process where actors attribute meaning to its influence in the city. Prior literature acknowledges that, while confronted with the possibility of adopting a specific technology, technological appropriation takes place (Kudina, 2019). Technological appropriation denotes the attribution of meaning people give to new technology and how, during that process, people develop an implicit and explicit relation to technology, and update their frames of reference (Kudina, 2019). Encountering an urban technology, people make sense of it and attribute meaning to it relying on their own past experiences, socio-cultural embedding, and information from various sources. However, these processes are often implicit, and the meaning attributed to technology is contested by various stakeholders.

In this context, design in general, and participatory design in particular, can provide the means to make explicit a diversity of meanings encompassing urban technology.

3. Design and sense-making

Previous literature has acknowledged the connection between sense-making and design. Krippendorff (1989) states that design revolves around making sense and helping stakeholders provide meaning to events around them. According to Kolko (2010a; 2010b), during design synthesis, designers make explicit the typically implicit processes of sense-

making and framing, as they distill meaning out of data through interpretation and modeling. Boer et al. (2013) discuss how design activities incite organizational sense-making by triggering dialectical processes to make assumptions explicit and invite stakeholders to empathize with a human-centered perspective. Sanders and Stappers (2014) describe how design fiction can enrich, enlarge, and activate people's capacity for making sense of the future before getting there. Other studies (Hummels & van Dijk, 2015; De Jaegher & Di Paolo, 2007) provide insights into the connection between design and participatory sense-making, elaborating on how people participate in the generation of meaning and, in that process, they enact the world around them.

This paper adds to the previous body of knowledge by reflecting on how participatory design activities support sense-making in the context of technological appropriation in smart cities. To this end, we build upon Eneberg (2012), who provides an account of how design competencies support the seven properties of sense-making introduced by Weick (1995), as illustrated in the summary provided in table 1. Working down sense-making in seven properties allows having a workable framework for our analysis.

Table 1 ummary of sense-making properties and design properties

Sense-making properties (Weick, 1995)		**Design competencies supporting sense-making (Eneberg, 2012)**
1.	*Construction of shared identities*: Selecting an interpretation of an experience, people are simultaneously defining their identity (and vice-versa).	Design integrates multiple perspectives from different stakeholders to create a collective identity.
2.	*Retrospective:* Identification of patterns based on previous experiences and retrospective identification of patterns.	Design supports the development of several hypotheses based on previous experiences as an argument in a dialogue with different contexts to test different futures. Design helps to move to a fictive future and to anticipate what has not happened yet.
3.	*Enactive of sensible environments:* People create their environment while making sense of it.	Design helps to materialize a specific context, and the creation of this context influences people´s own interpretations and perceptions. Design helps to join the abstract and concrete thought while forming ideas as interaction takes place using sketches and prototypes.
4.	*Social:* Allocating meaning is an individual and collective process that happens through interaction.	The use of prototypes, stories or sketches helps to share explicit and tacit knowledge. Design facilitates providing several possible alternative explanations of a problem.
5.	*Ongoing*: Sense-making happens over time and constantly, triggered by new experiences and events.	A design process helps to punctuate and create moments that crystalize meanings.

6.	*Focused on and by extracted cues*: Cues are recognizable structures that are the seeds from which people make sense of events.	Design provides triggers to have a coherent understanding of the context.
7.	*Driven by plausibility rather than accuracy:* To allocate meaning, people need a coherent story rather than an accurate one.	Design helps to allocate meaning by (co) creating a coherent story that focuses on plausible outcomes rather to accurate ones.

Smart city projects involve heterogeneous groups of stakeholders with diverse interests and frames of reference around technology. Here, participatory design offers approaches through which stakeholders (designers and non-designers) generate, share and understand ideas about the future (Forlano and Mathew, 2014) to build shared understanding and vision of a future smart city (van Waart et al., 2015), and elicit issues of interest (Tironi, 2018). In participatory design, designers have tools to (1) make, (2), tell and (3) enact (Brandt et al., 2012).

- Making activities support the collective exploration of future ways of living and being by creating prototypes, tools or products (Brandt et al., 2012; Sanders and Stappers, 2014). These activities turn abstract concepts into concrete and tangible objects, evoking discussions and allowing the involvement of multiple perspectives and frames.
- Telling activities are about providing verbal descriptions about future scenarios (Brandt et al., 2012). These can be scenarios about anticipated experiences, or fiction (Knutz et al., 2016) that enhance cross-disciplinary reflection and reframing of socio-economic conditions for design. Telling activities draw boundaries in the thought realm to make futures tractable (Candy, 2018).
- Enacting is about imagining or acting out possible futures by trying things out (by use of the body) in settings that resemble or where future activities are likely to take place (Brandt et al., 2012).

In this study, we develop and analyze making and telling activities, namely prototyping, scenario development, and storytelling. We chose our focus on these activities as we consider the nature of making and telling to be supportive of enacting approaches.

4. Method

To explore how participatory design approaches support sense-making for the anticipation of technological effects in smart cities, we organized five sessions with various groups of stakeholders ranging from practitioners, students, and the general public. To this end, we developed participatory activities with the objective of testing how people make sense and anticipate the impact of technology in the smart city. We focused on two effects: (1) potential tensions emerging from the implementation of technology and (2) value changes. Following Brandt et al.'s distinction between making, telling, and enacting activities, our design activities corresponded to making and telling. Table 2 summarizes the sessions, the

activities, the goal of the sessions, and the data collected.

Table 2 Overview of sessions

Activity	# participants	Type	Goal and type of session	Data collected
1	1st session: 25 2nd session: 14	Prototyping (make)	Anticipate value changes in smart cities. Workshop with students	8 forms filled by participants describing the process of prototyping. Pictures taken during the process of building 8 prototypes. Observations by researchers including the explanations provided by participants about the process (one per group).
2	1st session ~40 2nd session ~20	Scenario development (tell)	Controversies originating from the implementation of technology. Workshop with practitioners	Session 1: 5 scenarios written by participants. Session 2: 4 scenarios written by participants. Observations by researches during the group discussions.
3	1st session: 120	Storytelling (tell)	Envision value changes emerging from technology implementation. Design exhibit	120 stories written by participants.

4.1 Activity 1. Making: Prototyping to visualize value changes in smart cities

To support sense-making for the anticipation of value changes in smart cities, we organized a workshop focusing on prototyping potential value changes resulting from the implementation of technology. Based on Forlano and Mathew (2014), participants had to prototype a neighborhood based on a value. Accordingly, participants received a value card, had to discuss what this value meant to them, and prototyped a neighborhood based on the value.

Expanding Forlano and Mathew's approach, we unexpectedly introduced a technology card. Immediately after, we requested to reflect on and prototype how the values would change because of the implementation of a technology, and how this value changes would alter the neighborhood.



Figure 1 Prototype based on 'inclusion'

4.2 Activity 2. Telling: Development of scenarios to surface smart city controversies

Prompted by the tensions originating from technological implementation in smart cities (Kitchin, 2014; Valdez et al., 2018; Van Zoonen, 2016), we developed a workshop approach1 to make controversies in smart cities explicit. Therefore, we developed a method where participants could individually develop their dream and nightmare urban scenarios. First, we probed participants showing a neighborhood and images of the type of urban data that companies and governments collect, and where they collect it. Then, participants developed their dream scenarios about how they would use technology and data in an ideal smart city. Later, participants reflected on the associated risks and nightmares to their dream scenarios; and discussed them within their groups to identify tensions and controversies resulting from the use of technology.



Figure 2 Visualization provided to trigger the development of scenarios.

1 Approach co-created with the Design Innovation Group.

4.3 Activity 3. Telling: Storytelling to anticipate changes in human values

During a design exhibit in 2019, we invited visitors to write a story about a future smart city. At the event, participants drew four cards from each deck and wrote a story about how, given a societal trend, smart technology could lead to value changes in our society. Our goal was to elicit people's imagination on the role of technology in cities and explore how they anticipate value changes as a result of the implementation of urban technology. Thus, we adapted the game 'Thing of the Future' (Candy, 2018) to the smart city context.

In our adaptation of the game, we provided four types of cards to participants: (1) Arc cards (A) including societal trends, (2) technologies (T) implemented in smart cities, (3) places in the city (C) , and (4) human values (V). The first type of cards, 'arc', included societal trends related to growth, collapse, transformation and discipline, like the cards included in the original game (Candy, 2018). Arc cards provided the context for the stories of participants. The second type, 'technology', included technologies potentially implemented in smart cities based on the categorization provided by Forlano and Mathew (2014): screens and surfaces (i.e. touch screens, signs), networked artifacts (i.e. surveillance cameras), or technologies of the body (i.e. mobile phones, wearables). The third type of cards, 'city', consisted of urban places such as schools, post offices, train stations, and so on. The fourth card, 'values', included principles that are highly regarded by humans, such as freedom, friendship, inclusion, etc. To develop the content of the cards, the authors brainstormed as many cards as possible to have a card deck that provided enough combinations to trigger people's imagination and stories.



Figure 3 Card game used at the design exhibit

4.4 Data analysis

To analyze how the different activities supported the seven properties of sense-making, we developed and used the checklist included in table 3 to search for instances in the data that showed how the activity supported the sense-making property, and provide evidence of it. The first author of the paper analyzed the data. The second author, who attended the

sessions and was actively involved in the data collection, validated this analysis.

Table 3 Checklist to analyze the activities

Sense-making properties	Checklist for activities based on framework of table 2
1. Identity construction	The activity helps to integrate multiple perspectives and reach a single outcome/deliverable that elicits participants' perspectives on technology in an urban context.
2. Retrospective	Participants create a fictive environment to anticipate and attribute meaning to the future based on different perspectives on technological impacts and making use of past experiences.
3. Enactive of sensible environments	The activity supports creating a context and, while creating it, participants develop new perspectives and become aware of others. The activity facilitates making intangible concepts/constructs tangible, helping to join the abstract and concrete.
4. Social	The activity facilitates social interaction and supports an exchange of tacit and explicit knowledge. The activity helps to express alternative explanations of a situation.
5. Ongoing	The process is continuous and occurs over time.
6. Focused on and by extracted cues	Participants extract cues from their environment by being involved in the activity, understanding the context and implications of technology.
7. Driven by plausibility rather than accuracy	The activity helps to develop a coherent story, plausible but not necessarily accurate to understand the current context and potential implications of urban technology.

5. Results

This section describes how the use of the three making and telling design activities previously introduced supported sense-making while anticipating the impact of technology. We do so by elaborating on how each activity supported each sense-making property and providing evidence from the data.

5.1 Identity construction

Prototyping and developing scenarios supported identity construction by integrating multiple perspectives on urban technology in a single outcome. In activity 1, while prototyping a tangible representation of a neighborhood, participants negotiated the meanings they attributed to values, and agreed upon a common outcome per group. Prototyping helped to create a shared identity around the values governing the prototype and the effects of technology on those values and urban life. For example, one group built a prototype based on 'solidarity.' To this group, 'solidarity' meant 'sharing' both in terms of 'sharing their problems with others' and exchanging products and intangibles like knowledge. While prototyping, this team agreed on how the meaning attributed to 'solidarity' would impact the city configuration. The final prototype included areas to exchange food, share knowledge,

with the end goal of avoiding waste and minimize consumerism. This way, they stood for the meaning of solidarity as sharing among citizens.

In activity 2, scenario generation prompted participants to take an individual and collective standpoint about desirable or undesirable effects of technology. Building a collective scenario made participants decide for which value they stood and their concerns. At the end of the exercise, in groups, participants stood for a specific use of technology while collectively agreeing on the negative impact a technology could have on other values. For example, participants developed a scenario where technology provided services 'immediately and efficiently to people in need'. While thinking of associated nightmare scenarios, this team reframed the dream, and debated how this scenario put pressure on other values. According to them, this scenario could make people lose autonomy because they would rely too much on the system to take care of them. Besides, it would raise questions about control of technology since there would be a top-down mandate to determine what being ´in need´ means. This way, this group built an identity where helping others was important while respecting people's autonomy and having transparency on who and how technology is being controlled.

In the storytelling activity, participants wrote the stories individually hence we did not identify instances of the creation of a shared identity.

5.2 Retrospective

Sense-making is retrospective: it happens with hindsight once an event has occurred and, to allocate meaning, people use a repertoire based on previous experiences. All three activities helped participants to allocate meaning to a situation that had not arrived yet, assisting them to imagine the future and providing a lens to frame the technological impacts.

In activity 1, participants built their prototypes using a repertoire of prior experiences to make sense of technological impacts. To make these prior experiences tangible, participants provided physical representations of metaphors. For example, while discussing the influence of surveillance cameras on solidarity in the city, participants placed eyes as watchers of urban activities. These eyes represented participants' past experiences while being confronted with surveillance technology.

For scenario generation and storytelling, participants created fictive narratives to anticipate technological impacts. In both cases, these narratives included hypotheses based on existing retrospective interpretations of how technology, values and cities are (or could be) interconnected. For example, in activity 2, a group wrote a dream scenario of a city where citizens could get personalized services everywhere. Reflecting on their own experiences on social media, participants reflected on the impact this would have on polarization and the creation of social bubbles: by personalizing everything people would not be confronted with other realities, distancing them. This example illustrates how the activity helped participants to move to a fictive future and allocate meaning based on prior interpretations.

5.3 Enactive of sensible environments

The activities supported creating a specific context and, while creating it, participants developed new perceptions and became aware of others. Furthermore, all three activities made intangible constructs like values embedded in a city tangible.

Building a prototype in activity 1, participants created an environment (a neighborhood) to reflect on value changes resulting from a technological implementation. Developing this prototype and 'thinking with the hands', participants reshaped their interpretations. For example, one group created a prototype for the value ´romance´ and reflected on how wearable technologies would change this value and the neighborhood. While building the prototype, this group interpreted that romance and the elderly are not usually connected, so they thought of approaches to facilitate romantic encounters for senior citizens. Building the prototype upgraded their own perception and, by upgrading this perception, the prototype changed. For instance, realizing that buildings are often too far away for elderly to visit each other, participants started creating rooftop meeting-points to organize activities for senior citizens.

In activity 2, building dream and nightmare scenarios provided lenses to frame and reframe technological impacts. By reframing impacts, participants created a scenario, and their perception about a technological impact evolved during the activity. This means that, while creating a context, participants also created a new perspective. For example, a group developed a scenario in which technology could maximize efficiency by seamlessly synchronizing all urban activities. Imagining how efficient their lives would become, this team reflected on how such an efficient city would not leave any room for boredom or creativity, upgrading their own interpretation about the impact a technology might have on different values.

This was similar in activity 3, where participants used the cards to both build a future smart city narrative while making sense of the influence of technology on social values. For example, a participant wrote a story based on the following cards: (A) grow, (T) wearables, (C) graveyard, and (V) humor.

> "Graveyards are (…) sad places. Visiting deceased loved ones, you run into other visitors. (…). Talking to others going through the same is a great way to deal with your feelings. Wearables that prompt humor-full stories about the deceased person help tackle the sad and negative feelings."

While writing the narrative, the participant reframed her perception of graveyards from being a sad place to becoming humor-full due to the introduction of wearables.

5.4 Social

Prototyping and developing scenarios were highly social and, as described for 'identity construction' and 'enactive of sensible environments', the making and telling activities helped to externalize tacit and abstract value interpretations. Working towards a single prototype or scenario was a highly social process where participants listened to each other

and built awareness of the consequences of framing technology from different perspectives.

The storytelling activity did not happen in a group setting since participants wrote narratives individually. Although written individually, participants could share their stories with others in two ways: by hanging them in a wall during the design exhibit and by publishing them in a booklet that included all the contributions. The prospect of hanging or publishing their narratives encouraged participants to be part of a social process and share their stories, solutions or future projections with others, to express their perspectives on the impact of technology in the city.

5.5 Ongoing

Sense-making happens over time. The activities here presented took place in specific sessions. Subsequently, we could not observe a continuous and longitudinal process of meaning allocation.

5.6 Focused on and by extracted cues

All three activities provided cues to participants to notice technological impacts in the city so they could expand them into explanations of what was happening.

While prototyping, the introduction of an unexpected card was a cue to allocate meaning to unexpected urban changes. For example, following the previous example of ‘solidarity’, participants created a neighborhood based on ‘sharing’. Getting the technology card (‘surveillance cameras’) was the cue to realize that ‘solidarity’ and the city configuration could change. After getting the card, participants made tangible modifications to the prototype anticipating a positive influence of surveillance cameras on solidarity by realizing the opportunities of real-time data.

The scenario generation activity provided a context (images of neighborhoods) and frames to imagine urban scenarios. After developing dream scenarios, the activity made participants reframe their dreams into nightmares. The introduction of this new frame acted as a cue to allocate meaning to the future by anticipating other technological effects that were not explicitly debated at first. For example, a group created a dream scenario where technology would make it easy for children to play in a residential area. However, providing a new frame to anticipate associated negative effects triggered participants to realize that it would be necessary to provide additional mobility solutions if the streets became playgrounds.

For the storytelling exercise, to realize that there was an urban change caused by technology, the main cue was the use of seemingly disconnected cards. Providing aleatory card combinations, participants reflected on not so obvious technological impacts. Consequently, the cards acted as cues of alternative relationships that might not have been initially foreseen by participants.

5.7 Driven by plausibility rather than accuracy

While making sense of events, people allocate meanings that are plausible rather than accurate. All three activities facilitated assigning meaning to representations of technological impacts that seemed reasonable but not necessarily an objective truth to be accepted.

In activity 1, rather than focusing on accuracy, the prototypes acted as plausible metaphors for urban changes resulting from technology implementation. For example, assigning a positive meaning to surveillance cameras connected to solidarity was not necessarily an exact prediction of events, but helped to manifest a shared meaning among participants.

In activity 2, using a dream/nightmare lens stimulated focusing on the plausibility of scenarios rather than their accuracy. The discussions were not about whether the scenarios could potentially occur or not, but aimed at building empathy among different participants' perspectives, and at having constructive debates about tensions originating from technology.

For the storytelling activity, the main goal was not to deliver predictive narratives about the future, but to reflect on the impact that technology might have on our values and allocate meanings to those potential future experiences. The activity supported this goal by using cards to stimulate people's imagination. For example, a participant wrote a story anticipating the influence of artificial intelligence on citizen interaction, where people could only communicate with each other by using chatbots. To this participant, technology would reduce language barriers, making it possible to live in diverse and multi-cultural cities. This example shows how the activity stimulated participants' imagination by providing combinations of cards to build plausible stories about urban futures that might not be accurate predictions but help to make sense of a future that could potentially occur.

6. Discussion

The previous section has provided insights into how the three activities supported sense-making in participatory settings. Based on our results, this section discusses the characteristics of the activities that supported sense-making in the context of technological appropriation in smart cities. We present and reflect on insights for the provision of participatory design activities to support the development of smart city visions that articulate and incorporate multiple meanings around technological impacts.

In our study, making and telling design activities supported attributing meaning to the effects of technology in three different ways, namely: (1) 'visibilizing', (2) reframing and (3) imagining.

First, 'visibilizing' is about bringing to the surface what was previously hidden. This was an important characteristic of the participatory design activities presented in this paper that supported sense-making. Prototyping, creating a scenario, or writing a narrative provided representations to make intangible technological effects tangible. These representations helped participants to understand what others stood for, and to build a shared identity by integrating various perspectives in a single outcome. Furthermore, by 'visibilizing',

the activities helped to structure social interactions, allowed participants to allocate plausible meanings and communicate them to others, and acted as cues to expand existing explanations of what was happening. Our results give insights into how participatory design activities support 'visibilizing', crucial for participation in this context, and to debate the anticipated impacts of technology. This is in line with Schoffelen et al. (2015) who, like Latour (2005), emphasize the importance of making things visible to encourage public debates concerning a wide range of issues. 'Visibilizing' the impact of technology is about 'making things public,' revealing and stimulating multiple perspectives to be expressed. In smart cities, participatory design can disclose differences among participants and articulate matters of concern. Since technological impacts in cities can be abstract and difficult to grasp, smart city visions can benefit from participatory design approaches that acknowledge controversies originating from the use of urban technology and move beyond the logic of solutionism pervasive in smart city discourses. In line with Tironi (2018), we consider it essential to rethink forms of collaboration that create areas of friction and counter-participation.

Second, building a prototype, creating scenarios, or writing a story helped to frame technological impacts from multiple perspectives, encouraging a reframing attitude towards the anticipated effects of technology that supported sense-making. This enabled participants to shift viewpoints by asking 'what if' questions and producing responses to alternative imagined possibilities. Upgrading their frames, participants negotiated new meanings in a social process, contributing to the development of shared identities. Furthermore, the activities enabled creating a specific context and, while creating it, participants developed new perceptions and became aware of others, being enactive of sensible environments. Last, while engaging in the making and telling activities, reframing acted as a cue to allocate meanings to the future by anticipating other technological effects that were not explicitly debated at first. Our results illustrate that the reframing attitude stimulated by the participatory design activities enables an increased appreciation of, and empathy for, the interests of multiple sectors of society, instead of deploying solution-oriented approaches that only treat smart cities as technical problems. As stated by Van Waart et al. (2016), developing this empathy is essential to stimulate mutual understanding and a shared vision of a desired smart city. Since the effects of technology are ambivalent, approaches that allow for the manifestation of multiple meanings help to develop inclusive smart city visions that articulate differences instead of reducing them. With this view, similar to Bjögvinsson et al. (2012), participatory design can provide platforms to provide 'agonistic' approaches, not to solve conflict but to constructively deal with differences.

Third, our results show how the activities triggered participants' imagination supporting sense-making and its effort to understand the connections between technology and society, to anticipate its impact and act effectively. While engaging in making and telling activities, participants could reflect on the present with an eye that was not at hand, retrospectively thinking about their own experiences while containing cues for future-making. By fostering imagination, the activities helped participants to anticipate a future that was not there yet, providing cues to participants to notice technological impacts in the city, so they could

turn them into explanations of what was going on. Furthermore, the activities supported imagination to build plausible explanations rather than accurate ones required for sense-making. Our results illustrate how making and telling activities offer the means to trigger people's imagination to anticipate technological impacts. In line with Kukka et al. (2019), we consider it important to harness people's imagination to transform our ideas about urban life and project them into alternative futures. Imagining various technological effects supports surfacing multiple meanings, and stimulates critical debates about urban technology and its impact in the city. This critical attitude is important to avoid reductionist technocratic and top-down visions of the smart city that restrict stakeholders' imagination and limit the creation of solutions to the existing and future urban challenges (Vanolo, 2014). Participatory design can provide the means to trigger people's imagination, encompassing alternative meanings or interpretations of technological impacts.

7. Conclusion

Our study explores the role of participatory design activities supporting sense-making in the appropriation of urban technology, being relevant for design researchers and practitioners to reflect on how participatory design can open spaces to discuss and confront a diversity of meanings around technology and the city. Furthermore, our results provide insights for researchers and practitioners working in smart cities that use of participatory design to bring together heterogeneous groups of stakeholders for the development of smart city visions. Combining the insights gained from our understanding of the role of making and telling activities, our goal is to keep exploring approaches that acknowledge the differences in the meaning attribution for technological appropriation in smart cities. Furthermore, we aim at creating means that contribute to the design of cities that recognize the agency of urban technology and its relationship with its socio-technical context, in line with Forlano (2016).

In future research steps, we plan to explore the role of enacting activities. Following Candy and Dunagan's (2017) experiential scenario approach, our goal is to bridge the gap between abstract notions of technological impacts and embedded and embodied experiences on the ground.

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To empathize or perceive? Towards a 'perceptive design' approach.

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Abstract: Empathy is key in human-centred design but has become more of an ideology than a principle (Heylighen and Dong, 2019). This study proposes perception as an alternative to understanding users that holistically considers their contextual, cognitive, affective and environmental states. To apply perception for understanding users, this research integrates three predominant approaches of mindreading, social cognition - Theory Theory, Simulation Theory and Interaction Theory. A methodology centred on a conceptual 'perceptive design' scale and taxonomy of the four levels – 'recognize, resonate, relate and realize' - is developed. The 'perceptive design' scale's applicability as a framework for two different human-centred design contexts and as an analytical tool are demonstrated. The contribution is threefold. It can contribute to design practice, research and education by providing structure in the phase of understanding users; enhancing existing and supporting the development of new design tools; and offering opportunities to practice perception in understanding users.

Keywords: empathy in design; perception in experience design; social cognition in design; perceptive design scale taxonomy

1. Introduction

Imagine a team of designers trying to reduce homelessness in a city. How do these designers, who have no lived experience of homelessness, attempt to understand those experiencing homelessness? Should the designers empathize with them or perceive them?

Every day, designers around the world attempt to understand users to design better products and experiences. Over the last three decades, the contextual and affective factors of design have gained prominence in design literature (Kouprie and Visser, 2009). In human-centred design (HCD), understanding the user has come to be synonymous with the construct of empathy (ideo.org, 2009; Battarbee et. al 2014; Mattelmäki et al., 2014). Empathy allows the designer to stand in the user's shoes (ideo.org, 2009; Battarbee et. al 2014). However, recent studies have shown that empathy, in general (Bloom, 2016) and empathy in design

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(Heylighen and Dong, 2019; LLoyd, 2009) has its limitations.

This research builds on these studies and insights from the field of mindreading (social cognition), it's three predominant approaches of Theory Theory (TT), Simulation Theory (ST) and Interaction Theory (IT). This study proposes that in the process of understanding users, users should be perceived (a more holistic way of understanding), rather than empathized with (understanding of predominantly affective states). While empathy asserts the value of becoming the user, this study proposes that perception allows the designer to retain their own consciousness and objectively draw from it to better inform the design process. As such, perception becomes key to designers' understanding of users.

To support the application of perception in the design process, this study develops a methodology for 'perceptive design', centred on a conceptual scale and taxonomy. Perceptive design holistically considers contextual, cognitive, affective and environmental factors in the understanding of users. Being aware that there are multiple ways of understanding users can allow designers to engage in the type or level of perception relevant to the design context. This study further illustrates the application of the scale as (1) a framework in two different design scenarios of (a) social change design and (b) user-centred design and (2) an analytical tool to evaluate several common user-centred tools.

The 'perceptive design' methodology can contribute to - design practice by providing guidance and structure in understanding users; design research by enhancing current HCD applications and supporting the development of new HCD tools; design education to help teach and practice perception in user research and engagement. This study can also inform and contribute to larger discussions about the roles of empathy and perception in HCD.

The following sections discuss empathic design, the proposed perceptive design; the development of the perceptive design scale and taxonomy; and their applications.

2. Empathic design and the case for Perceptive design

2.1 Empathic design

Empathy originated from art history in 1873 as Einfühlung, German for "feeling into", "to describe an embodied response to an image, object, or spatial environment" (Koss, J. 2006). In the field of design, Dandavate et al. (1996) were one of the first to note that product development overly relied on cognitive models in the consideration of human thought and behaviour. These authors called for a shift from the rational to the emotional in the early stages of product development to build more successful products that users could connect with. Segal and Suri (1997) went on to harness the inferential capacity of empathy through analysis and advanced its standing as a design approach. Empathy has since become an integral principle in universal design (Krznaric, 2014) and human-centred design (ideo.org, 2009). The latter encompasses user-centred design, goal-directed design and experience-centred design, all of which leverage empathy (Cooper, Reimann, Cronin & Noessel, 2014).

Recently, Heylighen and Dong (2019 p.107) highlighted the limitations of empathy in design and state "… empathy has become a design ideology rather than a principle…" and is selectively appropriate. Heylighen and Dong (2019) cite Lloyd (2009) and Le Dantec & Do (2009) to assert the ethical implications of applying empathy to design. These ethical implications include the design impact and solution-generating process being driven by the ability of the designer to gain empathy (which sometimes cannot be achieved).

Although, as de Vignemont and Singer note, "there are probably nearly as many definitions of empathy as people working in this topic" (2006, p. 435), empathy in design has, in recent times, become synonymous with understanding the user. This study asserts that, although empathy in design started out to balance the over-reliance on the rational, design has since become focused on the user's emotional states (Battarbee, Suri, & Howard, 2014; Mattelmäki et al., 2014).

2.2 Kouprie & Visser's (2009) framework for empathy in design

An influential work on the role of empathy in design, Kouprie & Visser's (2009) work drew on psychology studies to create a framework to apply empathy in design. The developed framework clearly defines a four-stage process for the designer to follow in creating empathy for the user to support the design process. Their framework entails four phases - Discovery, Immersion, Connection and Detachment and is intended to provide 'a fundamental understanding of the mental process of achieving empathy and using that understanding in designing' (Kouprie & Visser, 2009 p.446).

However, the 'stepping-in' stage (comprising of the second and third phases of Immersion and Connection) allude to a range of levels of empathy but seems to make a leap from Immersion to Connection. The authors equate resonance (phase three Connection) with sharing the user's experience in the same phase. This study proposes that resonance and experience-sharing are two different degrees and that sharing mental experiences can be a different level from sharing experiences that take into consideration physical, environmental context as well.

Kouprie & Visser's (2009) framework establishes that a process to understand users is very relevant to designers. However, this study questions centring the process of understanding users around empathy. Although empathy considers both cognition and affectivity, it is predominantly associated with the designer's cognitive reasoning and affective resonance of the user's affective or "emotional state" (Kouprie & Visser, 2009 p. 442).

Based on the limitations of empathy in providing a holistic understanding of the user and Kouprie and Visser's (2009) framework for empathy in design, this study proposes perception as an alternative construct for understanding users in human-centred design.

2.3 The case for 'perceptive design'

Perception is defined as both - 'awareness of something through the senses' and 'the way in which something is regarded, understood or interpreted' ("Perception", 2020). Although

the first definition seems to indicate perception is just information received through our senses, such as what we see; the second definition clarifies that perception is more than mere information from our senses. Perception is our inference and even interpretation of the information from our senses. This study builds on the dictionary definition to propose that one's perception of another is shaped by the perspectives, experiences and consciousness of the perceiver. Einstein said, "Creativity is seeing what everyone else has seen, and thinking what no one else has thought." As such, perception is key to design as it presents the opportunity to look at design problems in different ways. Perception allows the designer to retain their consciousness, while considering the user's consciousness, allowing for a plurality of consciousness to better inform design processes. As noted by Taboada et al. (2020) citing Freire (1970) and Foucault (1997, 1982) "a plurality of consciousness" in the design process would allow for "mutual creative understanding" and balance in power.

For the team of designers trying to reduce homelessness in a city, as Parcell (2020) notes, by citing Bloom (2016), empathising with those experiencing homelessness results in responses that are counterproductive to achieving housing stability in the long run. Empathy is mainly limited to the affective states. Perception in understanding users, however, can consider the user's contextual, cognitive, affective, physical, and environmental factors. Perceptive design allows user research to be holistic and includes all aspects pertinent to the design issue such as context from the existing service design of the housing system. The scenario of homelessness is used to illustrate the potential of perception for HCD. HCD in general, can benefit from the designer objectively drawing from their own consciousness, experiences to infer and interpret user research towards problem-definition, ideation and iteration.

Phenomenologists such as Scheler, Stein and Husserl equate perceiving with direct experience and consider empathy as a more indirect experience of the other's original experience (Zahavi, 2014). This study proposes that perception always undergoes a process of inference or interpretation and builds on social cognition studies to draw on both kinds of perception in social cognition – direct perception and inferential perception (where inference is from intuition and/or simulation (Gallagher and Varga, 2014)) and applies them in the development of the perceptive design scale in sections (3.2 and 3.3) below.

3. Developing the 'perceptive design' approach

In developing the 'perceptive design' approach, this study acknowledges that there are degrees to understanding users and proposes a conceptual scale to define these degrees. For a conscious understanding of users, designers need to draw from their expertise as well as their everyday experiences as fellow human beings. Thus, literature in the fields of mindreading and social cognition is drawn on, to develop the perceptive design scale which considers the holistic understanding of users and their experiences.

The following sub-sections expand upon - the three predominant approaches of social cognition; how perception varies for each approach; and how their integration contributes to the development of the perceptive design scale.

3.1 Social Cognition, the three predominant approaches - TT, ST and IT

Social cognition is the branch of cognitive science that involves perceiving and inferring others, to understand, explain and predict their actions and behaviours (International Social Cognition Network). Social cognition predominantly comprises three approaches (Table 1) - Theory-theory (TT), Simulation Theory (ST) (which together encompass the Theory of Mind (ToM) approaches) and the newer Interaction Theory (IT)

Table 1 The three predominant approaches of social cognition

Theory-Theory (TT)	**Simulation Theory (ST)**	**Interaction Theory (IT)**
we infer other's mental states such as beliefs, desires, fears etc. through basic, intuitive, psychological theories based on common-sensical principles and generalizations (Fodor 1968; Lycan 1981, 1982; Ratcliffe 2006)	we use our own minds as models to mirror or understanding other minds. (Goldman 1989; Goldman 2000; Gordon 1986; Gordon 1995 a; Gordon 1995 b; Gordon 1996; Heal 1995; Heal 1998; Heal 2000)	we perceive through social interactions comprising embodied interactions, direct perception and narratives (Gallagher and Varga, 2014). Gallagher (2001) coined the term 'Interaction Theory' and equates social cognition with social interaction (Gallagher 2008a)
E.g. inferring X left the building because they heard the fire-alarm OR Inferring X is searching for their key or phone when they reach into their pocket upon approaching a locked door.	E.g. inferring X will like a movie that you liked because you have similar taste in movies OR Inferring X is distraught at his dog's passing away because you are as attached to your dog too.	E.g. direct perception, embodied interaction: perceiving someone's joy or anger from their tone of voice or expression E.g. narrative competency: assuming a parent will save their child from danger (ingrained from stories, movies from childhood)
Hybrid versions of theorizing and simulating that aim to address the limitations of each individually, have also been advocated for (e.g., Nichols and Stich, 2003; Goldman, 2006).		
This study draws from an integration of TT, ST and IT as supported by Zahavi (2011, p.556) "Our social understanding comes in many shapes and forms, and we need multiple complementary accounts in order to cover the variety of abilities, skills and strategies that we draw on and employ in order to understand and make sense of others."		

3.2 Perception in TT, ST and IT

The three approaches differ in their views on perception. ToM (both TT and ST) supports the core assumption that the mind of others is imperceptible, it requires "some extra-perceptual cognitive step (inference through theory or simulation) as necessary for "mindreading" the mental states of others" (Gallagher and Varga, 2014 p.185). IT's core concept, however, is perception, providing both function as well as content, and enables the understanding and interaction with others (Macgann and De Jaegher 2009; Gallagher 2008b). Several authors (Freedberg and Gallese 2007; Rizzolatti and Craighero 2005; Rizzolatti and Sinigaglia 2008; Goldman 2011) believe that ST is based on empathy, in which the empathizer undergoes

similar processes as the target's psychological or neurological states. Interaction Theorists however, counter that empathy is a form of perceptual experience of another's mental state (Gallagher & Varga 2014; Zahavi, 2008) and this is the view that this study takes.

All three approaches are important in the value they provide in the day-to-day context of perceiving others. One prominent version of IT is the direct perception thesis of social cognition. The direct perception model proposes that for everyday interactions, by directly perceiving other's expressions, bodily movement and actions, we can gain insights into their intentions, emotions and meanings behind their behaviour (Gallagher 2008b) such as perceiving X's disappointment from their body language. Gallagher and Varga (2014, p.192) assert that although perceiving other's mental states is complex and dynamic at "sub-personal, sensory-motor level", it does not occur from additional, extra-perceptual influences. However, Gallagher and Varga (2014 pp.191) also acknowledge that "on some versions of TT and ST, an extra-perceptual inference (or simulation) is added to the perception" because perception by itself is not enough.

The three approaches also differed on their views on perceiving context. ToM focuses on the cognitive processes of understanding others and does not consider environment, context and embodiment in social cognition (Bohl and Bos, 2012). This research considers environmental, social, cultural factors and prior experience also as stemming from theory-laden perception (TT) besides the narrative and perceptual processes of IT.

For this research, wherein the designer needs to also take on the role of an expert, the proposed scale goes beyond the value provided just by direct perception. It draws on (1) the larger IT that focuses on embodied interaction as well as narrative, besides direct perception in social cognition and (2) the extra-perceptual inferential capacities of TT & ST. Jacob (2011) argues against this model that he terms "the direct perception model of empathy" in which perception can be direct as well as inferential. Zahavi (2011), a proponent of Interaction Theory counters by asserting that given the variety of social contexts, diverse and complementary ways would be required to "understand and make sense of others." Zahavi (2011 p.556) thus makes the case for integrating TT, ST and IT, which this study draws on.

3.3 Integrating TT, ST and IT for the proposed perceptive design scale

This research merges elements of TT, ST and IT, as done by Gangopadhyay and Schilbach (2011), Michael (2011) and Bohl and Bos (2012) as all three TT, ST and IT offer specific value in understanding others, that can be relevant to application in design. This section delves into how relevant aspects of each approach is incorporated in the perceptive design scale.

TT plays a significant role in the process of designers understanding users. The very premise of any design is that it is based, explicitly or implicitly, on assumptions, or theories. An example of working from theory in the phase of understanding users or user-research is the identification of user-groups. Common-sensical principles or generalizations (theories from TT) are at play even when identifying users of a certain demographic. TT is thus woven throughout the phases in the 'perceptive design' scale.

The ways in which the different social cognition approaches lent themselves to the formulation of each stage of the proposed perception scale are outlined below:

The first stage builds preliminary context about the user. IT advocates for the importance of social, cultural understanding for a full social perceptive understanding (Gallagher and Varga, 2013). ST advocates for prior information about the target's mental states being key (Goldman 2013). TT as theory-laden perception (from sec 3.2). These are considered in the first stage where designers can 'recognize' the context, not necessarily through interaction.

The second stage involves grasping the mental states of the user, through potential interaction. IT's embodied interaction, communicative, narrative competency, enactive, direct perception all play roles in this stage. ST - the designer can draw from their experiences to have the user's ideas resonate with them. TT - consciously or subconsciously, the designer is working from a theory about the potential user in relation to the product or experience or idea. This stage facilitates aspects of the user to 'resonate' with the designer.

The third stage involves the process of reconstructing another's experience (with the product or service) to mentally experience it, while retaining one's own consciousness. Thus, ST, IT and TT can be drawn upon in this stage – ST, when we are using our minds as models to perceive by inference through simulation and TT, when we are working from a theory. IT, when the user is involved in the process, to perceive the user's embodied processes to inform the design process. This stage aids the designer to 'relate' to the user.

The fourth stage weaves insights gained from the previous stages to create 'almost' experiential processes. This stage relies primarily on ST and IT when it potentially includes narrative, communicative practices and environmental context. One cannot experience someone else's experience (Pine & Gilmore 1998, Forlizzi & Ford 2000, Buchenau & Suri 2000). However, as Battarbee (2004) notes, in everyday life, we transfer experiences (about holidays, food, etc. by discussion), and such a "close enough" experience should work for design. This last stage aids the designer to (almost) 'realize' the user's experience.

4. Proposed scale and descriptions of the levels of perception

This resulted in the development of a perceptive design scale as shown in Figure 1 (below), with a taxonomy relating to the four degrees of perception as - Recognize, Resonate, Relate and Realize.

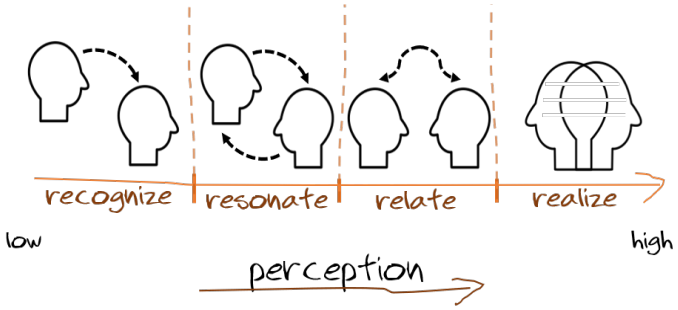
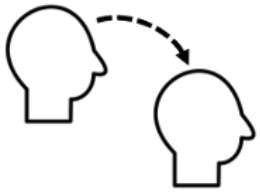
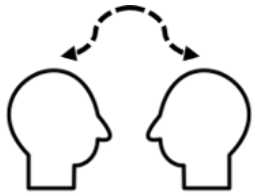
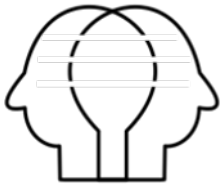


Figure 1 The design perception scale as recognize, resonate, relate, realize

The proposed perceptive design scale is centred on there being various degrees and aspects of understanding the user. The scale is a guide to aid designers in the process of understanding users' lives. It aims to provide awareness of the range of conceptual depths the designers can go to, to achieve an understanding of the user. As designers step into territory that is unfamiliar to them, a scale can let them gauge how deep they want to go. It can allow the designers to navigate these conceptual depths, potentially allowing for (re) assessment and modulation to achieve the optimum level of perceptive design. In Table 2 (below), the taxonomy and the associated degrees are described:

Table 2 Taxonomy of the levels of perception on the 'perceptive design' scale.

Level of perception	**Description**
Recognize 	The lowest level of perception is where the designer gains understanding about the user by becoming aware of the user's context, requirements, without necessarily interacting with the user. The term adopted for this level is 'recognize', where the designer can 'recognize' aspects of the user. E.g. surveys, user-data.
Resonate 	The lower level of perception is identified as the level in which the designer gains insight into the user's mental and emotional states, such as their beliefs, hopes, desires, etc. This level involves the designer engaging with potential users to build more context. The term adopted for this level is 'resonate' where aspects of the user can resonate with the designer. E.g. interviews and stories

Relate 	The higher level of perception is identified as the level in which the designer relates to the user either by consciously, actively placing themselves (mentally) into the user's context - (social change design) OR gaining insights into the user's behavioural responses to a stimulus - (user-centred design). The term adopted for this level is thus, 'relate' where the designer and the user can be at the same level. E.g. journey-map, role-play
Realize 	The highest level of empathy is identified as where the designer shares experiences with the user as part of the process of understanding the user. The term adopted to depict this level is 'realize', where the designer can 'almost' realize the user's experience. E.g. Augmented reality exercises, immersion exercises.

5. Application of the scale

The perception scale can potentially be applied as a framework as well as an analytical tool. The following sections 5.1 and 5.2 illustrate both applications. The application of the scale as a framework is depicted in 5.1 as two HCD scenarios, one with a user-centred design context and one with a social change design context. In 5.2, the scale's application as an analytical tool is illustrated by evaluating ten common user-centred tools on the conceptual scale. Given that perception is difficult to quantify, the levels within the proposed design perception scale are to be considered as conceptual and boundaries between levels are to be considered fluid. They are subject to the specific design processes, requirements and outcomes that they are applied to.

5.1 Illustration of the application of the scale as a framework

The perceptive design scale can potentially serve as a framework for structuring and guiding the designer through a process of sequentially progressing through the levels on the perceptive design scale. The application as a framework is depicted below, in two different design scenarios of designing for social change and designing for user-centred design. Please note that further research is awaited as the proposed framework is applied as part of the author's research. The below scenarios are indicative of the potential of the scale.

To illustrate how user understanding differs, depending on the design context: Janzer & Weinstein (2014) note that the differences in design contexts such as user-centred design and development challenges is a case of object-centric versus situation-centric processes. While user-centred design focuses on creating products, development challenges need interventions as responses to situations and thus require a service design or situation-centric

process. Lee (2015) cites the difference between the two as designing a computer mouse for a user versus designing better health service systems for poor villagers, a situation in which diverse stakeholders are involved. For the design of a computer mouse - the user's cognitive, emotional, physical states would need to be considered. For the design of better public health services in a village, the user's cognitive, emotional, physical and contextual (environmental, spatial contexts) states would need to be considered.

(User-centred design context) For a group of diverse stakeholders designing a transit app for residents of a location, the levels of perception to be engaged in could range over several levels. It could start from the level of 'recognize' (demographic data, transit surveys), before moving on to the 'resonate' level (user circumstances relating to their transit requirements from user interviews). These levels of perception can be enough for the initial design. Based on these, a shared representation of the user could be created to align stakeholders' understanding and objectives to design key features of the app. The initial design could then progress to the 'relate' level (behavioural insights from users trying the app) and 'realize' level (where user experience with the app is simulated) to further the design of the app.

(Social Change design context) For the scenario in the introduction - service (re-)design of the homelessness system - a basic overview of how the scale can act as a framework follows: The first level 'recognize' would act as the first phase, in which cognitive understanding of the homeless person's context is established from sources such as surveys, demographic data, reports, spatial data and journeys through the existing service of the homelessness system. The second level 'resonate' would act as the second phase, in which the demographic data is supplemented with interview information about the user's journey through the existing homelessness service system, their mental and emotional states such as their beliefs, hopes, desires projected to a time where they did/will have a home and regular lives. This is the level that is expected to resonate with aspects of the designer's life. The third level 'relate' would act as the third phase, in which the designer consciously adopts the (mental) perspective of the experience of homelessness in relation to their own lives. In this phase, the designer, potentially through exercises, draws from their own potential experiences with uncertainty, instability in their lives to reconstruct the mental and emotional states that the homeless person feels. The fourth level 'realize' would act as the fourth phase, in which the designer, through a process of immersion attempts to understand the user's experience through simulation etc. This phase could build on the insights gained from the previous stages and potentially incorporate physical or environmental aspects such as applying augmented reality to 'almost' experience homelessness at specified locations.

5.2 Illustration of the application of the scale as an analytical tool

A study of several commonly used user-centred tools (Figure 2) demonstrated that they offered various degrees in understanding users. The study also showed that the kind of understanding offered by the tools varied, and the outcome of the tool employed, depended on the specific design context.

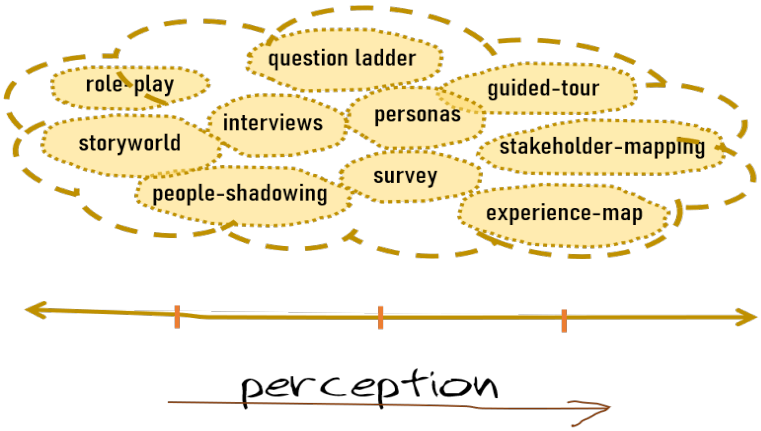


Figure 2 Commonly used user-centred design tools

In this section, the application of the perceptive design scale as an analytical tool is demonstrated by evaluating ten commonly used user-centred design tools as shown below, in Table 3. These user-centred design tools are typically applied to gain a deeper understanding of the user in the early stages of design. Please note that the categorization and justification provided is indicative of how the scale can be applied. Every design problem is unique, and every tool can be customized to gain the kind of insights required.

Table 3 Categorization of common user-centred tools on the perceptive design scale.

Tool	Function	Level	Justification
Stakeholder Mapping Nesta (2014)	provides a clearer picture of how all the different people and organisations involved, relate both to the work and each other	recognize	basic insights into design contexts involved, lets the designer 'recognize' user aspects
Surveys	provide preliminary design context through insights from user needs, wants, demographics, etc.	recognize	provide key context for the designer to 'recognize' aspects of the user
Personas Nesta (2014)	provides a fictional character as a user type to represent a group with similar characteristics such as user needs relevant to the design problem	recognize, resonate	ranges from providing basic context about user needs (recognize), to insights into user's emotional, mental states (resonate), if used with narratives or scenarios
Storyworld Kimbell L., Julier J. (2012 p.24)	provides ways to harness and transmit most relevant insights about people into stories that make users easier to relate to	resonate	the user's contexts, mental, emotional states serve to 'resonate' with the designer
Question Ladder Nesta (2014)	provides various ways to start asking probing questions, and to configure combinations of questions to the best route to arriving at the core issue(s)	resonate, relate	insights into user's mental and emotional states (resonate) allows the designers to shift their mental state (relate)

Tool	Function	Level	Justification
Interviews	provide insight into a person's opinions, desires and fears on a given subject, range widely depending on modes, outcomes	resonate, relate	designer resonates with and relates to contextual, mental, emotional insights
Empathy Map Gray, Brown & Macanufo (2010 p. 65-66)	provide insight into what the user says, thinks, does, feels, sees and hears in response to a product or a service	relate	the designer can 'relate' to these insights by drawing from their own experiences
Journey maps Stickdorn M., Schneider J. (2010)	provides insight into various routes, points at which users become aware of, connect with (potential) products or services.	relate	the designer can 'relate' to insights from the user's journey by drawing on their own experiences
Roleplaying Boess, S. U. (2006)	provides insights into users' contexts or experiences of a product, service by acting it out	relate	the designer can relate to insights about the user's experience through roleplay
People-shadowing Nesta (2014)	provides insights into user's environment, providing contextual details into a person's motivations and behavioral responses	realize	provides experiential insights at the simulation level, allowing for the designer to realize the user's life.

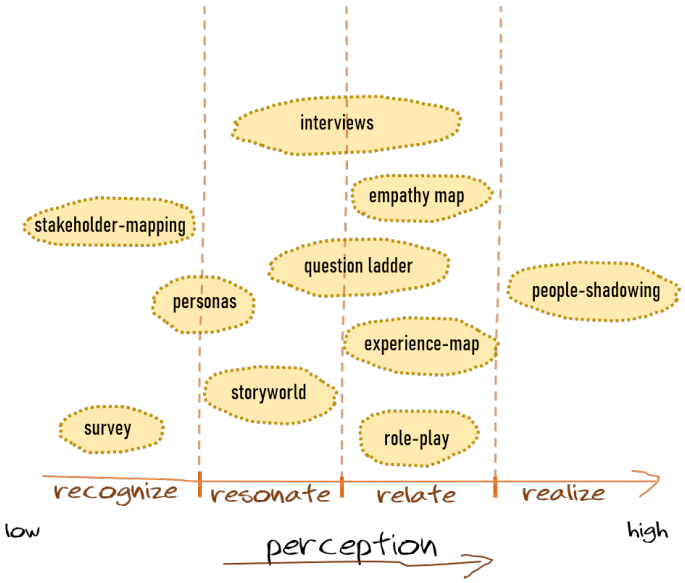


Figure 3 *Demonstration of the perception scale as an analytical tool to assess ten commonly used user-centred design tools*

Figure 3 depicts how the conceptual perceptive design scale can assess design tools. The scale can also be used as an analytical tool to assess design processes to guide the designer. The levels can be stand-alone levels to evaluate where a design process is on the perception scale and gauge if that is the appropriate level for it or whether it needs to be at higher or lower levels. It can indicate how deep the designer is going or the type of understanding required (contextual, mental or experiential), to understand the user.

It also provides opportunities for the user to (re)assess and modulate that level on the conceptual scale.

6. Discussion

This study proposes that perception allows for a holistic understanding of users by considering their contextual, situational, cognitive, affective and environmental states. Each of the three key approaches of social cognition offers a different kind of perception. Theory Theory (TT) offers a theory-laden intuitive perception, Simulation Theory (ST) a simulative perception and Interaction Theory (IT) offers direct, enactive perception. This study draws on and integrates all these perceptions to harness the value provided by "multiple complementary accounts" in applying a "variety of abilities, skills and strategies" to comprehend others (Zahavi, 2011 p.556). This study acknowledges that certain levels on the scale could be considered empathy, but for such instances takes the view of Interaction Theorists, who argue that empathy is a form of perceptual experience of another's mental state.

The perception scale for user-centred design presented in this study serves three key functions in Human-Centred Design (HCD). It can (1) create awareness that the design process involves a range of types and/or levels of understanding the user. Some design processes may require functioning from a certain level or a certain type of perception such as contextual or mental states; (2) act as a roadmap for the designer to navigate the fluid concept of understanding the user in HCD by providing structure; (3) align understanding about the user, as user insights gained can lead to development of shared representations of the user. When a diverse design team with members from several disciplines agree on user insights, it can lead to alignment in identifying user needs and design outcomes.

This study demonstrates through two scenarios (1) social change design and (2) user-centred design, the applicability and customizability of the proposed scale in different HCD contexts.

One cannot experience someone else's experience (Pine & Gilmore 1998, Forlizzi & Ford 2000, Buchenau & Suri 2000). The proposed 'perceptive design' scale supports 'almost experiential' experiences. For design problems that require an understanding of the physical experiences of the user, such as wearables, participatory exercises with the user, would aid stages 3 (relate) and 4 (realize). From these exercises, the designer can perceive the user's experiences through direct, enactive perception and embodied interaction (IT).

Other frameworks for understanding users, such as Stein (1917), Reik (1949), Kouprie and Visser (2009) which rely on empathy, require that the empathizer detaches after immersion "for competent action" based on insights gained (Kouprie and Visser, 2009 p.444). This study considers and acknowledges that designers will often retain their physiological, cultural and psychological consciousness while trying to understand the user. In retaining their consciousness, the designer needs to exercise caution and be mindful of potential egocentric views and biases seeping into the processes. However, applying the proposed construct of perception can potentially allow the designer to perceive and include their own experiences

and perspectives in the design process objectively, rather than denying them. Further research is awaited as the proposed framework is applied in the author's research.

7. Conclusion

The study shows that empathy, although valuable in design has its limitations and proposes perception as a potential construct for holistically understanding users in human-centred design (HCD). The methodology for 'perceptive design' is centred on a conceptual scale and taxonomy of the levels - recognize, resonate, relate and realize. The methodology is developed by integrating the three predominant approaches of social cognition - Theory Theory, Simulation Theory and Interaction Theory. The 'perceptive design' scale is applied as a framework as well as an analytical tool to demonstrate its applicability. This study's theoretical contribution is the proposed concept of 'perceptive design' and the application of mindreading and social cognition approaches to design. This study's methodological and empirical contributions are the applicability of the perceptive design scale as a design process (method) and as an analytical tool (empirical) respectively.

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Fixperts: models, learning and social contexts

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Abstract: Fixperts is a learner-centred, creative-problem-solving and project-based learning programme. In a Fixperts project, participants (Fixperts) team-up with an insight provider (Fix Partner) to identify a daily problem in the Fix Partner's life that becomes the focus of a project aimed at delivering a solution or Fix. This paper introduces four pedagogic models developed via delivery of Fixperts projects at leading international design universities. It presents four approaches to the challenge of moving from the Person, to the Problem, to the Fix. These four models – Primary, Partnerships, Community, Public - represent the evolution of the Fixperts framework to better enable the development of students as confident and empathetic socially-led designers. Fixperts builds competencies which are predicted to become essential to an ability to thrive in our increasingly uncertain future.

Keywords: social design; creative problem solving; project based learning; education

1. Introduction to Fixperts

Fixperts is a learner-centred, creative-problem-solving and project-based learning programme. It serves as an experiential hands-on introduction to human centred design, maker culture, and design-based thinking. It develops empathy, creativity and communication competencies in its participants. Fixperts was developed by Charny, to support delivery of a vision of a renewed design education which incorporates the disciplinary shifts needed to respond effectively to real world challenges.

Fixperts incorporates elements from established methods and approaches - user-centred design, universal design, design ethnography, participatory design, design thinking, action research, co-design, design activism, disruptive design, frugal design, multi-disciplinary, action-oriented – in an agile, adaptable and robust learning framework. Since 2013 it has been taught in 42 Higher Education Institutions across 20 countries, including design and

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engineering courses in universities in Australia, Canada, China, Denmark, Germany, Japan, Ireland, Israel, Mexico, Poland, Scotland, South Africa, Spain, Thailand and UK. Over 100 tutors have delivered versions of the framework to around 4,500 students, adapted to the needs of their accredited programmes for up to six years. Fixperts has also been adapted by Charny for use by schools, cultural organisations and companies. This paper identifies models for delivering Fixperts demonstrated by four of the universities around the world.

In a Fixperts project, participants (Fixperts) team-up with an insight provider (Fix Partner) to identify a daily issue in the Fix Partner's life that becomes the focus of their project. Following a process of empathic modelling and rapid prototyping of potential approaches to a possible solution, the collaborators improve and resolve the optimal solution through iterative real-life testing. On completion of the project, a working prototype is presented and gifted to the Fix Partner. The project is documented at all stages, and brought together in a narrative format, following provided guidelines to tell the story of the People, the Problem, and the Fix. This is usually a film, which is uploaded to a publicly available open source online archive (fixing.education). The archive is managed by the organisation FixEd, and curated into playlists which collate individual films in a teaching resource which is available worldwide. There are now over 550 films uploaded to the archive, and more on other online platforms. Some courses teaching Fixperts additionally require learners to upload the designs of their Fixes as 'How to' instructions on open source platforms such as instructables.com and thingyverse.com, so others can benefit from accessing the solutions.

Fixperts learning programmes were initially developed by Charny for universities in 2013. This paper is concerned with Fixperts for university-level learners. It describes four models of the framework. It presents the Pilot model, which led to the Primary model, and three further models that have evolved subsequently over the years by lecturers responding to local contexts and needs. This paper is jointly written with the lecturers who developed these variants on the Fixperts framework. The Primary model included here is from Kyoto Institute of Technology (KIT), Japan, presented by Julia Cassim. The Partnership model at Kingston University London, UK, is presented by Maya Alvarado. The Community model at Tongji University, China, is presented by Yumei Dong. The Public model at the Royal Melbourne Institute of Technology (RMIT), Australia, is presented by Ian de Vere. Guidance for delivery of Fixperts in universities is freely available online. (FixEd, 2017) The case studies presented below are examples of putting this into practice.

2. Pilot and Basic model

Fixperts was initially thought of as a micro volunteering initiative inviting design professionals to use their imagination and skills away from their offices and screens, with the additional benefit of promoting repair. The pilot phase included five films, identity and a website developed by a group of volunteers. An example of the pilot model of Fixperts is 'The Little Things' from 2012, in which Denise volunteered to support the Fixperts pilot project as a Fix Partner. Denise has multiple sclerosis (MS) and finds it difficult to put her earrings on. She

was reached via the online Shift MS community, who published an invitation to which she and five other members responded.

The Fixperts team met Denise at her home where she shared the challenges of living with MS. They focused on her frustration with tremor in her hands, which impacts on small movements such as buttoning shirts or putting on earrings. Following an observation session, Fixperts spent time in the workshop developing a solution for earring placement. Feedback from Denise on the 'Earing stapler' concept informed another session in the workshops, resulting in a refined mechanism which delighted Denise. A year later, the Fixperts had a new concept based on tweezers, and returned to deliver the improved prototype to Denise. The stages of the project included: (1) Search for, and invitation of, a Fix Partner; (2) Interview between Fix Partner and Fixperts, and identification of problem to address; (3) Concept prototyping, and testing with Fix Partner; (4) Improvement; (5) Gifting the Fix to the Fix Partner; (6) Film production and upload to internet. The Pilot model did not include mentoring of the designers or empathic modelling as appears in later (pedagogical) models – both were identified as necessary and subsequently added to the process, as valuable for raising the quality of the solutions.



Figure 1 *'The Little Things' (Pilot Fixperts project, 2012). Fix Partner: Denise Stephens; Fixperts: Florie Salnot, Peter Judson and Rachel Singer.*

'The Little Things' demonstrates the Basic independent model of Fixperts, developed for the pilot phase and based on independent people initiating their own project in their community and building a Fixperts team with others. Fixperts was not yet a pedagogical format.

3. Primary model

In the Primary pedagogic model, authored by Charny in 2013, learners are introduced to the Fixperts project by their tutors and are tasked with finding their own Fix Partners with whom to identify a problem through conversation. They develop initial possible solutions and make prototypes on which they gain feedback from the Fix Partner, improve this and make a final model to gift to the Fix Partner, and document the process of the Person, the Problem and the Fix. This story is made into a short film for dissemination.

Daniel Charny was invited to run a workshop at KIT in 2015 on the theme 'One, Two, Many', to introduce students to a more conceptual and experiential ideation style. The impact of this workshop led Julia Cassim and three other teaching staff with different specialisms (media, interaction design, product design) to embed Fixperts in the curriculum that year as a means to:

- Provide an understanding of a human-centred design process from inception to finish;
- Gain skills in solving practical real world problems;
- Generate a real word learning experience with face to face engagement;
- Help students understand the vital role of iterative prototyping;
- Promote a team-teaching model of instruction;
- Introduce the ethical and IP issues of working with design partners;
- Allow a pedagogical structure to be built around it.

The project was run as an elective over a three-month period, using the allotted curriculum time slots, the longest being a three-hour teaching period. Hence, the physical design and fabrication took place in the students' own self-directed time, with contact time devoted to critical discussion and evaluation by the teaching team. Fixperts guidelines were respected, but the project followed the inclusive design model developed previously by Cassim (Cassim & Dong, 2013). A design brief was set each time: 'Invisible People', 'Silver Workers', 'People who work outside', 'People who work in small spaces'. Emphasis was placed on the idea that the design solution, while inspired by the needs of an individual, should be broadly applicable and have the potential to be developed as a commercial product in its own right.

Students were briefed on the project structure, aims, and ethical considerations, and introduced to ethnographic techniques and documentation formats and styles. They were asked initially to identify three potential Fix Partners, and present their reasons for selection and the issues they wished to address. Critical discussion around this ensured that the final choice of a single Fix Partner was robust and considered, rather than expedient, and had been sufficiently interrogated to enable an interesting Fix.

A key learning for staff was that students had little understanding of iterative prototyping as an ideation method in its own right – prototyping was perceived as the final step of the design process. In collaboration with the designer Frank Kolkman, KIT's first Design Associate, the Fixperts project was enhanced with a 'methods-based approach to rapid protoyping

for designers'. The aim was to help students understand the different purposes for which prototyping can be used, at different stages of the design process. This workshop has since been held each year within the Fixperts project programme, once teams have identified their Fix Partner and have rough prototyped initial ideas, and has proved to be a significant accelerator in the development of their thinking through making.

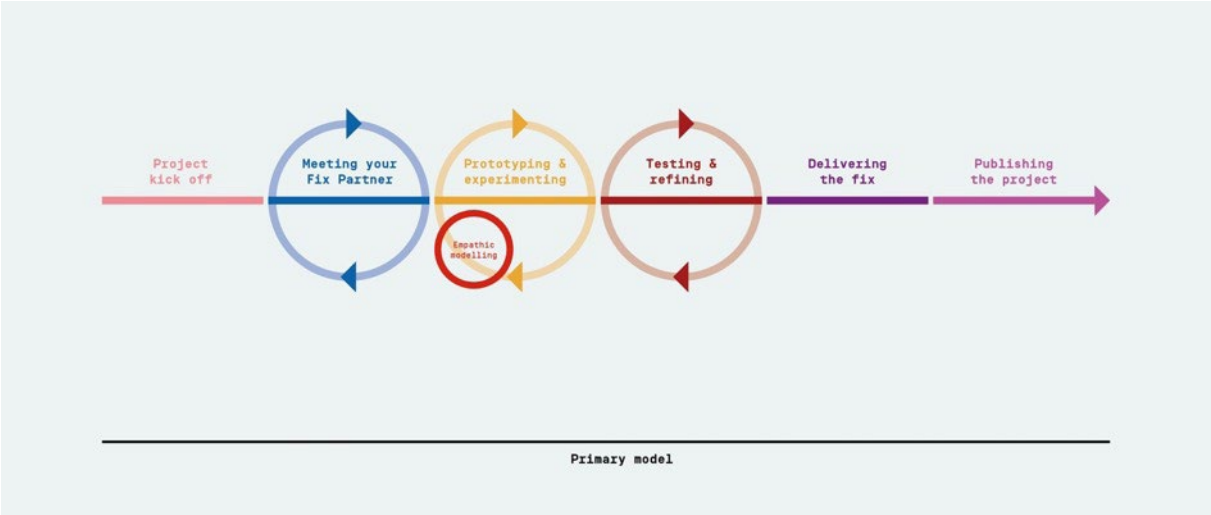

Figure 2 *Primary pedagogic model of Fixperts (as demonstrated by Kyoto case study) has 6 stages with a distinct element of the students identifying their own Fix Partner. Fixperts method diagrams, developed by Daniel Charny with Maya Alvarado, communicate the linear stages, iterative phases (noted by the circles with arrows) and discrete embedded activities (indicated by small circles) The diagrams are designed to help tutors understand and plan a Fixperts project fit for their context. The method and diagram learn from and reference lean, agile, scrum and design thinking methods.*

Key specific principles for success:

- Students gained an understanding of the realities of real-world design practice which were difficult to transmit through the previous conventional curriculum;
- Participants' confidence in subsequent work has demonstrated the value of Fixperts as a unique knowledge transfer model at KIT.

The 'Bebento' project at KIT is notable in that the student Fixperts team had to gain the trust of a Fix Partner who was both a skilled maker, and did not initially want to appear on film. The students created an initial blue foam prototype of their proposed Fix, of which the Fix Partner promptly produced a final version in wood, thereby completing the fix himself. On their next visit, the students then had to return to square one, and identify an alternative problem and potential additional Fix. His delight at their final solution is evident in the video.

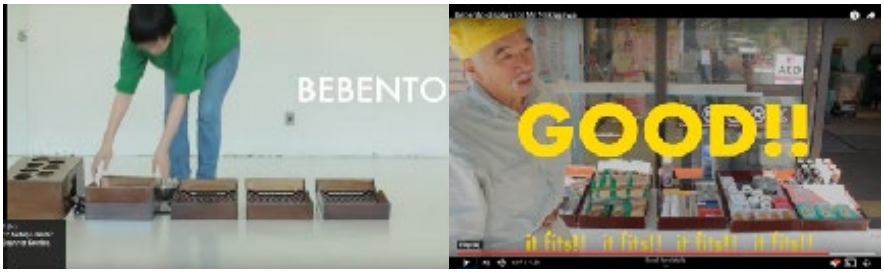

Figure 3 *'Bebento display solution' for itinerant shoe repairer Mr Nakagawa (Fixperts project at KIT). Stills from Fix Film that can be seen here: https://vimeo.com/270312611*

4. Partnership model

In the Partnership pedagogic model, tutors develop Fix Partner relationships before engaging students. This is often with an organisation, and includes secondary Fix Partner support in the form of carers or teachers.

The Product & Furniture Design undergraduate course at Kingston University has delivered Fixperts via partnerships with local community institutions, notably The Bradbury Centre for over 60-year-olds, and Bedelsford School, which specialises in educating pupils with a wide range of physical disabilities including profound and multiple learning difficulties, moderate learning difficulties, and complex health needs. In addition to the aims of the Primary model, the Partnership model seeks to:

- Help students understand the social role of designers in a community;
- Build sustainable connections between the university and local organisations;
- Understand and learn to work with those around Fix Partners, for example carers.

Fixperts tutors Rodrigo García González, Kathleen Hills and Maya Alvarado were aware of the difficulties posed by the Primary model in finding a Fix Partner within a given timeframe. Securing partnerships in advance seemed a more promising approach. Local institutions that could be potential partners for Fixperts were identified, based on close proximity, high level of prior direct engagement, and perceived openness to engage with outside people. They took time to build their understanding of Fixperts and assess whether collaboration was feasible. Tutors have built and sustained these partnerships across three years of Fixperts projects.

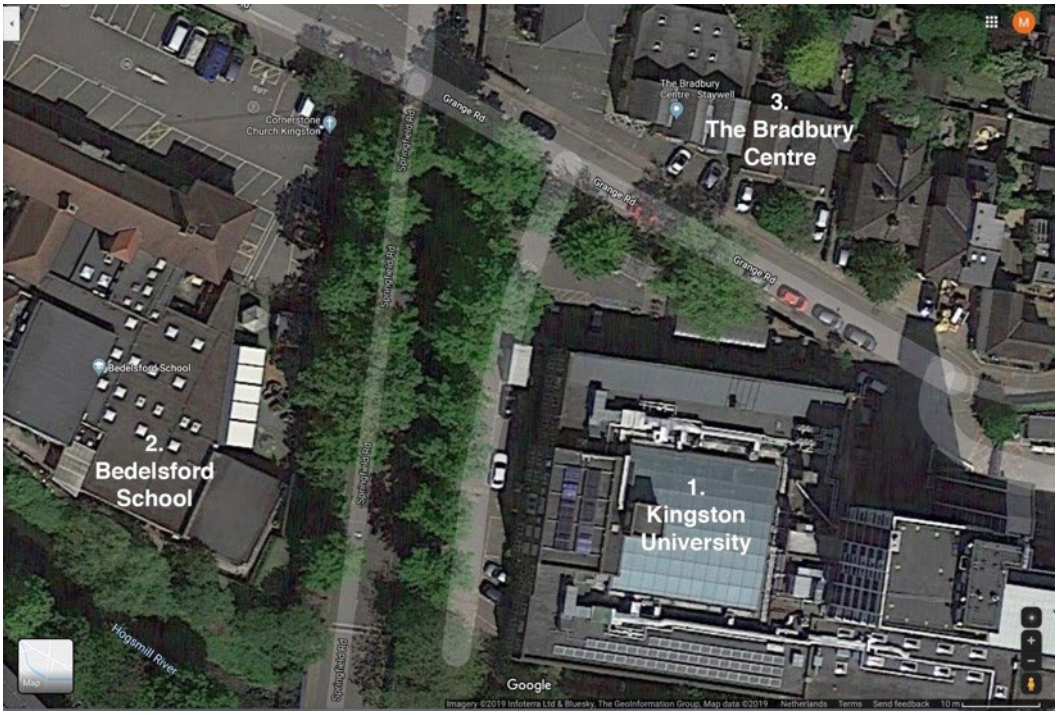

Figure 4 *All collaborators are located in close proximity within a five-minute walk, allowing close and continued direct contact: (1) Kingston University, (2) Bedelsford School, (3) The Bradbury Centre. Image adapted from Google Maps.*

Both locations are nearby the University, so the partner institutions are already familiar with the University and its community. This proximity also allows students easy access to their Fix Partners - typically three to four visits during a project.

Students work in groups of four to five, with around ten projects per year group. Project kick-off involves a '1-minute film brief', independent of the main project, in which students create proto-fixes via a 'simulations workshop' using existing Fixperts resources, and document the problem they are trying to solve and the 'Fix' they propose. Including this stage ahead of 'Meeting your Fix Partner' allows students to build-up the skills to prototype and design quickly with basic materials, something they may need to do in situ with their Fix Partner, particularly as they may be limited to a small number of visits. Filmmaking skills are thereby developed through an initial three-week project. One person from each team then becomes the 'filmmaker', responsible for documenting the process from start to finish, as well as designing.

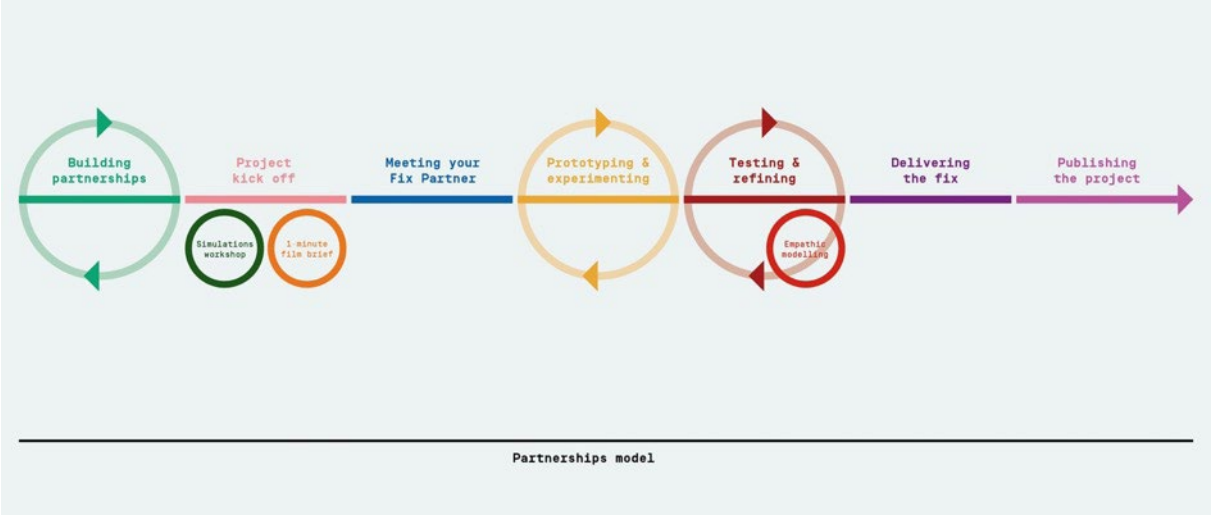

Figure 5 *Partnership pedagogic model of Fixperts (as demonstrated by the case study at Kingston University) has 7 stages. It is based on the primary model but with a distinct additional preparatory stage of the staff building external partnerships before engaging the students who are introduced into the relationship.*

The value and success of a Fix is defined by the impact for the Fix Partner in their daily life. Kingston Fixperts projects have often been associated with, but are not limited to, topics of disability, particularly in partnership with the specialist Bedelsford School and The Bradbury Centre. Other themes include: walking, mobility, carrying, play, music, cooking, eating and drinking. Projects are assessed academically on:

- Significance of impact on Fixpartner's daily life;
- Scalability of the solution;
- Quality of the story telling and film making;
- Quality of the making and finishing.

Key specific principles for success:

- Use existing Fixperts films to share process and value;
- Co-create the relationship and expectations with your partner;
- Timetable visits to your partner's environment where appropriate, to avoid overload of students on site;
- Check in on the project regularly with your main point of contact;
- Wrap up the project by checking that everyone has received their fixes;
- Check-in later in the year to see if any fixes need repairs or updates.

The Fix Partner of 'A rocket for Reece' was a Bedelsford school student who is oxygen-dependent. Reece's carer typically follows him around as he moves, carrying his oxygen tank. Kingston students designed a rocket oxygen tank carrier for Reece himself. Tutors added an empathic exercise element to the Fixperts model by inviting students to each carry around a fire extinguisher for a whole day, to gain an understanding of the weight and volume, and the difficulties of taking it everywhere you go. Empathic techniques such as this can be helpful

to progress with prototyping when it is not always possible to meet with a Fix Partner when most convenient.



Figure 6 *Empathic modelling exercise – gaining appreciation of the burden of an oxygen tank by carrying around a fire extinguisher for a day.*



Figure 7 *A rocket for Reece' (Fixperts project at Kingston University) – Reece can now transport his own oxygen tank, rather than relying on a carer to walk with him and carry it.*

5. Community model

A Community pedagogic model is a Partnership model with a group of Fix Partners, rather than an individual. Building and maintaining the relationship with the community is seen as part of the learners' responsibilities – a unique aim of this model.

Hua Dong introduced Fixperts as part of her undergraduate User Research course at Tongji University. She used it as a structured project for design students to apply their user research skills in a real-world context. Class sizes have ranged between 30 and 70 students in different years, and project group sizes ranged between three and five students. Students have worked with a variety of individual Fix Partners, including an express mail delivery worker, a shop keeper of a local flower shop, a personal trainer suffering colour blindness, and a cleaner working for the University. In 2017, Hua introduced the Fixperts project to postgraduates, and developed a new model - the Community model. In this model, students no longer worked with a single Fix Partner, but each group of two to three students worked with a Neighbourhood Centre in Yangpu District, Shanghai.

In addition to the aims of the Primary model, the Community model seeks to:

- Engage collectively with organisations such as civic community centres;
- Learn and apply co-design tools for use with participant groups;
- Scale useful results for wider use, to bring positive changes to a broader community.

Neighbourhood Centres are a relatively new phenomenon in Shanghai. They are run by third parties such as independent social organisations, that receive Government funding to improve community services by engaging local residents. The Centres provide easy-to-access communal spaces for a variety of free activities such as playing chess, practising calligraphy, reading and dancing. Neighbourhood Centres are open to all, and their users are typically retired people as they have more free time. Each Neighbourhood Centre has its unique characteristics, and differs in size and type of services and activities. Through working with Neighbourhood Centres, the postgraduate students were exposed to social contexts full of product and service 'fixing' opportunities. They were encouraged to work with the Neighbourhood Centres' users, volunteers and service providers, as their Fix Partners.

Before commencing the Community Fixperts project, Hua and her teaching assistant identified 16 suitable Neighbourhood Centres through visiting them, to ensure a variety of Centre types, and that they were within reasonable distance of Tongji University, to ensure students could visit several times without too much difficulty. An official letter was given to students to introduce the project upon their first visit to the Neighbourhood Centre.

The course lasted nine weeks, half a day per week. In addition to attending lectures on user research and design innovation, the students paid visits to Neighbourhood Centres, on average three times. The first visit was to become familiar with the environment, make observations, and identify problems or opportunities. The second visit was to investigate the problem and explore opportunities with different stakeholders, and co-design concepts and

potential solutions. The third visit was to implement a solution and gain user feedback.

Students made two presentations during the project: one after the initial visit, and one towards the end. These presentations were to share insights and gain feedback from tutors and fellow students. Of the 16 proposed solutions, six focused on product design, two on visual communication design, and eight on service design and interaction design.

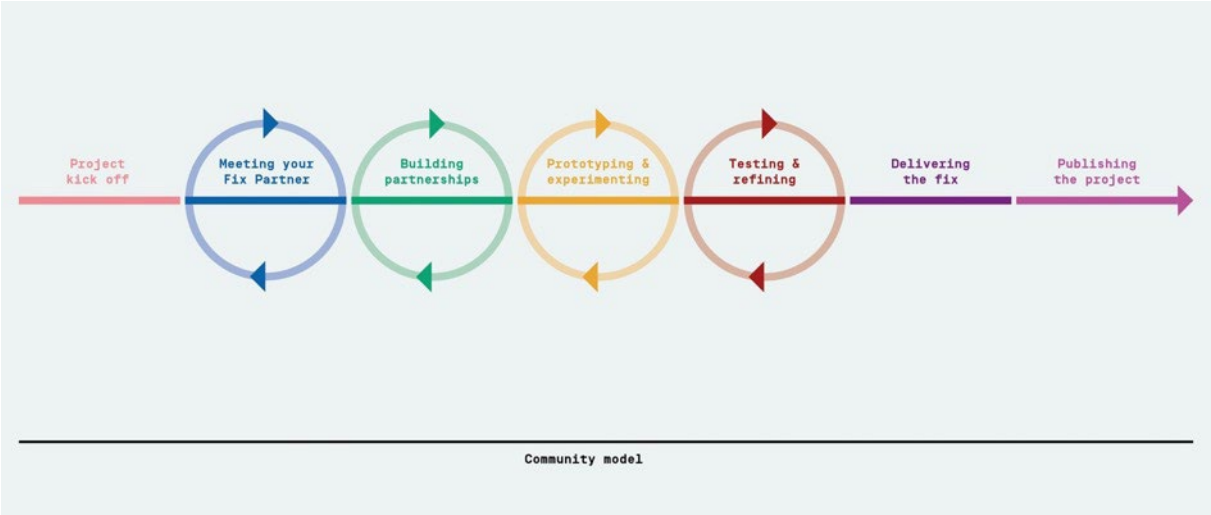

Figure 8 *Community pedagogic model of Fixperts (as demonstrated by the case study at Tongji University) has 7 stages. A distinct aspect is the work across a group rather than an individual and requires the students to engage with building partnerships with the community.*

Key specific principles for success:

- Engage with a group of Fix Partners collectively, rather than individuals;
- Use collaborative making as a means to develop skills exchange between Fixperts and Fix Partners;
- Remain inclusive by finding communal activities that can accommodate differing skills levels of participants.

'Co-knitting' is a product solution demonstrating the Community model. The two Fixperts identified several problems and design opportunities when they visited the Miyun Neighbourhood Centre near Tongji University, where many retired teachers ran chess clubs, knitting clubs and Ping-Pong clubs. After their first presentation, the Fixperts focused on the knitting club activity by developing a knitting template for participants, accommodating those with high skills and those with no skills. To test the inclusiveness of the concept, the Fixperts invited university students who were knitting novices to join a knitting session with the skilful 'grannies'.



Figure 9 'Co-knitting' at Miyun Neighbourhood Centre (Fixperts project at Tongji University).

The Community Fixperts project was well received by the postgraduate students, who said they really enjoyed working with 'real people' and developing 'real-word' solutions which had a clear impact on users. A limitation of the Community Fixperts model is lack of time for observing the projects' long-term impact. When Fixperts is applied in a community context, the collective Fix Partner is a combination of multiple stakeholders. In this project, as the Neighbourhood Centres shared some common issues, it was decided to additionally create a set of cards for knowledge exchange. The cards illustrated the 16 design solutions developed via the project, categorized as 'space', 'facility', 'activity', 'people' and 'other', each with a short description of the problem and solution. These cards were given to each of the participating Neighbourhood Centres, to enable mutual learning from each other's Fixperts experiences. The card set was called 'Empower', as all the Fixes aimed to empower local residents to run their Neighbourhood Centres better.



Figure 10 'Empower' cards for Neighbourhood Centres (Fixperts project at Tongji University).

6. Public model

A Public pedagogic model is a Partnership model with two distinct variations. The Fix Partners are met via a host Partner, and this meeting as well as final presentations of Fixes are part of a public programme.

Having previously run a Primary and Community Fixperts model at Brunel University London 2014 - 2018 (de Vere and Phillips, 2015; de Vere and Charny, 2017), a move to RMIT offered a new collaborative opportunity for de Vere. Fixperts was here initiated by MPavilion (mpavilion.org), Australia's leading architecture commission. The aim was for students and the university to generate social benefit via cultural organisations.

Unlike de Vere's previous Fixperts projects with up to 160 first year design students using the Primary model at Brunel University, this was envisioned as a more boutique project with a small group of up to 15 third year Industrial Design students working directly with predetermined community partners. Whilst the Fixperts engagement model often requires student teams to go out into their local communities to find a suitable partner and project, in this instance Fix Partners were sourced from MPavilion's network. Three partners were secured, two of whom had previous interactions with the MPavilion, with another direct referral from Occupational Therapists at Royal Melbourne Hospital. The project began with direct engagement between the Fixperts project leader and community Fix Partners. This direct contact enhanced the lecturer's understanding of the core issues in this specific instance, which proved key to developing the trust necessary to conduct a sensitive project in such a public forum.

In addition to the aims of the Primary model, the Public model seeks to:

- Learn to engage with cultural organisations;
- Communicate to public audiences.

The process of engagement in the MPavilion project was aligned to the Partnership Fixperts model, in which partnerships are developed prior to student involvement. An initial project pitch was written and distributed to invited participants, who on acceptance were invited to a public launch event at which Fixperts was introduced, the project was explained, and sensitivity, privacy and other ethical concerns were discussed. It was at this point that invitees became participants and Fix Partners. The audience was primed with FixFilms of previous Fixperts projects. These were chosen to illustrate the sensitivity of both the design intervention and the filmed presentation of the community partner. Issues and projects were selected based on what was feasible within the six-week timeframe and the skills of, and technical resources available to, the student Fixperts. Project proposals involving potential health and safety risk, for example mounting a baby carrier on a wheelchair, were gently deflected to professional assistive technology organisations. In this model, there is a deeper level of involvement for the tutors as ambassadors of the project across the cultural organisation.

Students and Partners met at the MPavilion in an open to the public event, where student groups were formed and initial discovery discussions were held. Partners were paired with student teams and initiated the observation and problem definition processes, facilitated by design lecturers. This process was key to an early establishment of the rapport and trust, which must underpin these projects. From this point students worked directly with their community partners.



Figure 11 Initial community engagement process: partners and students meet at MPavilion for the first time to discuss projects (Fixperts project at RMIT).

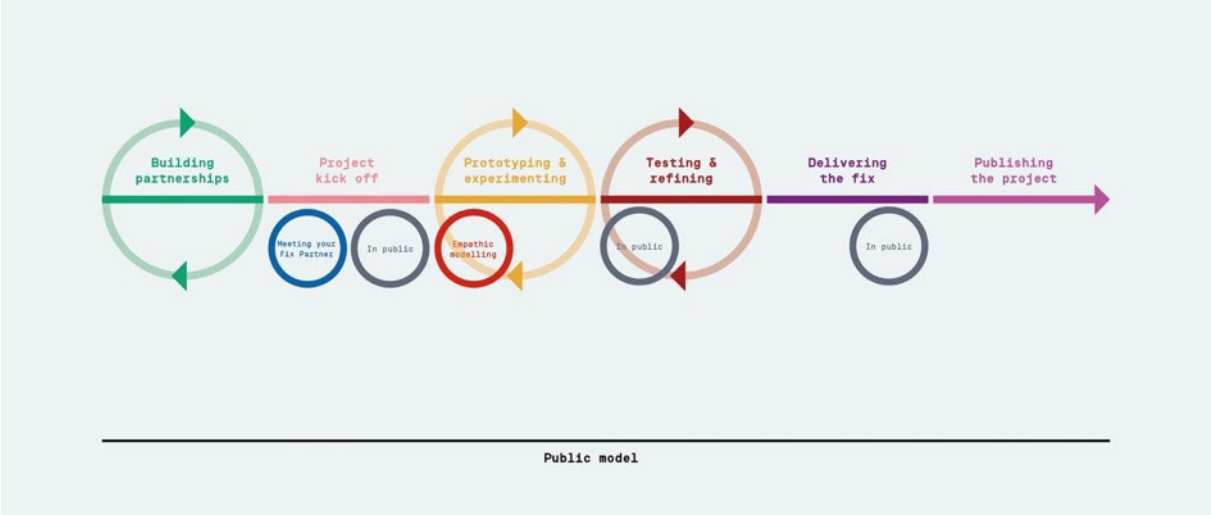

Figure 12 *Public pedagogic model of Fixperts (as demonstrated by the case study at RMIT) has 6 stages. Distinct to this model is the complexity of preparing the partnerships with a host organisation and Fix Partners from their wider network. An additional defining character is that part of the teaching takes place in the public eye.*

Key specific principles for success:

- Fix Partners were invited to review and sign an informed consent statement and form in which they agreed to filming and publication;
- Careful preliminary brokering between tutor and cultural organisation;
- Presentation of FixFilms by Fixperts and Fix Partners to a community audience at a public event at the MPavilion.

The Public model is demonstrated by a writing aid developed to help an elderly woman with an essential tremor to write again.



Figure 13 *Fix Partner Ann demonstrates the writing aid developed for her by students that allowed her to overcome her essential tremor and write again (Fixperts project at RMIT).*



Figure 14 Fix Partner Ann discusses the writing aid solution at the MPavilion (Fixperts project at RMIT).

7. Discussion

Comparative factual data relating to the four case studies presented above are compiled in Figure 15.

Model / year it emerged	Case study institution	No. of years Fixperts taught there	Year of case study	Group size / no. of groups	Project duration / delivery	Student level	Course	Tutors' Design expertise
Primary 2013	Kyoto	2015 - 2019	2016	4 x 6	12 weeks twice weekly + prototyping workshop	Undergraduate 3rd year + Exchange	Design	Product, Media Interaction Inclusive
Partnership 2015	Kingston	2013 - 2020	2016	4 x 11	12 weeks / weekly	Undergraduate 1st year	Product & Furniture Design	Product, Service
Community 2017	Tongji	2014 - 2018	2018	(2-3) x 16	6 weeks / weekly + event	Postgraduate	User Research and Design Innovation	Product, Service, Communication, Inclusive
Public 2018	RMIT	2018 - 2019	2019	3 x 4	6 weeks + event	Undergraduate 3rd year	Industrial Design	Industrial, Social Innovation

Figure 15 Summary data of the case studies of four pedagogic models of Fixperts presented in this paper.

More broadly, within universities Fixperts is mostly run in Product Design, Communication Design, Technology institutes and Engineering courses. This is mostly at undergraduate level, but a fifth are postgraduate programmes. Class sizes range from 12 to 160 students. Teams range from two to seven learners. Project duration can be an intense four consecutive days, up to a weekly class over a 12-week semester. The final film making is sometimes an additional stage.

Key reasons for courses using the Fixperts framework for teaching include:

- introduction to social design, user centred design, universal design and research methods, prototyping and material knowledge;
- building agency and an entrepreneurial mindset;
- engagement with specific themes such as design for disability, sustainable design, and design innovation;
- the appeal of the global platform, with high visibility and access to professional communities and audiences (for example the 'Bebento' project at KIT was selected to be shown at The Crafts Council's 'Real to Reel: The Craft Film Festival' in London in May 2019)

Fixperts builds creative problem-solving skills, and core skills in qualitative research methods such as shadowing, in-depth interviews and prototyping-led idea development. This in turn builds generative and evaluative approaches, and acts as a foundational introduction to, for example, service design. Tutors often see Fixperts as an important early project in building empathy and creative problem-solving skills to inform later years of study. It also opens up students to social design at an early stage, and often for the first time: "You saw the potential that designing has to improve people's lives. This was the first time I saw a direct impact on improving someone's lives." (Fixpert) "It forces people to engage with users with needs, marginalised needs, people who they, as young and fit people, may have not considered." (Design Tutor) (Tavistock Institute, 2016, pp. 12, 11)

The Primary model is still the most common; of the 42 known higher education institutions teaching Fixperts, 23 work with the Primary model. Additional benefits such as the accelerated process and greater quality control have however seen the Partnership model become more established. A Partnership is increasingly seen as the easiest way to start a Fixperts programme, particularly when specific collaborators are not yet allocated, and problems are identified and selected together after an initial meeting. Lecturers set up the invitation to a community or organisation, but the learners still find a specific person and identify an issue or problem with them.

In addition to the key specific principles for success given in each of the case studies above, we can identify key generic principles for success in using Fixperts:

- Significant involvement of Fix Partners in a co-design model, especially through the prototyping, testing and evaluation stages;
- Establishing a 'client-pull' rather than 'designer-push' process;

- Understanding Fix Partners are experts of their own situation and needs;
- Driving design by focus on bespoke solutions, tailored to address the specific needs of a single individual;
- Avoiding design driven by students' personal aesthetic or technical preferences;
- Ensuring solutions are underpinned by empathy and understanding of the disability or impairment, and the environmental context in which the assistive technology solution will be used;
- Constructing multiple iterations to test function, mechanisms, safety, ergonomics, and more, before the final Fix prototype is presented to the Fix Partner.

Some universities invite Fix Partners as guests into the classroom, rather than have the students go out to find them independently. Some courses however see an important entrepreneurial and agency-building aspect to students finding and establishing a Fix Partner themselves. Longer running programmes may develop a hybrid model based on returning to established sources of contacts. Although not a formal partnership, this reflects mutual interest in sustained collaboration, and is maintained through personal contacts.

This variation in delivery demonstrates Fixperts' value as an easy to engage, robust and agile framework that successfully synthesises (1) a user centred process, (2) a creative problem solving process, and (3) a social benefit agenda in a learner-centred project based format. Since Fixperts focuses primarily on the process, not on a specific agenda, the framework allows courses and tutors to introduce themes that are specific to their programme and local contexts. The flexibility in time frame and range of issues that can be addressed have enabled diverse courses to accommodate a Fixperts project. These projects offer students a real world, hands-on, empathy enhancing learning experience. As Fixperts, students develop their capacity in research and iterative prototyping, refining creative problem solving, decision taking, communication sharpening - and most importantly, empathy and agency building.

Model	Pedagogy	Design methods highlighted	Aims of the model	Unique to this model
Primary	Project Based Learning [A] Cooperative & Collaborative [A] Learner centred Active learning Real world learning Open-ended design task [A] Constructionist Learning [B] Social Critical **The Primary model pedagogic approach is the basis of the other models. Each then adds or modifies aspects in response to specific contexts.**	User Centred Design	• Understand human-centred design process • Gain skills in solving real world problems • Experience real word learning • Understand vital role of iterative prototyping • Introduce ethical and IP issues of working with design partners	Develop entrepreneurial skill through the students being tasked with finding their own Fix Partners
Partnership	Pedagogy of engagement [C] Multiple stake holder involvement	Social design Service design	**In addition to those of Primary model:** • Help students understand the social role of designers in a community • Build sustainable connections between the university and local organisations • Understand and learn to work with carers	Outreach Local outreach contacts Working in a care home
Community	Community Co-design [D] Participatory Co-design	Inclusive design Universal design Co-design	**In addition to those of Primary model:** • Engage with civic community centres • Learn co-design tools for group work • Scale useful results for wider use	Pursues advanced levels of understanding of Group work, Cross generational, cultural responsiveness and community based field experience
Public	Collaborative exchanges [E] Outreach and public engagement	Social design Social innovation Public engagement	**In addition to those of Primary model:** • Learn to engage with cultural organisations • Communicate to public audiences	Cultural organisation engagement brief Advocacy

Figure 16 Differences in context and pedagogical approach in the case studies of four pedagogic models of Fixperts presented in this paper. Cited sources: [A] Huang et al (2006), [B] Kafai and Harel (1991), [C] Layal (2018), [D] Thamrin et al (2018), [E] Ryan and Charman (2014).

All this accords with our understanding of how to teach design for social change:

> "Design for social change entails the adoption of a variety of strategies that at their core and in various degrees, are human-centred. The increased expectation that design education should cater for the skills and competencies that empower design graduates to deal successfully with the challenge of design for social interventions, brings to the forefront reflections on the pedagogies that rely upon teacher-centered and master-apprentice instructional approaches." (Souleles, 2017, S934)

Fixperts is a project-based learning (PjBL) pedagogy for real world design education. (Huang et al, 2006) It presents a model of social design education integrating sustainability pedagogy as described in MacVaugh (2009).

Fixperts also exemplifies use of design 'doing' as a mode of inquiry for learning, as discussed in Ejsing-Duun and Skovbjerg (2018), specifically to develop a "pragmatic philosophical underpinning" Barab & Squire (2004:6). The choice of which Fixperts model to use should relate directly to the teaching aims, local needs and opportunities which are to be addressed, via an "equation of suitability" between contextual factors and appropriate or desired pedagogies. (Huang et al, 2006: 31)

8. Conclusion

Fixperts builds key competencies and skills needed to thrive in the future, namely: problem solving, creativity, emotional intelligence, collaborative and communication skills. (WEF, 2016; Easton and Djumalieva, 2018) This paper is the first instance of capturing Fixperts pedagogy and its variations. The four models presented here were identified via the process

of documenting the case studies, and reflecting on them critically as a set. The paper demonstrates how Fixperts has been used and adapted in response to local contexts, and what can be taught through these variations on the method. We collectively hope this makes a valuable and timely contribution to design education. Sharing knowledge around the development of Fixperts via pedagogic practice has already proven useful in inspiring and enabling others to adapt the framework for courses that fit their own particular interests and curricula. In preparing this paper, we collectively hope to make the Fixperts project framework more accessible to others by demonstrating its flexibility and versatility in contrasting contexts.

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