



Fake it till you make it

Envisioning the end product
with design artefacts

Ekaterina Glushkova

Master's Thesis
Media Management
2019

MASTER'S THESIS	
Arcada	
Degree Programme:	Media Management
Identification number:	6751
Author:	Ekaterina Glushkova
Title:	Fake it till you make it: envisioning the end product with design artefacts
Supervisor (Arcada):	Tomas Träksman
Commissioned by:	
<p>Abstract:</p> <p>Design practice and research increasingly invites various stakeholders to contribute to the design process. Generative practices are widely adopted to guide collaborative activities. In the discourse of creative collaboration, design artefacts have become a popular concept. Whereas previous literature gives examples of using boundary objects in design practices across the domain, in digital product design, there is a lack of studies that address the following questions: <i>What are the repercussions of using the existing design assets as a starting point for designing a digital product? How does using high-fidelity digital artefacts early in the development affect the communication between stakeholders?</i> The practical framework was developed by analysing several short-term empirical cases in relation to the existing literature on co-design and boundary objects. This study explores the relationship of web designers with stakeholders in the co-creational settings from the designer's perspective. We look into the early design phases, in which the most critical decisions concerning the product are made. Overall, the study suggests that introducing visualizations early in the development process improves communication and collaboration in the client-designer relationship.</p>	
Keywords:	boundary objects, design artefacts, case study, design process, co-design, participatory design
Number of pages:	39
Language:	English
Date of acceptance:	5.12.19

CONTENTS

1	INTRODUCTION	5
1.1	Choice of research topic	5
1.1.1	<i>Motivation for this research</i>	5
1.1.2	<i>What is design?</i>	6
1.1.3	<i>Focus of this research</i>	7
1.2	Research aim	7
1.3	Research design	8
1.3.1	<i>Material</i>	11
2	BACKGROUND	11
2.1	Paradigms relevant for this research	12
2.2	Design process	12
2.3	Mediation: boundary objects in co-creation	15
2.3.1	<i>Knowledge structures</i>	15
2.3.2	<i>Boundary objects defined</i>	16
2.3.3	<i>Role of boundary objects in co-creation</i>	18
2.3.4	<i>Creating digital artefacts with design assets</i>	19
3	RESEARCH FINDINGS	20
3.1	Case studies: data collection and analysis	20
3.1.1	<i>Case #1</i>	23
3.1.2	<i>Case #2</i>	25
3.1.3	<i>Case #3</i>	26
3.1.4	<i>Case #4</i>	27
3.1.5	<i>Case #5</i>	29
3.2	Conclusion and discussion	32
3.2.1	<i>Research findings</i>	32
3.2.2	<i>Critical reflection and limitations of the study</i>	36
3.2.3	<i>Opportunities for future research</i>	36
	References	38

Figures

Figure 1. Research design (inspired by Murto 2017)	8
Figure 2. Systematic combining (based on Dubois & Gadde 2002).....	10
Figure 3. The current dominant design process model (Korhonen 2017)	13
Figure 4. Double diamond design process.....	13
Figure 5. Knowledge and research methods (inspired by Sanders & Dandavate 1999). 14	
Figure 6. Relationships between the three worlds (based on Hestenes 2006).....	15
Figure 7. Design project ecosystem and the stakeholder engagement.....	21
Figure 8. Design process and design artefacts (Cases 1–4).....	22
Figure 9. Sketch of a website’s structure (Case #1).....	24
Figure 10. Screenshot of a completed exercise (Case #1), tool: Trello	24
Figure 11. Wireframes (Case #2), file for print	26
Figure 12. Screenshot of an unfinished exercise (Case #2), tool: Trello	26
Figure 13. Sketch of a website’s structure (Case #3).....	27
Figure 14. Screenshot of a completed exercise (Case #3), tool: Trello	27
Figure 15. Sketches of a website’s structure (Case #4)	28
Figure 16. Quiz report (Case#4), tool: Typeform	29
Figure 17. Score sheet for a “gut test” exercise (Case#4), file for print.....	29
Figure 18. Digital wireframes (Case #5), tool: InVision	30
Figure 19. Printed wireframes (Case #5).....	30
Figure 20. Customer personas (Case #5), tool: InVision.....	31
Figure 21. Curated mood board (Case#5), tool: InVision	31
Figure 22 Framework inspired by this research.....	33
Figure 23. An elephant is soft and mushy (illustration by Sam Gross)	35

Tables

Table 1. The changing nature of design (based on Raja 2015).....	6
Table 2. The reorientation of the study.....	10
Table 3. Design artefacts taxonomy (based on the design science research)	16

1 INTRODUCTION

The Media Management programme is about finding appropriate resources and working with other people to accomplish organizational goals. Modern technology and changing user behaviour pose new creative and managerial challenges. To be able to respond to them, a successful professional needs to have a multidisciplinary understanding of business, technology and culture. This study looks into managing the collaborative design process. “Designers play key roles in the conversion of new scientific knowledge into designed real world products, systems and services that are the physical manifestations of innovation processes” (Love 2003).

1.1 Choice of research topic

The Introduction outlines the Why (topic choice), the What (research aim), and the How (methodology) of this thesis. In the following subsection, I talk about the inspiration for the research from my own academic and professional background and define the boundaries of the topic area.

1.1.1 Motivation for this research

After graduating from the Art school with a degree in Graphic design, all my classmates went their own creative ways: art, textile, typography, illustration... Whatever they all do now, they are still driven by the “designerly way of knowing” as Nigel Cross put it in his infamous treatise (Cross 2017). And Koskinen (2011 p. 8) claims the following:

The art and design tradition has an important message to more technically oriented designers. Above all, designers coming from the art school tradition have many ways to deal with the “halfway” between people and things.

I found my calling in designing digital products. UX (User Experience) and UI (User Interface) design are in high demand right now, with professionals entering the job market from diverse academic and work backgrounds. Having collaborated with different people, one could spot the unchanging fact: where there is design there are visual artefacts.

Most schooling systems seem to regard the visual expression as “artistic” disproportionately favouring textual and logical expression (Passera 2017 p. 41). Coming from a highly visual background myself, I got interested in the ways designers use visualizations in their practice. It has been said that a picture is worth a thousand words. But does it? Why do the images often have to be explained? Should designers draw? Should clients design? How do we bridge the communication gaps?

1.1.2 What is design?

This question is an extremely difficult one to answer. The activities encompassed under the umbrella of design are in flux and constantly expanding (Rampino 2012, Poggenpohl 2009). Poggenpohl explores design as a craft and a discipline, an object and an action. Koskinen (2011 p. 8) as well talks about the ambiguous nature of design, “as it covers both planning [...], and also what most other European languages would loosely call “formgiving”. Pikas (2019 p. 27) points out the dichotomy in design thought: the technical approach is concerned with the causality of the design object and activity, and the argumentative approach—with the interpretation of human purposes and interactions.

Table 1. The changing nature of design (based on Raja 2015)

	Design for consumption	Design to sell	Design for innovation	Design as business strategy
Period	Beginning of the 20th century	1930s–1960s	1960s–2000s	2000s–present
Influencing movements	Industrial evolution, architecture	Advertising, Marketing, Industrial design	User-centred design, Usability, Ergonomics, HCI	Service design, Strategic design, UX design
Customer involvement	None	Little	For feedback	As co-creators

Table 1 illustrates the changing nature of design. When it comes to the place of design activities in the development process, “some designers have moved from the aesthetic configuration that typically happens near the end of a project to the beginning where what may develop is unknown” (Poggenpohl 2009 p. 8). The job of a modern-day designer is to interpret and transform the needs into tangible solutions in close collaboration with various stakeholders: businesspeople, technical engineers, marketers, end-users.

1.1.3 Focus of this research

In this study, the notion of design is narrowed to the researcher's own design practice (UX, UI, product design) with a focus on creating corporate websites based on the provided brand assets. The goal of this study is consolidating the researcher's design practice through a series of co-creational experiments.

The outcome of design is not solely dependent on the creative abilities or expertise of the designer, but to a large extent on the collaboration between the designer and the client. [...] [However,] it has been largely neglected in contemporary studies. (Leisti-Szymczak et al. 2013, Love 2003)

By examining the empirical cases and the existing literature on design artefacts, the author intends to develop a practical framework for introducing a visual aspect to the communication of designers with colleagues and stakeholders. The word "practical" stands for the empirical grounds of the study rather than a step-by-step guide. The research is built on a theoretical background stemming from design research, participatory design and selected angles on design thinking and boundary objects.

1.2 Research aim

The preliminary hypothesis is that with a systemic approach towards design assets and design artefacts using the modern digital tools, one can produce a high-fidelity output that helps to envision the end product relatively quickly. The author aims to explore the balance between the gains and restraints that are brought upon cross-functional teams by digital artefacts.

RQ1 What are the repercussions of using the existing design assets as a starting point for designing a digital product?

RQ2 How does introducing high-fidelity digital artefacts early in the development affect the communication between stakeholders?

The remainder of this paper is organised as follows. In the next section, the research method is described. Then goes the outline of the theoretical background. The findings will be presented for five case studies, followed by main conclusions.

1.3 Research design

Objectivity and generalizability of the existing scientific methods do not suit the needs of the design domain (Lee 2012 pp. 16–18). The descriptive studies, where the researcher is primarily an observer, are of lesser practical value, as opposed to the prescriptive research, where the researcher takes an active role in the project as an agent of change. (Pikas 2019 p. 44)

The synthesized approach adopted in this thesis, qualitative and exploratory in nature, underwent the iterations of experimenting, analysis and writing. The exploration of complementary literature continued in parallel with the empirical data collection. The framework developed gradually, influencing later cases. Figure 1 illustrates the phasing of the open project-level questions in reference to the overall reduction of open research-level issues. The main characteristics include:

- participatory nature,
- interdisciplinary collaboration,
- attention to the artefacts and interactions,
- transformation through explorative action.

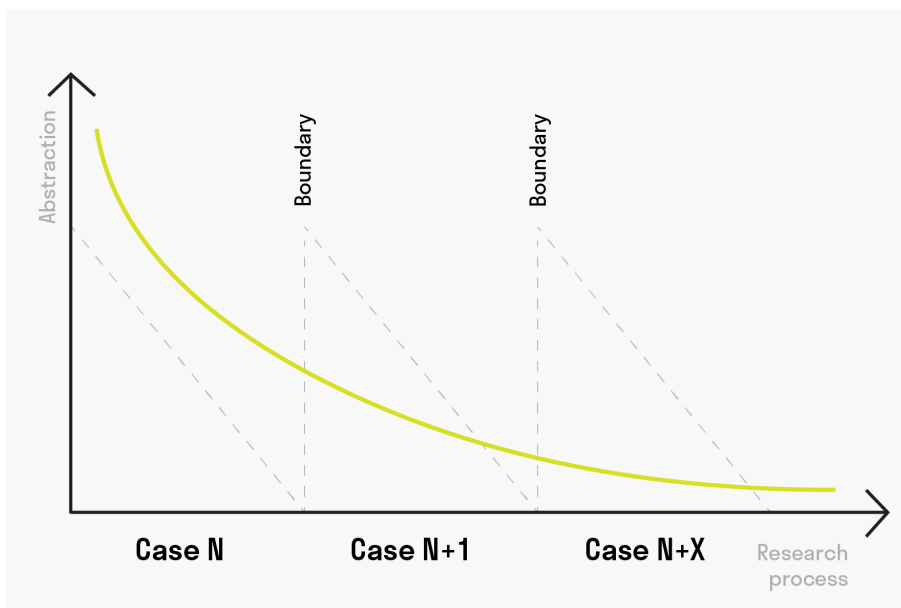


Figure 1. Research design (inspired by Murto 2017)

Below are the adopted methodologies that share the aforementioned characteristics.

Interaction analysis, described by Jordan & Henderson (1995 p. 39), “is an interdisciplinary method for the empirical investigation of the interaction of human beings with each other and with objects in their environment”. Observing and identifying regularities gives access to the expert knowledge that is seen as is situated in the interactions, not in the heads of individuals. Process of looking is informed by what is found as one gets deeper into the analysis. (ibid. p. 41 ff.)

Action research includes the targets of the research in the research process that can be described as spiral. Every case consists of planning, interventions, observation and data collection, analysis and conclusions. The research frame changes along with the research process and the constant evaluation. (Leinonen 2008; Greenwood & Levin 1998 p. 4)

Developmental work research argues that to analyse work processes “one should focus on the whole system of action instead of just the accomplishment of a task. Tools and language shape human beings while they also provide opportunities to influence and create the world.” (Leinonen 2008)

Progressive boundary development approach was introduced by Murto (2017 p. 148):

The term progressive refers to cumulation between activities across different phases [...]. The term boundary refers to both the product and project boundaries within which later phase design and development occurs.

Systematic combining is a research approach identified by Dubois & Gadde (2002 p. 556) as “as a nonlinear, path-dependent process of combining efforts with the ultimate objective of matching theory and reality” (see Figure 2).

[...] we have found that the researcher, by constantly going ‘back and forth’ from one type of research activity to another and between empirical observations and theory, is able to expand his understanding of both theory and empirical phenomena. (Dubois & Gadde 2002 p. 555)

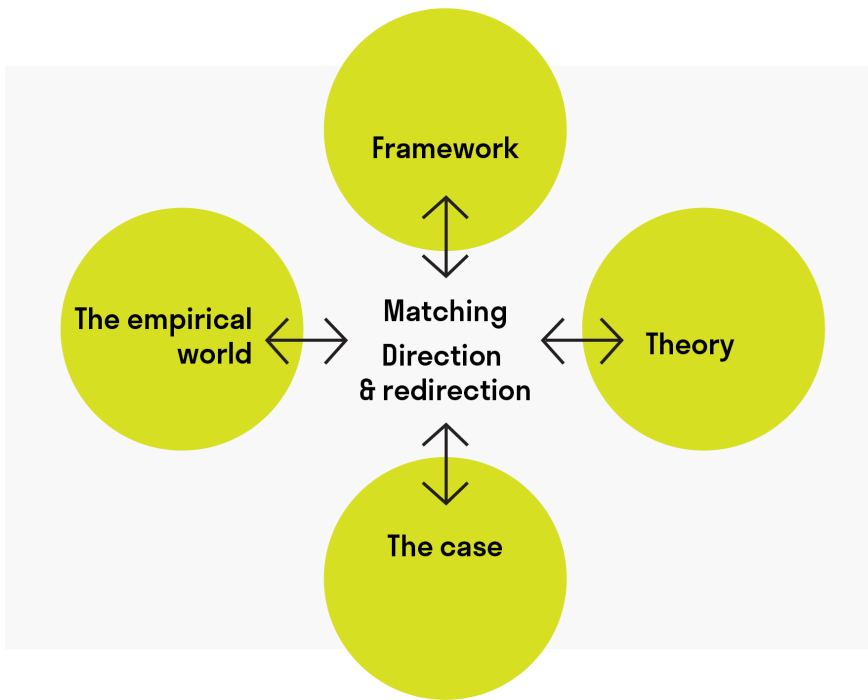


Figure 2. Systematic combining (based on Dubois & Gadde 2002)

The initial objective of this study was to introduce the visual aspect to the designer-client communication. The agency’s intention was to improve the process and increase customer satisfaction. After some time, the company decided to revise the strategy, and cut the staff by half, leaving the researcher with a dilemma: the research could no longer be continued in this company. When a new research setting was found, the study was reoriented towards collaborative design practices with multiple stakeholders. Data collection continued in a similar way, but with the new research focus (see Table 2). Thus, my research resembles what Dubois and Gadde (2002) called “systematic combining”.

Table 2. The reorientation of the study

	Focus	Main direction
Phase 1: Cases 1–4	Designer-client communication	Introducing visual artefacts in a form of exercise to increase the sense of participation and responsibility on the client’s side and minimize the “fixes”
Phase 2: Case 5	Collaborative practices with multiple stakeholders	Facilitating collaborative design practices through the boundary objects

1.3.1 Material

The concept of design artefacts was studied separately and in the environment they are applied in—collaborative design activities. The empirical material was collected during sessions that took place in comparable settings with different actors. Case studies presented in chapter three are based on the projects executed by the author with colleagues and external clients. The selected case studies differ in length and context while sharing a similar approach dedicated to increasing the involvement of stakeholders in the design process using boundary objects as a starting point for co-design. Particular qualities of the cases were beyond the author’s control and in turn, influenced the research process. The changes correspond with two stages of the study that can be identified in retrospect (see Table 2).

The goal was not to compare the outcomes of the projects but to examine the patterns that occurred in the process. Author’s experience in the field of design allowed to uncover similar dynamics in diverse cases that took place at the time when the research was carried out. Projects that were executed during the time of the research but excluded from the case studies helped to contextualize the examined phenomena.

2 BACKGROUND

Specialization in the design domain led to the pluralism of approaches and theories. Attempting to legitimize its recent academic status, the design discipline littered the literature with “theory fashions” (Melles 2008 p. 3). Each concept emphasizes isolated aspects of the field while simultaneously claiming universality. Although many efforts have been made, no unified theory of design has emerged. (Pikas 2019 p. 87)

In this chapter, the research paradigms are outlined to understand the possible framing of the design theory. Through the notion of the design process and co-design specifically, I try to explicate what makes an artefact a boundary object.

2.1 Paradigms relevant for this research

Two major approaches to design conceptualization are distinguished: *a naturalistic approach* (how things are: descriptive studies, encompassing positivist and constructivist paradigms) and *an activity approach* (how things should be: pragmatist paradigm) (Pikas 2019 pp. 72–80). Notably, these approaches are not mutually exclusive and are combined in this study.

The individual case studies and experiments of this thesis follow the constructivist approach. The knowledge is gained through systematic reflection and interpretation by interacting with material and human worlds, involving the perspectives of different stakeholders (Pikas 2019 p. 73). Most existing design concepts follow the constructivist paradigm. For example, “research through design” (Koskinen 2011), “production-based research” (Seliger & Hahn Young-ae 2015 p. 24 f.) and “wicked problems” (Rittel & Webber 1973) search for solutions to situated problems.

The overall transformation of the framework covered by this research is aligned with the pragmatist paradigm. According to the pragmatist views, “reality and knowledge of reality emerge from a continuous process of experimentation directed at changing a situation” (Pikas 2019 p. 77). Pikas (ibid. pp. 72–80), Melles (2008 p. 3) and Lee (2012) propose that activity approach and pragmatism constitute the proper philosophical view of design theory. Although the full potential of pragmatism in design is yet to be discovered.

2.2 Design process

The constructivist view influenced the formalization of “*wicked problems*” (Rittel & Webber 1973): ill-formulated problems open for interpretation depending on the designer's experience (Pikas 2019 p. 73). These problems typically have no definite solutions that can be identified beforehand, and the success of the adopted approaches can only be assessed in retrospect (Björklund et al. 2017).

Design thinking methodologies emerged in response to the acknowledgement of the ill-defined problems. Korhonen (2017) criticizes the current design process model, as it holds designers off from creating ideas early in the process (Figure 3, 4).

If you google around, you will see that all process models portray the same picture, with insignificant variations. Have we found the ultimate process model for design, or are we too busy designing that we don't have the time and energy to develop our process further? (ibid.)

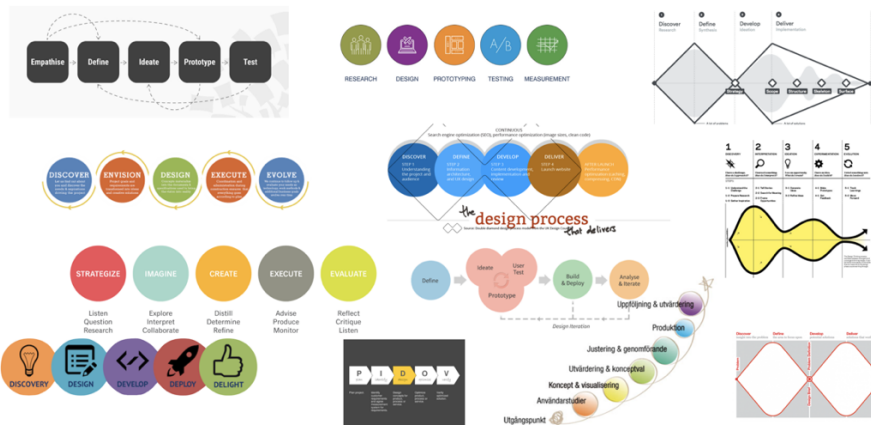


Figure 3. The current dominant design process model (Korhonen 2017)

The plethora of the design process visualizations (Figure 3) always comes down to the lapses of divergent and convergent thinking. It is often presented as a spiral process, but if we stretch a leap into a linear segment, we would always find an identified problem at the beginning and a deliverable at the end (Figure 4). With the next iteration, the problem is reframed, and the solution is improved.

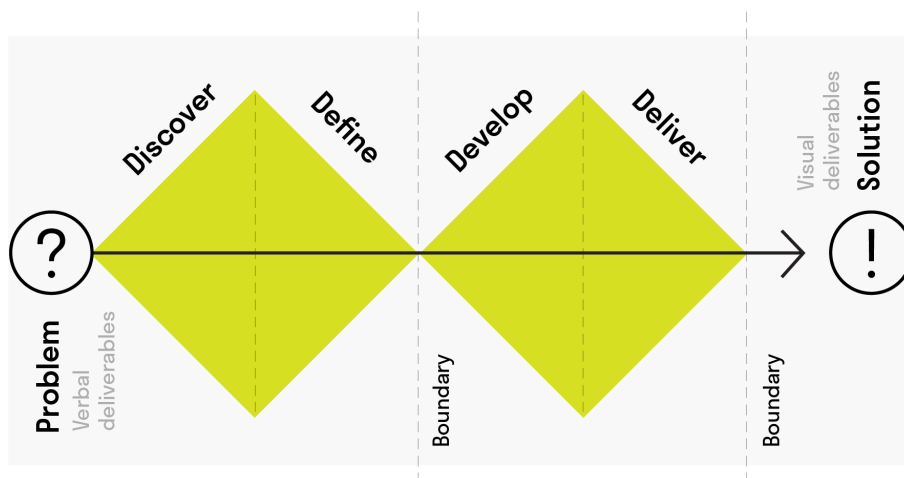


Figure 4. Double diamond design process

Participatory design (or co-design) approach “acknowledges that it is possible to gain access to the experienter’s world only through his/her participation” (Sanders & Dandavate 1999). As various stakeholders got a seat at the creative table, designers had to turn to the co-creation practices that would be accessible to non-designers. Figure 5 shows how different techniques help to externalize tacit knowledge.

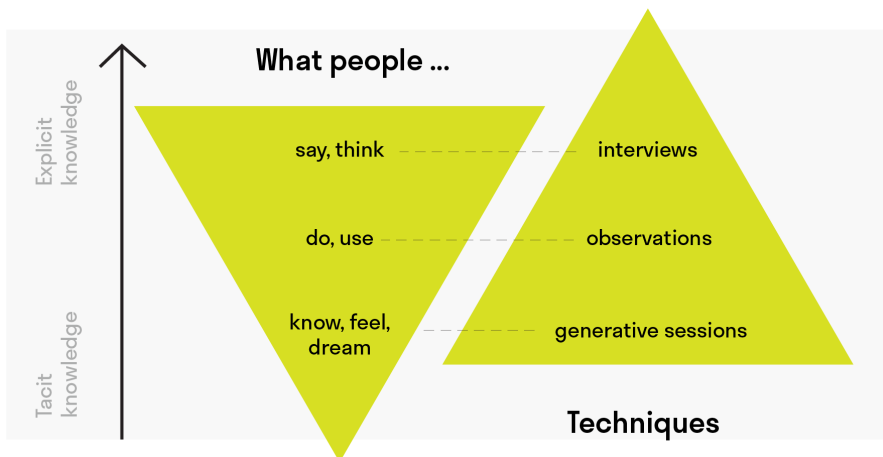


Figure 5. Knowledge and research methods (inspired by Sanders & Dandavate 1999)

Creativity is not aimed only towards designing new products but towards creating opportunities for creative collaboration among different actors (Vaajakallio 2012 p. 13). During the past couple of decades “generative” research methods put design practice at the core of the research process. There are dozens of these methodologies, including prototypes, design games, mood boards, personas, various types of role-plays. (Koskinen 2011 p. 23)

Generative methods are a new language that enables all stakeholders to contribute directly to the development of products, goods and services. This new language relies on visual literacy and begins to bring it into balance with verbal literacy. (Sanders & Dandavate 1999 p. 5).

Lee (2012) questions the portability of generative methods and the belief that they are universally objective. She argues that design researchers, practitioners, and educators are not equipped yet to understand how innovative methods actually work in designers’ practice—they tend to adapt the methods in just those ways that the innovative methods in fact sought to overcome. This research attempts to address these shortcomings and explore how generative methods can bring visual communication to the forefront of a design practice.

2.3 Mediation: boundary objects in co-creation

This section looks at different aspects of boundary objects that are the centrepiece of this research. An overview of the boundary object theory is followed by the notion of design artefacts in the context of this study.

2.3.1 Knowledge structures

Creating and maintaining common ground throughout the project is challenging, especially in multidisciplinary and geographically dispersed teams (Passera 2017 p. 47). We make sense of the environment using cognitive frames. They are like filters that colour how individuals see and interpret the world. And we use cognitive representations to reduce and represent reality—like maps that provide a basis for action. (Zuzul 2019 p. 742)

Poggenpohl (2009 pp. 4–8) characterizes design practice as “a dance that moves between the tacit and explicit”. Tacit knowledge is embedded in practices and personal experiences, hard to verbalize. Explicit knowledge is readily accessed, verbalized, or articulated. Tacit knowledge is best transferred in a codified tangible form for the sake transparency and memorialization (Passera 2017 p. 40). Pikas (2019 pp. 55–57) suggests that the conceptual world of human ideas mediating between individual mental models and material systems is subject to criticism and empirical tests (see Figure 6).

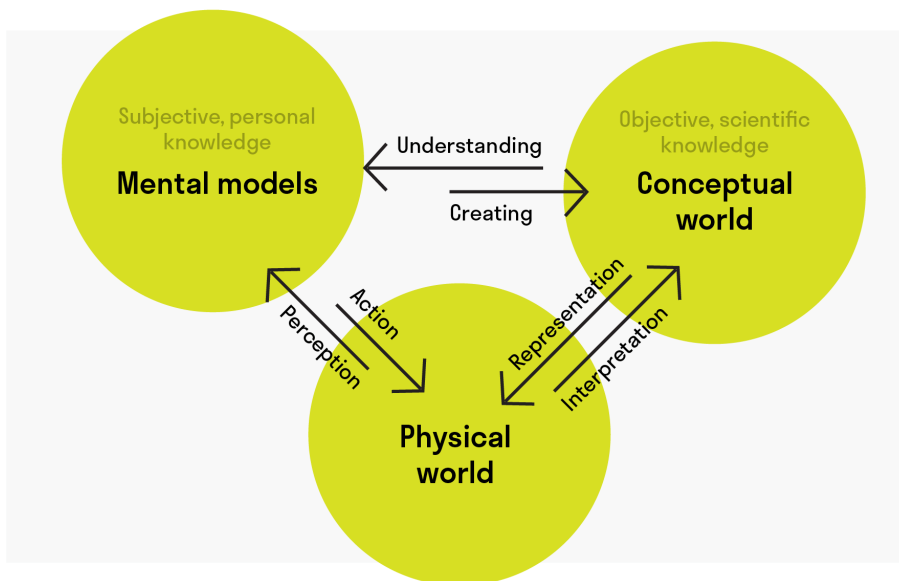


Figure 6. Relationships between the three worlds (based on Hestenes 2006)

2.3.2 Boundary objects defined

The term “boundary object” was first introduced in the field of sociology by Susan Leigh Star in 1989 (p. 393): “Boundary objects are those objects that are plastic enough to be adaptable across multiple viewpoints, yet maintain continuity of identity”. In the field of design, there are many terms under the umbrella of boundary objects sharing similar meanings. This subsection covers two conceptual levels and characterizes the object of this research.

Cognitive representations, visualizations, and prototypes

The modern designer experiments not with the object itself (like a craftsman) but with representations of it (Lawson 2004 p. 31 f.). Actors generate artefacts in ambiguous environments where the meaning, the connections, or the processes are unclear (Zuzul 2019). The complexity is reduced to the trackable characteristics, which take verbal, visual, or physical form—in the shape of cognitive representations, visualizations, or prototypes respectively.

Due to the specialization and ongoing fragmentation in the design domain, there are multiple ways to address these artefacts. Table 3, for instance, presents the classification by design science research (Pikas 2019 p. 45).

Table 3. Design artefacts taxonomy (based on the design science research)

Artefact	Definition	Examples (from projects covered in this study)
Constructs	Constructs make up the vocabulary of a domain. They constitute a conceptualization used to describe problems within the domain and to specify their solutions.	Online knowledge banks, Sales decks, Offer, Contract, Technical brief, Creative brief, Email correspondence, Meeting memos
Model	A model is a set of propositions or statements expressing relationships among constructs. In design, models represent situations as problem and solution statements.	
Method	A method is a set of steps (an algorithm or guideline) used to perform a task. Methods are based on a set of underlying constructs (language) and a representation (model) of the solution space.	Project framework, Timelines and Gantt-charts, Task boards, Meeting slides, Workshops
Instantiation	An instantiation is a realization of an artefact in its environment, that is, the implementation(s) of constructs, models, and methods, demonstrating the feasibility of the conceptual elements that the solution contains.	Mood boards, References, Sketches, Wireframes, Personas, High-fidelity prototypes

Boundary objects

Any artefact can potentially serve as a boundary object. Passera (2017 p. 48) distinguishes the notions of visualizations and boundary objects:

Visualizations often play a boundary object role, and, in general, it is good to remember that boundary objects do not only support collaboration around the solution being created. They also support collaboration on a meta-cognitive level, helping the team keeping track of what they individually and collectively know (and do not know!) and where they are in their innovation process.

And her definition is close to the original one: “[...] a true boundary object offers robust rules for its use and interpretation but also allows different professional groups to flexibly use it on their own terms and for their own goals” (ibid).

Jordan & Henderson (1995) recognize the importance of boundary situations, as well as seamless transitions and hand-offs between participants in collaborative work environments. According to the Communities of practice theory, the shared meaning is developed at the intersections where certain information is used by multiple actors from distinct fields of knowledge (Björklund 2017 p. 54). Boundary objects encourage innovation by providing a common reference point that actors can point to, work with, and manipulate as they seek to combine their knowledge. Doing so can make their implicit differences concrete and can allow them to develop nuanced understandings that are difficult to elicit through verbal depictions or descriptions. (Zuzul 2019 p. 741)

This study focuses on the visualizations serving as boundary objects, although other media were also used during the research (see Table 3). The terms “boundary object”, “visualization”, “prototype” and “design artefact” from now on will be used interchangeably. The objects of this research share the following characteristics:

- they are used in the early stages of the design process;
- enable communication between actors from different knowledge domains;
- help to envision the final solution;
- concretize the differences in understanding and move the process forward.

2.3.3 Role of boundary objects in co-creation

Visual materials enable a meaningful dialogue between “the researcher” and “the researched” by externalizing highly tacit knowledge such as ideas, feelings, values, and beliefs (Passera 2017 p. 43 f.). Creating shared understanding, however, is problematized through the ownership of meaning (socially negotiated perspectives create “an economy on meaning”). Prototypes can act as brokers in this complex landscape by translating, coordinating and aligning the conflicting perspectives. (Björklund 2017 p. 53 f.; Lawson 2004 p. 33)

Björklund (2017, pp. 53–64) and Passera (2017 pp. 41–50) devise similar roles that design artefacts play in co-creation:

- *Affective role.* The artefact helps to tell a story. It serves as an imagination prompt or as a prop evoking empathy rather than a representation of a product.
- *Cognitive role.* The artefact helps in thinking, understanding, and analysing; serves as a communication tool illustrating intangible and tangible knowledge that can influence the decisions about the direction of the project.
- *Collaborative role.* The artefact can be constructed with the stakeholders to help coordinate ideas and goals with others. In this case, it becomes the embodiment of collective knowledge.

Lawson (2004 pp. 33–51) distinguishes eight types of visualizations based on the role they play in the design process: presentation (envision the final result), instruction (brief the developer), consultation (communicate the current state of design), experiential (capture the idea), fabulous (speculative) drawings, diagrams (reductive “thinking” drawings).

Design artefacts can be most useful in the early stages of the development. They encourage “hands-on experience”, everybody has the competence to modify them, and they are cheap to produce. (Ehn & Kyng 1991 pp. 172–173) The malfunction of a prototype is distinguishable from malfunctioning of the design, which allows focussing on the task rather than analysing objects and relations (Ehn & Kyng 1991 pp. 181–183).

Visualizations are helpful in managing creative projects, which often have to deal with uncertainty: multidisciplinary, geographical distribution, ill-defined briefs, and a lack of knowledge as to what a valuable, desirable final outcome should be. (Passera 2017 p. 49) Artefacts serve as documentation and help to trace back the decision-making process (Vaajakallio 2012 p. 208).

Zuzul (2019) introduces a critical approach to the boundary objects in innovation and raises the topic of the divisive nature of boundary objects. She witnessed divergent cognitive representations shaping incompatible ideas and leading to disappointing material outcomes. Leisti-Szymczak (et al. 2013) noticed that working with clients quite often appears to pose a threat to the designer's professional identity. Clients may at times restrain designers from actualizing the fundamental principles of their profession.

2.3.4 Creating digital artefacts with design assets

Ehn & Kyng in their research (1991) imitated computer screens and interfaces with boxes and paper. At the dawn of personal computing, using digital technology for early prototyping was rather challenging and limiting. Today the tables have turned, and even paper prototypes are being digitized before being tested. A vast array of digital design tools are available on the market. Below are the products used for producing and handling the boundary objects of this study.

- Sketch—designing layouts
- InVision Prototype—turning layouts into an interactive prototype
- InVision Boards—collecting and curating images for the mood board
- Trello—interactive imageboard for the design experiments
- Typeform—questionnaire tool (allows images as answers)

As Frost (2016) puts it, “Each screen isn’t a special snowflake, but rather part of a big, interconnected system”. Pre-designed components of a design system serve as out-of-the-box building blocks that are used when designing a new product. The described approach is still relatively new. And as it gains popularity amongst practitioners, the academic sources are still very scarce.

3 RESEARCH FINDINGS

The visual “blocks” (as well as the rules on combining them) that are used to build new products constantly evolve as the business matures. Therefore, design assets can serve as artefacts containing encrypted knowledge about the product and the brand. This information can be extracted through design interventions, where the designer gathers knowledge and aligns the perspective with the stakeholders. After the shared understanding is reached, design assets become a boundary object that is used for constructing new boundary objects using design assets as a starting point.

Through the iterative process of empirical experiments and reading I attempt to consolidate my own design practice by enhancing the described framework and testing the hypotheses stated in chapter one. The suggested framework is merely an attempt to model the process, not an action guide.

3.1 Case studies: data collection and analysis

This section discusses altogether five cases. Phase one covers four sessions with four different clients. The final result of each project is a corporate website. Even though the clients’ business domains vary, all projects followed the same framework, and have a similar scope. The organizations will be named #1, #2, etc. for the reason of confidentiality. Phase two includes a longer in-house project Case #5 with the similar outline. Careful attention has been paid to the relevancy of the revealed information; some words have been replaced with more general terms.

The material was collected from July 2018 to October 2019. The design experiments vary in length and intensity while sharing similar settings and the focus on stakeholder engagement in co-design (Figure 7).

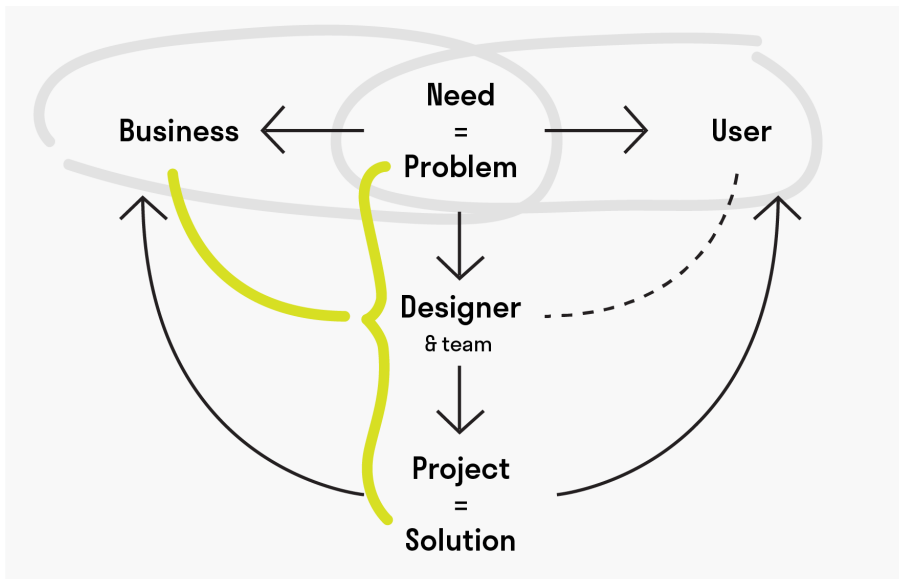


Figure 7. Design project ecosystem and the stakeholder engagement

Sanders & Dandavate (1999) write about “emotional toolkits” and “cognitive toolkits”. The former is used to create artefacts that tell us a story of feelings and aspirations, the latter result in artefacts presenting cognitive models revealing relationships between system components.

Each project commenced with a kick-off meeting. The introductory sessions were co-creational in nature and followed the same structure: identifying business goals, discussing the target audience, and sketching out the final solution. For the last part two types of boundary objects were used:

1. Wireframes to define the website’s structure (cognitive tool)
2. Imagery to define the look and feel of the website (emotional tool).

Both artefacts helped to kick start the web design process. Wireframes define the skeleton and the scope of the project (number of pages and elements). Imagery-based exercises help to grasp the personality of the company. These tools facilitate exchange between designers and people who experience products. It is a design language for users, not just for designers. (Sanders & Dandavate 1999 p. 4 f.)

In order for the meeting to be effective, preparational work was done beforehand. The workshop materials were prepared based on the project specifications communicated through other media (such as email correspondence, meeting memos, briefs, offers—see Figure 8 and Table 3). For the sake of focus and clarity, we will concentrate on the two aforementioned artefacts, acknowledging the supporting artefacts only briefly.

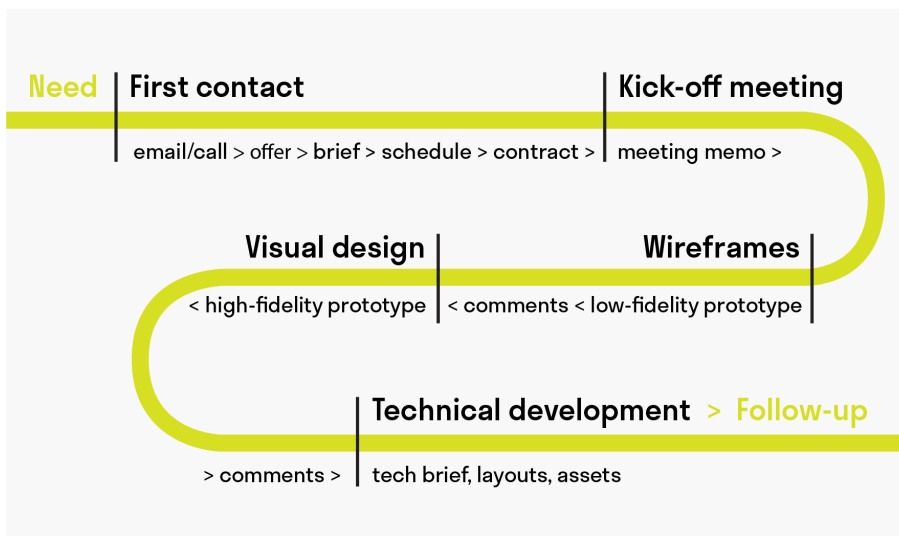


Figure 8. Design process and design artefacts (Cases 1–4)

Knowledge can be constructed not only through an analysis of *artifact data [sic]*, which is produced as end results, [...] but also from the process in which the method is carried out, especially when the conduct of the method unfolds interaction with the participants in the study. [...] This view implies that innovative methods allow designers and researchers to adopt a sensitive framework and design intentions when dealing with the interpretation. (Lee 2012 p. 68)

Similarly to the data collection, the analysis unfolded over time as the new cases emerged and the projects progressed. Field notes and design artefacts represent the empirical data. Each case description includes a structured summary in accordance with the action research steps (excluding the commonalities mentioned in the previous chapters):

- planning (project overview, existing design assets, participants involved),
- intervention: observation and analysis (structure discussion and design experiment),
- learnings for the following case.

3.1.1 Case #1

Planning

The first case comprises a project for a newly established attorney office. The brief served as a starting point for the functional solution, and the logo was the only available visual asset. Due to the small budget, the resources had to be distributed very efficiently based on the client's needs and wishes discussed at the kick-off meeting. Participants: business owner (male, mid-30s), his assistant (female, late 20s), designer (researcher), and project manager.

Intervention

The website structure was sketched in the meeting together with the client (Figure 9). Many aspects were defined by the brief, although some of them had to be revisited after the client delivered the design assets. For instance, the brief suggested the spinning animation for the logo, which was impossible due to its shape. This is an example of the client's and project manager's perspectives coming together in a boundary object "brief" and then being corrected with the help of the boundary object "sketch" constructed with the designer.

For the first exercise "What type of ... are you?" normally a set of open-ended questions would be asked (e.g.: What type of car are you?). Expected answers sound something like "a hybrid car because we value sustainable solutions". It was decided to introduce the visual component to this exercise. Based on the design brief, three images for each of the following categories were selected: animal, house, hand watch, shoe. Each of the images in a given category represents a particular quality (for example, traditional, functional, cutting-edge). The combination of the non-verbal cues gives an idea about the desired company image. The client's interpretation of metaphors is an important element of the activity. Individuals' histories determine what features of the environment they notice and include in their mental maps (Zuzul 2019). Design opportunities and solutions are not revealed by observing, there is a need for active data processing and reflection (Vaajakallio 2012 p. 196).

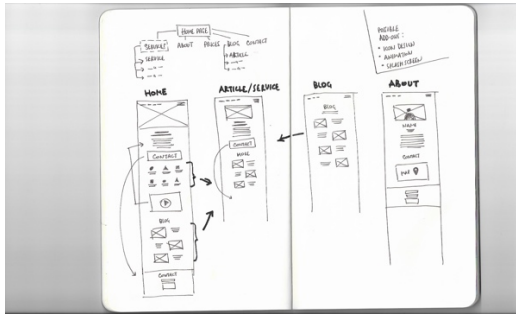


Figure 9. Sketch of a website's structure (Case #1)

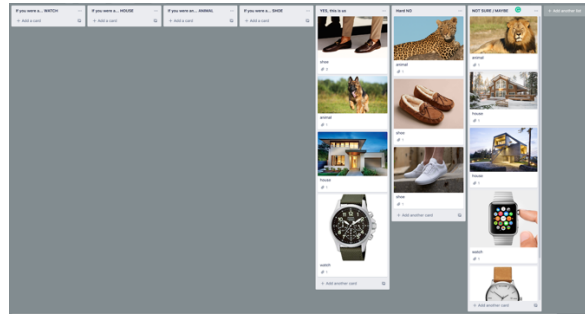


Figure 10. Screenshot of a completed exercise (Case #1), tool: Trello

Learnings

When going through the brief, it is important to manage expectations about what is going to be taken to the next phase. What was negotiated by the client and the manager, may not necessarily be possible to implement. Lawson (2004 pp. 21–30) mentioned the brief being too specific as one of the creative issues. All the evidence in his study supports the notion that designers want the client to begin the process without preconceptions about the nature of the solution. Granting all this, digital design follows a much more agile iterative pace, encouraging the end product taking shape as soon as possible.

Even though the tool (Trello) was easy to use, the exercise itself was unfamiliar and strange. I had to explain it twice and do a demonstration, verbalizing every move. We completed the exercise together (see Figure 10). The challenge of this experiment is the lack of a common level of abstract thinking and semiotics. Reading into the symbols and meanings brings unnecessary in this timeframe level of complexity. Any experiment would have been challenging because the client had no earlier attempts to pinpoint the company's identity.

“The process of building various representations employs participants' perspectives and conceptions, but at the same [time] becomes more than just the sum of these perspectives and conceptions” (Vaajakallio 2012 p. 196). As Lee (2012) noted, generative method should support design without presumptions. Conducting the design experiment helped to look beyond the facade (one of the oldest professions, formal attire and way of communicating). The daring spirit was later reflected in the visual language that can be described as classic with a twist.

3.1.2 Case #2

Planning

Case #2 had a bigger budget than the previous project. That allowed to allocate more time on preparation and design. The brief defined the preliminary structure and some of the brand attributes (logo, typeface, accent colour). Nevertheless, there was no information about the company's culture and brand. The business domain (mergers and acquisitions) was unfamiliar to me, and I spent significant time to learn about the trade and sketch out some ideas. Simple wireframes helped to externalise the mental image of the company and the services it provides. Later the sketches were presented in the meeting to a mixed group of three people (early 30s and mid-40s).

Intervention

The printed wireframes (Figure 11) helped a lot to both me and the client. We could point to the elements to establish interconnections and make notes. The client took their copy with them when they left. To support the discussion about the website's architecture we formulated the user personas. Envisioning the potential users of the future website helps to empathise with them and keep them in mind when making design decisions. The client is presented with twelve portraits of diverse demographics. Looking through the printed cards takes some time before the client finds the right ones.

For the second design experiment (Figure 12), I stripped the images of meaning and didn't sort them by categories. They were placed in a random order but represented polar sensations, e.g.: an icy landscape and a warm seashore. The images were chosen based on the preliminary analysis of possible colour schemes, and the existing logo geometry.

Rather than building common ideas, the actors agreed to decisions that would allow them to move on with the project. Sometimes settling for a decision can lead to disappointing results (Zuzul 2019). The client was committed to the basic system typeface, which significantly limited the means of expression. In this case, a satisfactory compromise was found later thanks to bringing it up in the meeting.



Figure 11. Wireframes (Case #2), file for print

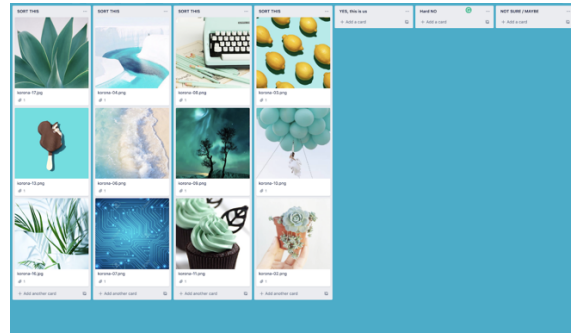


Figure 12. Screenshot of an unfinished exercise (Case #2), tool: Trello

Learnings

Client's experience significantly impacts the design process (Lawson 2004 pp. 21–30). Once again, it was hard for the client to think abstractly. They saw the images not as something that can potentially represent their identity but tried to find a direct application. It seems that the ability to operate abstract design concepts depends not only on the academic and professional background but also on the age. Younger participants were more prone to elaborate on the given visual cues. The simplicity of abstract photos was confusing for the subjects. With the familiar colour palette, and the meaning detached, there was nothing for the client to grab onto. Also, the affective role of the visualization got mixed up with the cognitive role (Passera 2017 pp. 41–50). The used artistic imagery appeals to the participants' emotions when it is supposed to represent the company brand in the eyes of their users.

It was difficult to operate a drag-and-drop interface with this large group of people. Older participants struggled to use the touchpad. Younger people hesitated to speak before their superiors.

3.1.3 Case #3

Planning

Case #3 is defined by the friendship between the agency's CEO and the client (minimal budget, limited resources, friendly atmosphere). The business is newly established by two athletes (male, late 20s), the only assets are the company name and some photos.

Intervention

The structure of the landing page was sketched in the meeting (Figure 13). The design experiment (Figure 14) had to be adapted to the short meeting. I selected compositions, through which several visual preferences can be identified at once. The selected images can be dissected into visual elements, such as colour scheme, typographical language, composition.

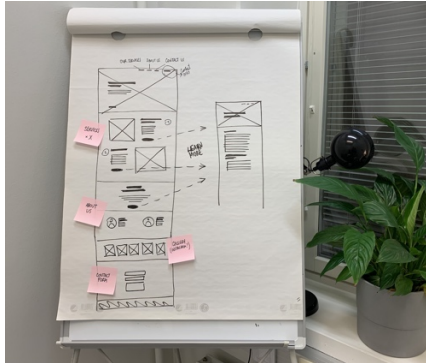


Figure 13. Sketch of a website's structure (Case #3)

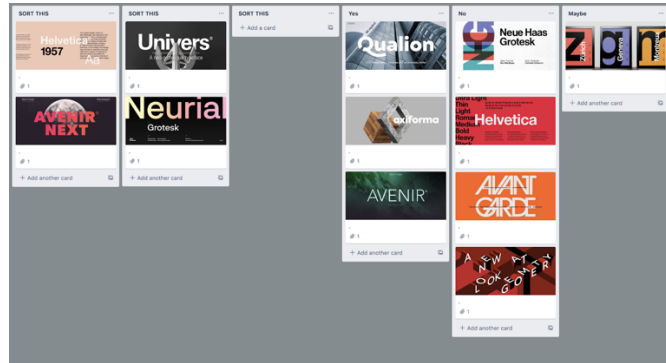


Figure 14. Screenshot of a completed exercise (Case #3), tool: Trello

Learnings

In retrospect, the use of the mixed media was quite successful. However, temporal pressure can leave actors with little time or interest in exploring multiple meanings and interpretations (Zuzul 2019). The client didn't experience much trouble with selecting appealing images but struggled to identify the likeable qualities in them. Interestingly, the junior designer that worked on the project also did not understand my intent. In the future, more attention will be paid to communicating the purpose of the exercise.

3.1.4 Case #4

Planning

This project is on the upper side of the budget scale. I had a chance to plan a longer meeting (with two design experiments). Participants: three decision-makers (financial sector, male, late 40s – early 50s), and a younger member of the team (male, mid-20s). The project was executed by another designer with my supervision. This time around I prepared an elaborate design brief for her. In addition to the assets provided by the client (verbal brief, logo, colour palette), I planned to include the report on two design exercises

tested earlier. For this project, I modified them so that they are clearer for non-designer actors and faster to complete.

Intervention

The pre-designed variants of the structure were discussed in the meeting (Figure 15). Having a set of reusable digital elements detached from the brand-specific attributes makes it quick and easy to sketch the ideas even before the first meeting with the client. This work does not take much time and pays off.



Figure 15. Sketches of a website's structure (Case #4)

The metaphor exercise took the form of a quiz (Figure 16). Each option had both an image and a textual label. That allowed to go through the questions quickly and spend more time on discussing the choices.

The “Gut test” exercise helps to jumpstart the design ideation phase. We looked at nine inspirational websites. They were scored by the client based on the gut feeling (Figure 17). Then we discussed the designs from the top and bottom of the list (similarly to Case #3: what did you like in this solution and why?)



Figure 16. Quiz report (Case#4), tool: Typeform

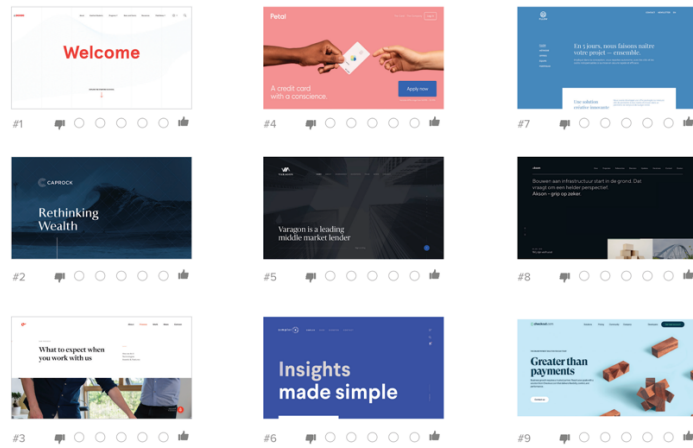


Figure 17. Score sheet for a “gut test” exercise (Case#4), file for print

Learnings

The clients from conservative sectors tend to neglect their brand. They prefer to use words like “traditional”, “classy” without providing any visual references or room for experimentation. It is very challenging to find any modern references that would appeal to such clients.

The previous case proved to be a success, as it gives an idea not just about the personal aesthetic preferences, but also about the cultural context the participants want to be associated with. Decoding the visual language together with the client makes the process more collaborative.

3.1.5 Case #5

Planning

The last case of this research took place in a different environment (due to the change of the researcher’s employer), although following the same framework. As an in-house team, we shared the responsibility for the project. In this case, there was no single decision-maker, and I had to explore more collaborative approaches. Also, due to the bigger company size, it is no longer possible to associate the business representatives with the brand. The company identity has to be constructed with the target audience in mind.

Starting point: brand assets (logo, typeface, accent colour), existing digital products built with the design system (website, mobile application, internal tooling).

Intervention

The website content produced over the years had to be restructured. The absence of the brief leaves a lot of room for interpretation. I completed an inventory of existing pages, content blocks and UI elements. Structural changes were presented in the form of digital and printed wireframes. Both were open to commenting.

In parallel, the digital customer personas are open to reviewing and commenting (Figure 20). The digital format is not limited by the selection of the printed photos used in Case #2. The format of the board also allows pasting other images and texts in addition to the predefined format of the customer profile.

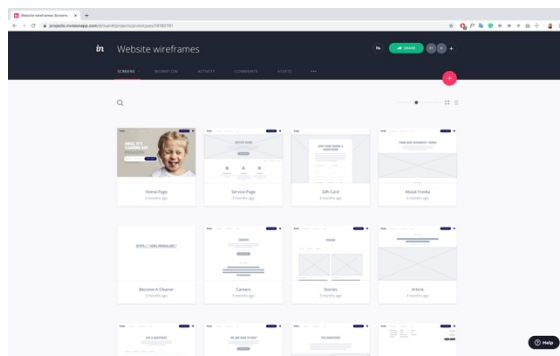


Figure 18. Digital wireframes (Case #5), tool: InVision

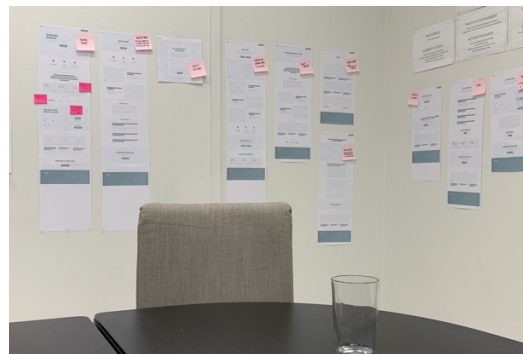


Figure 19. Printed wireframes (Case #5)

To address the visual language, it was important to distance the personal preferences of the team from the end-users'. Customer personas helped to crystallize the vision. The existing personas were enriched with personality traits and imagery representing the lifestyles. They were shared company-wide and open for commenting.

Then everyone was invited to add images to the digital mood board. Those images were later divided into categories (look and feel, photo style, illustration, typography, colour palette) and curated. Attached is a heavily trimmed version on the mood board.

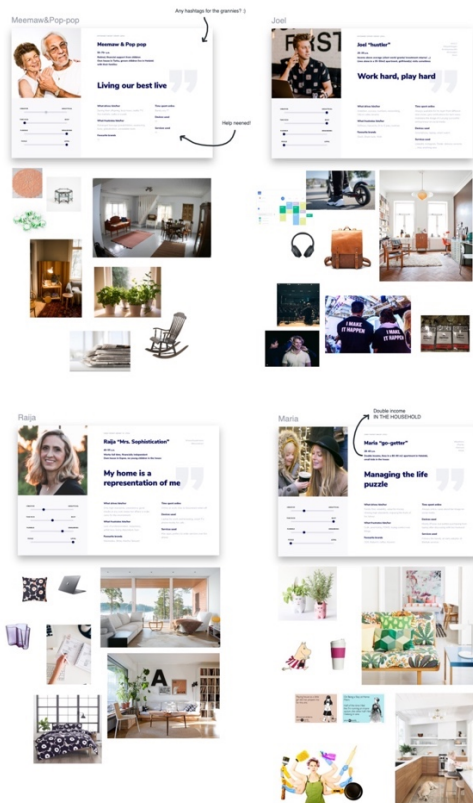


Figure 20. Customer personas (Case #5), tool: InVision

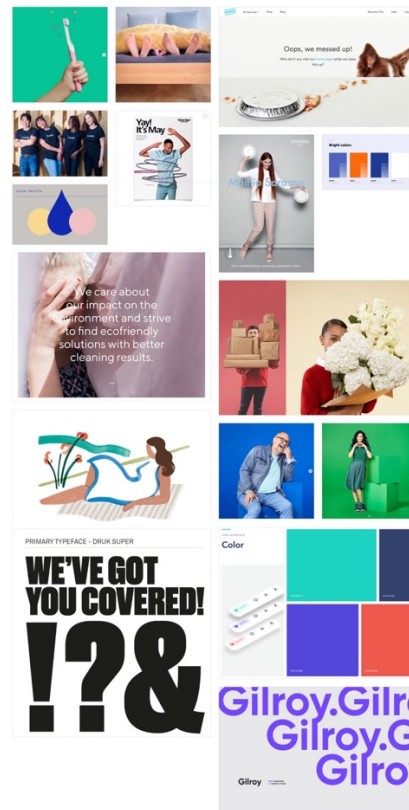


Figure 21. Curated mood board (Case#5), tool: InVision

Learnings

Varying degrees of coherence obtain both at different stages of the enterprise and from different points of view in the enterprise (Star & Griesemer 1989 p. 392). Communicating uncertainty at the beginning of the design process can be a problem (Lawson 2004 p. 37), especially for the prototypes using familiar assets. On one hand, they are a solid starting point, on the other, it is a legacy product that can be distracting. The team is reluctant to change, all the improvements have to be introduced incrementally and approved by various stakeholders.

Working shoulder to shoulder with the client has a major upside: possibility to collaborate closely. The ecological approach does not favour any one viewpoint; the viewpoint of the amateurs is not inherently better or worse than that of the professionals, for instance (Star & Griesemer 1989 p. 389). Collecting internal feedback on the project can be a lengthy diplomatic exercise when one has to negotiate between contradicting points of view. Choosing the right contributors is very important for collaborative practices. Boundary

objects help to make the design process transparent for the rest of the team. “When you’re translating ideas into something physical, decisions have material implications. You can’t agree to disagree, or try multiple options. [...] You can’t please multiple points of view. You have to make one decision.” (Zuzul 2019)

It seems so that the degree of familiarity with both the format of the exercise and the tooling affects the desire to participate in co-creation. The mood board was widely used by several employees, whereas the customer personas were almost completely ignored. The prototyping techniques should be used on the basis of how well they contribute to creating the illusion of using the future system. The tools may get in a way of the job to be done, changing the focus from the mock-up to the limitations of the tools. (Ehn & Kyng 1991 pp. 184–186)

3.2 Conclusion and discussion

This section first reviews the aim of this study, the research questions and looks at how they were addressed. Next, it summarizes the limitations and suggests the recommendations for future investigation.

3.2.1 Research findings

This thesis contributes to the studies on boundary objects as a collaboration tool in the nascent field of digital product design. The prior research typically covers more mature industries, such as architecture, industrial design, and automotive. Building on the existing literature and the empirical cases, the practical framework for improving the design process was developed. The results show that in the context of this study, introducing a visual aspect in the early stages of digital product design led to the efficient cross-functional collaboration between designers and other stakeholders.

These findings are likely to generalize to small and medium web design projects that often have to be completed within a limited budget and time. This framework was developed to consolidate the researcher’s own design practice. The reader is advised to consider the context of their work before applying these findings.

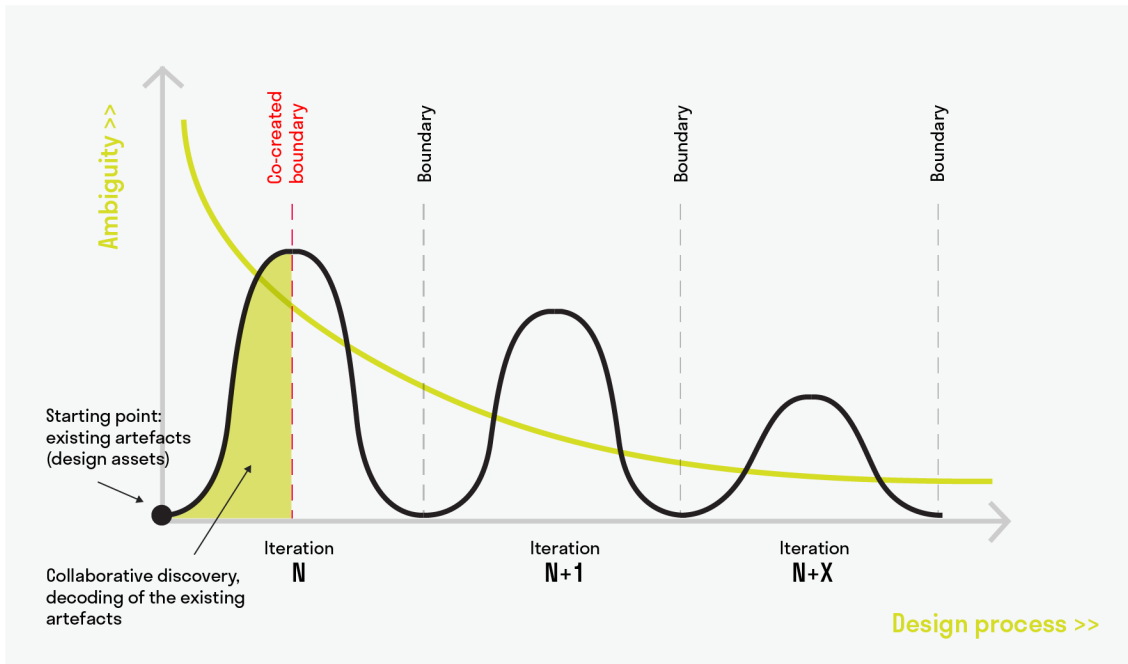


Figure 22. Framework inspired by this research

Regarding the first research question (*What are the repercussions of using the existing design assets as a starting point for designing a digital product?*), the examined cases showed that the maturity of the client’s design assets does not play a significant role for the given project scope. The prerequisites do not affect the workload, as branding is not the main goal of a web design project. Decoding the existing assets proved to be problematic if the actors did not participate in their creation. Therefore, the first project boundaries were shaped during the collaborative exploratory session. And the artefacts chosen in this study proved to be sufficient for this purpose.

We have illustrated how design experiments are a creative process in itself. The actors’ activeness, attitudes, and communication styles were compared during their participation. The result of the interventions always depends on the actors involved, and a great final product results from how the different pieces of the process come together based on a particular designer’s skills and project-specific needs. Below are the observations that help to answer to the second research question (*How does introducing high-fidelity digital artefacts early in the development affect the communication between stakeholders?*).

Shifting between analytical and emotional thinking

Wireframes, being a cognitive representation, were accepted well in all cases. Even though the level of detail was very low, they were perceived as mock-ups for the soon-to-be-developed websites. That gives both sides the confidence of the shared understanding. The following image-based experiments, on the other hand, were always received with resistance. In order to switch from the analytical mindset, the participants had to look beyond the obvious interpretation of images and approach them metaphorically or see them as pure textures and colours. Based on the reception, the level of abstraction was adjusted each time (coincides with the reducing framework ambiguity illustrated in Figure 1).

Embracing the diversity

The motivation to explore a better way of communication between different stakeholders leads to understanding and appreciating the situated nature at the heart of generative design methods. Cross-functional teams acknowledge and make use of the people's situated knowledge in their particular contexts, and a dynamic shaping of products through interaction. Any method is culturally bounded. Lee (2012) distinguishes two ways of dealing with that. Localization approach trusts in portability and the taxonomic view of culture (designing with preassumptions). The generative view on culture suggests designing a context-specific method. This study proves a synthesized approach to be more suitable for a given design practice.

Contextualizing the process

The findings suggest that construction of boundary objects benefits from the excessive commentary. When the designer leads with a simple example, the client feels more comfortable providing their own interpretations. Sending a follow-up memo after a workshop helps to document the decisions made at a project boundary (mainly for business stakeholders) and contextualize the individual contributions to the project.

Smart use of technology

Technology can stand in a way of effortless interaction with the artefact. But making a collage with scissors and glue doesn't make sense, when the digital mood board is so fast and easy to produce, and allows adding high-quality photos, animated images, even font

files and colour swatches. Digital artefacts used to take longer to make. Using modern digital tools for the early boundary objects speeds up the process and helps to envision the end result faster. The challenge is to produce an artefact that still looks like a work in progress but does not take additional time to make it look rough around the edges.

Setting the scene: beyond the artefacts

Artefacts are created to facilitate communication and to help progress forward by narrowing the distance to the final solution. It is easy to fall into the trap of documentation or spending time stating the obvious. Design artefacts are useful when they “make sense to the participants in a specific language game, not because they mirror “real things”, but because of the interaction and reflection they support. A new role for the designer is to set the stage and make it possible for designers and users to develop and use a common situated design language game.” (Ehn & Kyng 1991 p. 180) Being mindful of the people around you is very important—understand and set the roles. In a designer-client relationship, every project appears to be a small-scale power struggle (Leisti-Szymczak et al. 2013). Co-creative activities help to mitigate this problem, and boundary objects create a common perspective by bringing multiple points of view together.

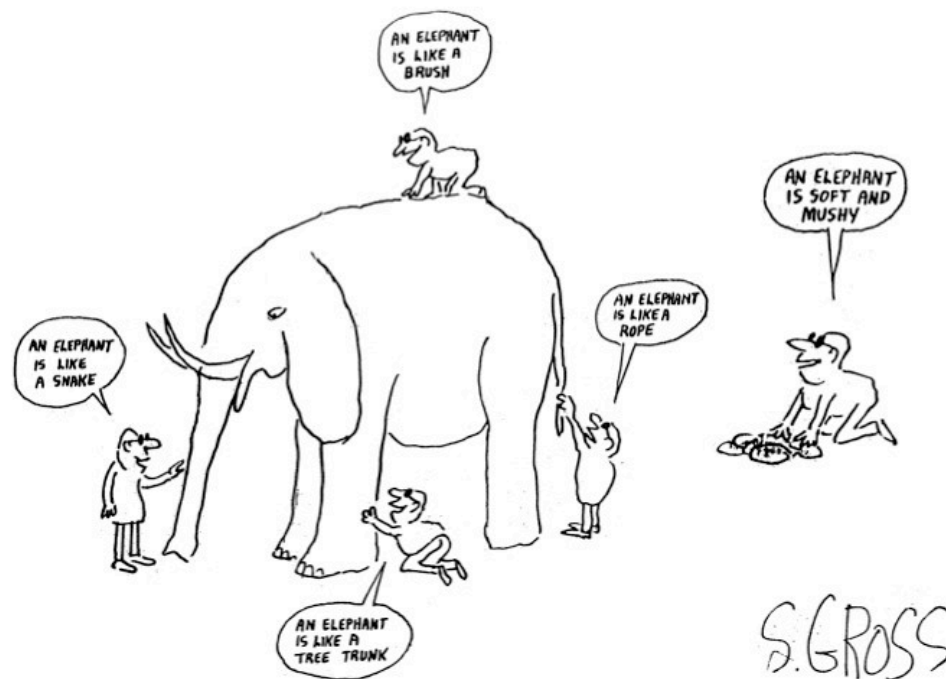


Figure 23. *An elephant is soft and mushy* (illustration by Sam Gross)

3.2.2 Critical reflection and limitations of the study

By employing multiple case studies this research does not attempt any statistical generalization. Systematic combining as a proper case study approach proposed by Dubois & Gadde (2002) has been inspired by the abductive approach. Following that approach makes it challenging to decide what parts of the empirical world to bring into the case. It is difficult to comprehend how a little depth and a little width could contribute to the analysis of any problem (Dubois & Gadde 2002 p. 558).

The experience itself may not be generalizable or portable, as it is acquired over a long period of time and situated in each [...] designer's project experience; nevertheless, documented reflection inspires others to explore new directions of experiments. (Seliger & Hahn Young-ae 2015 p. 26)

Since I was actively involved in the projects, I had to distinguish my own roles as a designer, a facilitator and a researcher. If the researcher guides the situation too much, there is a risk of preventing the emergence of unexpected issues. Nevertheless, there are also positive sides for acting in the double role of a researcher/co-designer, which justifies the involvement. These include the opportunity to utilise personal experiences, as well as pursuing the aims of the study by stimulating the discussion during co-design (Vaajakallio 2012 p. 38).

The conducted experiments are technically quasi-experiments since the researcher had no full control over the independent variables (availability of client work, timing). On the other hand, the constraints of real-life projects guided the design interventions, helping to keep them short and maximize efficiency. After all, one of the most important characteristics of design activity is its situatedness (Lawson 2004 p. 117).

3.2.3 Opportunities for future research

This thesis introduced co-designing with design artefacts from several angles, revealing the practical and conceptual aspects related to them. This research opens up the concept of boundary objects to the digital media context (the prior literature typically covers more mature industries). The developed framework can be considered for managing various media projects. My analysis suggests some directions that can be explored by further studies.

Influence on the designer's creative practice

The focus on short-term collaboration limits the possibilities for seeing the long-term influence of these practices on the maturity of design teams and individual professionals. Each of these experiences further enhances the “guiding principles” of design expertise. Boundary objects become the containers of knowledge and serve as a precedent that other designers can rely upon.

A step-by-step practical guide for applying different boundary objects as a tool and a structure

Although the use of the boundary objects covered in this thesis provides a fruitful ground for designing, discussing and analysing design artefacts in a co-design context, it does not provide a step-by-step action plan. Explicit guidelines were beyond the scope of this thesis. However, a toolkit spanning multiple artefacts in the form of a handbook, a canvas, or a game could improve the design processes in a variety of settings.

Boundary objects in agile teams

Agile development is fast-paced, iterative and cross-disciplinary by nature. The examined boundary objects mostly addressed the “known unknown” issues. How can they help to deal with the unknown issues in the later phases in the development process? Wagenaar (et al. 2015) distinguishes three major categories of artefacts used in agile development: process artefacts, product artefacts, and supporting tools. His study clearly identifies Design artefacts as a separate category. Although, the academic research in this field is still not enough to produce any certain categorisation and terminology.

I have come a long way from the first experiments. As the study progressed, I grew from trusting my creative vision towards making use of the stakeholders' situated knowledge. New knowledge was created, and new questions were raised. For example, the last case revealed the issue of inclusivity when the project team is not clearly defined and the feedback from different sources pours in at different stages of the project. There is much more to learn when it comes to applying co-design in organizations that aim at a sustainable and inclusive society, the direction I would like to go next.

REFERENCES

- Björklund, T., Laakso, M., Kirjavainen, S., Ekman, K. 2017 *Passion-based co-creation*, Helsinki: Aalto University, 251 pages.
- Cross, N., 2007. *Designerly ways of knowing*. Basel : London: Birkhäuser, 138 pages.
- Dubois, A. & Gadde, L.-E. 2002, Systematic Combining: An Abductive Approach to Case Research. *Journal of Business Research*, Vol. 55, No. 7, pp. 552–560.
- Ehn, P. & Kyng, M. 1991, Cardboard Computers: Mocking-it-up or Hands-on the Future. In Greenbaum, J. and Kyng, M. (eds.), *Design at Work: Cooperative Design of Computer Systems*, Lawrence Erlbaum Ass., Hillsdale, pp. 169–195.
- Frost, B., 2016, *Atomic design*, Available from <http://atomicdesign.bradfrost.com/> Accessed 11.8.2019
- Greenwood, D. J. & Levin, M. 1998 *Introduction to action research: Social research for social change*, Thousand Oaks (Calif.): Sage, 274 pages.
- Hestenes, D., 2006, Notes for a modeling theory of science, cognition and instruction, *Proceedings of the 2006 GIREP conference*, 27 pages.
- Jordan, B. & Henderson, A. 1995, Interaction Analysis: Foundations and Practice. *The Journal of the Learning Sciences*, Vol. 4, No. 1, pp. 39–103.
- Korhonen, P., 2018, *Re-thinking design thinking part I: Introduction*, Available from: <https://blog.nordkapp.fi/re-thinking-design-thinking-part-i-introduction-7b914387abc7>, Accessed 28.9.2018.
- Koskinen, I. K., 2011, *Design research through practice: From the lab, field, and showroom*, Waltham, Mass.: Morgan Kaufmann, 204 pages.
- Lawson, B., 2004, *What designers know*, Boston, MA: Elsevier Ltd., 127 pages.
- Lee, J., 2012, *Against method: The portability of method in human-centered design*, Helsinki: Aalto University School of Arts, Design and Architecture, 224 pages.
- Leinonen, T., Toikkanen, T. & Silfvast, K, 2008, *Software as hypothesis: research-based design methodology*, Proceedings of the 10th conference on participatory design, Available from <https://www.researchgate.net/publication/221631202> Accessed 1.4.2019
- Leisti-Szymczak, A., Liikkanen, L., Laakso, M. & Summanen, I., 2013, Let me do my job - Industrial Designer's Experiences of Client Collaboration. *Proceedings of the CO-CREATE 2013 - The Boundary-Crossing Conference on Co-Design in Innovation*, Espoo, 16-19 June, 2013, pp. 445–456.

- Love, T., 2003, Design as a social process: bodies, brains and social aspects of designing, *Journal of Design Research*, Vol. 3, No. 1, pp. 45–54.
- Melles, G., 2008, An enlarged pragmatist inquiry paradigm for methodological pluralism in academic design research, *Artifact*, Vol. 2, No. 1, pp. 3–11
- Murto, P., 2017, *Design integration in complex and networked product development: A case study of architectural design in the development process of a greener passenger ship*. Helsinki: Aalto University, 232 pages.
- Passera, S., 2017, Show don't tell: conceptualizing and sharing abstract knowledge. In Björklund, T., Laakso, M., Kirjavainen, S., Ekman, K. (eds.) *Passion-based co-creation*, Helsinki: Aalto University, pp. 38–49.
- Pikas, E., 2019, *Causality and Interpretation: Integrating the Technical and Social Aspects of Design*. Helsinki: Aalto University, 281 pages.
- Poggenpohl, S. & Sato, K., 2009, *Design Integrations: Research and Collaboration*, Chicago: Intellect, the University of Chicago Press cop., 314 pages.
- Rampino, L., 2012, *Design research: Between scientific method and project praxis: notes on doctoral research in design 2012*. Milano, Italy: FrancoAngeli, 167 pages.
- Raja, L., 2015, *The changing nature of Design, based on Product Development using Design Thinking & LEAN*. Available from <https://www.slideshare.net/Agile-CampSV/lavanya-raja-presentation> Accessed 13.10.2018.
- Rittel, H. W. & Webber, M. M. 1973 Dilemmas in a general theory of planning: *Policy sciences*, Vol. 4 No. 2, pp. 155–169.
- Sanders, E. B.-N. & Dandavate, U., 1999, *Design for experiencing: New tools*. Proceedings of the First International Conference on Design and Emotion. Delft University of Technology, Delft, Netherlands, pp. 87–92.
- Seliger, M. & Hahn Y.-A., 2015, *Thesis design. Research meets practice in Art and Design Master's Theses*, Helsinki: Aalto University, 147 pages.
- Star, S. & Griesemer, J., 1989, Institutional ecology, 'translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39: *Social Studies of Science*, Vol. 19, No. 3, pp. 387–420.
- Vaajakallio, K., 2012, *Design games as a tool, a mindset and a structure*, Helsinki: Aalto University, Unigrafia Helsinki, 241 pages.
- Wagenaar, G., Helms, R., Damian, D. & Brinkkemper, S., 2015, *Artefacts in Agile Software Development*. Available from https://www.researchgate.net/publication/314582891_Artefacts_in_Agile_Software_Development Accessed 12.10.2019.
- Zuzul, T. W., 2019, "Matter Battles": *Cognitive Representations, Boundary Objects, and the Failure of Collaboration in Two Smart Cities*. *Academy of Management Journal* 2019, Vol. 62, No. 3, pp. 739–764.