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Design capability in a software SME: Report from an embedded design innovation catalyst

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Recent studies on the added value that design provides to firms has led to widespread interest amongst the business community to develop design. However, knowledge of how organizations of varying industry types actually make use of design to generate competitive advantages remains limited. This study investigates a small- to medium-sized enterprise (SME) software firm that had recently taken steps to develop design capability[1]. The Dutch firm, titled *CM,* identified a need to increase design capability as a source of added competitiveness. During a six-month period, a design innovation catalyst (DIC) was embedded in the firm to build and integrate design capability across the firm. During the study's duration, the catalyst found the barriers to design capability to be a prevailing data-driven approach to value creation, reliance on self-referential knowledge rather than hypothesis testing with customers and users and a general low urgency to embrace design. The manner in which CM now leverages design as a value creation mechanism is shaped by addressing the opposing barriers to change that were encountered within the firm. This paper contributes practical knowledge on how design can be built quickly over six months and become a vehicle for a software firm to move from data-driven to user-centred solutions.

Keywords; design catalyst; user centred design; organizational learning; software

Introduction

[1] Design capability is defined as an organization's ability to apply design to strategic problem-solve, drive innovation, builds business success that leads to better quality of life through innovative products, systems, services, and experiences (World Design Organization, 2017).

Attempts to capture the added value of design capabilities have been made in the recent past, by listing the categories on which design practices add value to the business (Lockwood, 2007), or by comparing stock price performance between design-centric firms and the S&P500 index (Rae, 2016). On the specific topic of design's value for SMEs the UK Design Council (2012) writes that for every £1 invested in design capabilities, firms can expect increased revenues of up to £20. Despite the growing evidence of added value and attention by policy making institutions (European Commission, 2009), SMEs are often hesitant to invest in design capabilities for a number of reasons, including difficulty in understanding the full potential of design practices (Brown & Martin, 2015; European Commission, 2009), difficulties in understanding a design professional's capabilities (Gulari, Fairburn, & Malins, 2013), and designers' potential difficulty in communicating with business managers (European Commission, 2009; Lockwood, 2007).

In building design capability, an encounter with the existing status quo of an organization occurs. In fundamental social theory a clash occurs first followed by a resolution in which both new idea (being design in this case) and existing status quo are reconfigured to achieve a beneficial outcome (Mueller, 1958). This theory is pertinent as investing in design capabilities can yield significant returns for a firm, as long as the difficulties of adoption are overcome and design practices are embedded into an organization in such a way that is contextually relevant. Without overcoming such barriers, design as a source of innovation within organizations risks being resigned to a perspective or mind-set, rather than a set of an evidence based practices (Dong, 2015). Therefore, contextually specific accounts of how smaller organizations make use of design in relation to barriers to implementation are also required to promote evidenced based practices that represent the broader business community – not just the success stories of large multinational corporations (Muratovski, 2015).

The aim of this paper is to describe and understand how a software SME built and now uses design capabilities within the organization for a six-month period. To do so, the paper first provides account of the existing barriers to CM's use of design. The design innovation catalyst (DIC) actions to overcome such barriers in order to build design capability are then presented. The inquiry is structured through the following three research questions:

RQ[1]: What barriers to the development of design capabilities exist in a software firm?

RQ[2]: How can a design innovation catalyst overcome identified barriers to design, in order to build design capability within a software firm?

RQ[3]: How does a software SME make use of design?

This study adds to an increasing body of knowledge regarding the development and use of design capabilities by embedding a DIC in various organizations. At the base of the DICs work lies their ability not only to bridge the gap between research and practice, but also to move between a learning and teaching position (Wrigley, 2016). This forces the DIC to continuously digest and reflect upon findings in the organization and academia, to inspire his output both in academia and in organization learnings. Recent scholars (Pozzey, 2012; Doherty, 2014; Stevenson, 2016; Nusem, Wrigley, & Matthews, 2017; Price, Wrigley, Matthews & Dreiling, 2015), have focussed on the development of these capabilities in a broad range of industries. This work expands that knowledge by adding a software SME to the collection of industries covered. Furthermore, this study investigates a company operating in the Netherlands experiencing growth, whereas previous studies have been carried out in Australian firms experiencing relative economic challenges.

Software Development and the need for Design Capability

Beyond the profitability of software firms and the economic implications of thriving industries, the rationale guiding this research is the identification that in a digital era the design of software that

fundamentally shape society's form and function must be *good design*[2]. While poor software design (both in UX quality and system architecture) in the past resigned a launched product or service to failure or irrelevance, in the age of artificial intelligence, poor software design will have lasting ethical consequences for human – computer interactions. It must be a priority to ensure software firms and other technology developers translate the potential of technology into value that benefits all users. To do so, these firms must be capable of making use of design. Although Bruun et al. (2014) found that software development professionals can develop design proposals, integrating UX design into agile development methods remains difficult (Plonka, Sharp, Gregory, & Taylor, 2014). Many agile-driven development methods are suited to software development professionals, without considering input from external sources – such as the use case approach (Lárusdóttir, Cajander, Erlingsdottir, Lind, & Gulliksen, 2016). Use case approaches begin from the viewpoint that a system is built first and foremost for the user (Lee & Nien-Lin, 1999). However, at closer inspection of this viewpoint, weaknesses appear.

One of the flaws of the use case is that while the approach focuses on how a technology can solve a user's goal, the way in which a user is framed is easily underpinned by a set of assumptions (Jacobson, Spence & Kerr, 2016; Lorenz, 1993). The user is an actor within the system and often represented through a set of generic set of requirements. Comparatively, design encourages much deeper consideration of the user's desires and emotions in context – well beyond user requirements. Methods of the design discipline are specifically shaped to achieve such an understanding.

Further, many agile software development methods often do not explicitly discuss user experience at all (Bordin & De Angelini, 2016). This leads to differences of perspective within new product development processes (Plonka et al., 2014). Another challenge identified in literature is that software projects often become development-led once the development team was running well, making team members involved in user research feel less relevant (Muñoz, Helander, de Gooijer, & Ralph, 2016). Muñoz at al. (2016) found that design professionals rebrand their activities to be deemed relevant by developers. This indicates the urge to involve users is low for many product development teams and as a result, the user's needs may be overlooked. This practice is also visible in larger software firms that market themselves as having a good user-experience, where 'surprisingly few have adopted usability methods and successfully incorporated these into development practices' (Lárusdóttir et al., 2016). This is a relevant challenge, especially in business-to-business firms, where the customer paying for the system isn't necessarily the product's end-user.

Bringing user-centred design approaches into the realm of software development will be a necessity to complex technologies more human-centred, and therefore easier to understand by users. This creates competitive advantage for an organization in a particularly volatile market. Understanding how software firms adopt and make use of design is therefore of importance.

Research Design and Methodology

Organizational Context

The SME that is part of this study was founded in 1999 and provided the service of sending text messages for marketing purposes for the hospitality and entertainment industry. Over time the company has expanded to a firm with offices in 7 countries in Europe and the Asia-Pacific region, employing over 250 people. The expansion the firm is experiencing has led the firm to undertake a rigorous exercise to define the firms brand identity. This exercise supports the firm's ambition to move from a company selling technical products to a brand that is internationally recognized amongst the world's most 'human' high-tech firms.

[2] Dieter Rams' ten principles of good design.

Design Innovation Catalyst Actions and Data Collection

Over a period of six months, the DIC (primary author) was active in the participating company, CM. In this period, the catalyst investigated the company's existing design capabilities as well as supported the organization in further developing design capabilities by actively engaging the employees in design exercises (Wrigley, 2016; 2017). Table 1 below shows an overview of this research design. The following sections will discuss the methods used in the first and second rounds of investigation.

Table 1 Project timeline

Week	DIC Action	Method/s	Foci
1-8	First round data collection	Semi-structured interview (17), Survey (77)	Understanding the existing state of design capability in the SME
9-17	Engaging employees in design	Generative workshops, management engagements, usability evaluations	Developing design capability within the SME
18-26	Second round data collection	Participant Observation, Survey (79), Semi-structured interview (11)	Understanding the new state of design capability in the SME

First Round of Data Collection

The first round of data collection used a mixed method, consisting of a quantitative survey and a set of unstructured interviews. In total 77 employees from different departments filled out the survey, which was determined to be sufficient based on Barlett, Kotrlik, & Higgins (2001). The survey used was based on Storvang, Jensen, & Christensen's Design Capacity Model, displayed in Figure 1 (2014). The model is an adaptation of the design ladder (Kretzschmar, 2003), allowing the researcher to understand the state of design capabilities in the organization through 5 measures (awareness of design's value, application in the organization, user engagement, innovation drivers, and employment of designers). The survey data was collected on paper and processed using SPSS version 22. The total means were calculated as well as an analysis of variances between departments. The result of this survey can be accessed in Appendix A.

A total of 17 semi-structured interviews were held, all interviewees held different levels of seniority in the company. The topics discussed were the employee's attitudes to design, the methods applied for gathering and processing user insights, New Product Development (NPD) methods used by the company, and the interviewees' attitudes to user engagement in the NPD process. The interviews were carried out in the first weeks of the catalyst's presence in the company. All interviews took place in the company's main office in the Netherlands. The interview data gathered through interview notes that were processed through thematic analysis described by Braun & Clarke (2006)

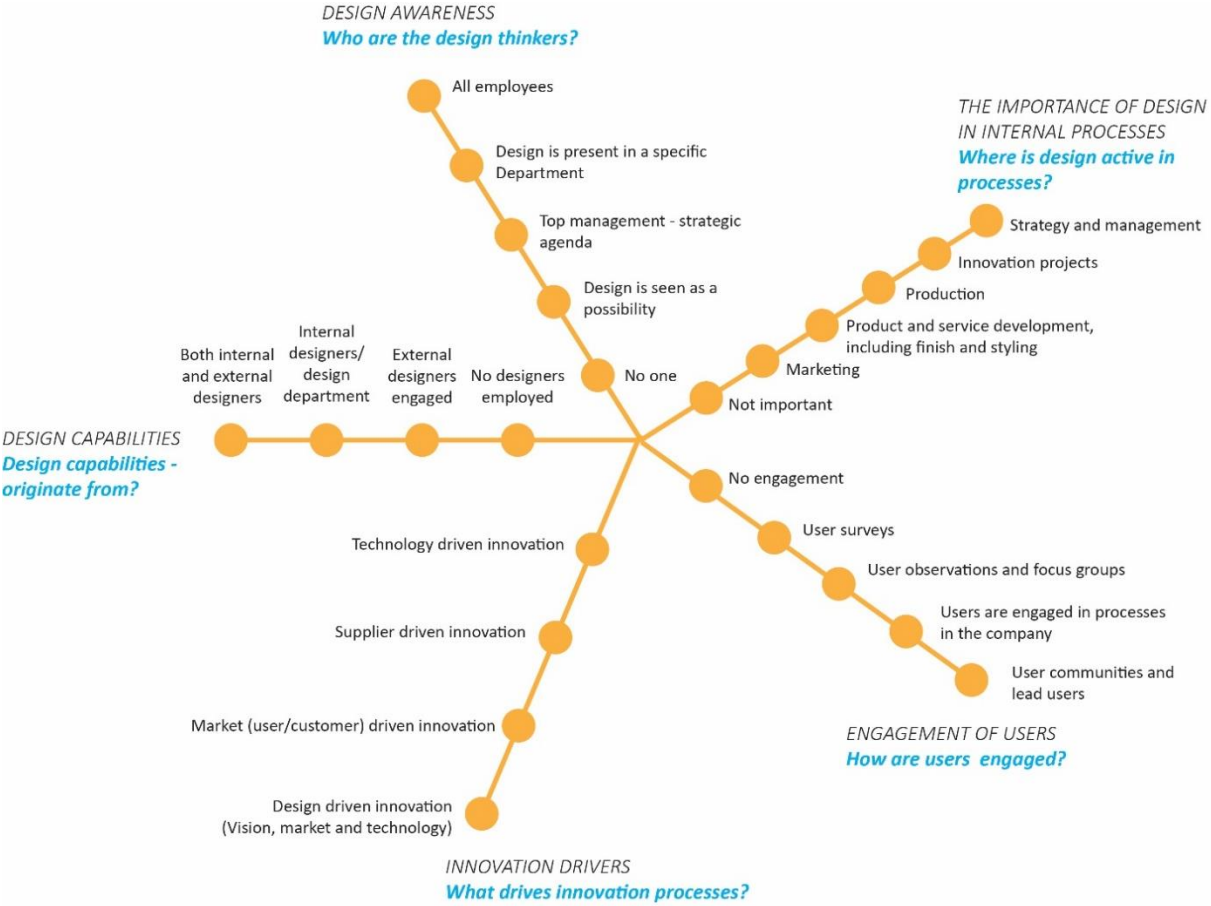

Figure 1 Design Capacity Model (Storvang et al., 2014)

Engaging Employees in Design: Catalyst Actions to Build Design Capabilities

The catalyst's actions in the firm served two purposes. The first was hands-on cooperation with individuals and project teams to work with design tools. These actions were mostly carried out in the form of workshops. These workshops were combined with individual engagements between the Catalyst and internal stakeholders. Figure 2 shows an overview of all catalyst activities over the 26-week presence in the company. Further, Table 2 presents these activities in greater detail.

Design workshops

As noted, during design workshops, the catalyst worked hands-on with a product team or individuals to apply design tools to their products. The emphasis of these workshops was placed on engaging or empathizing with users. For this, the catalyst used tools for usability evaluations, the value proposition canvas, and scenario building.

Stakeholder engagements

Stakeholder engagements were intended to involve employees with a higher level of seniority in the firm in the catalyst's actions, as Pozzey (2012) notes that involvement and approval from higher level individuals strongly contributes to the chances of success. Meetings included conversations with the CEO, the managing director, and the CTO where design was advocated by the DIC.

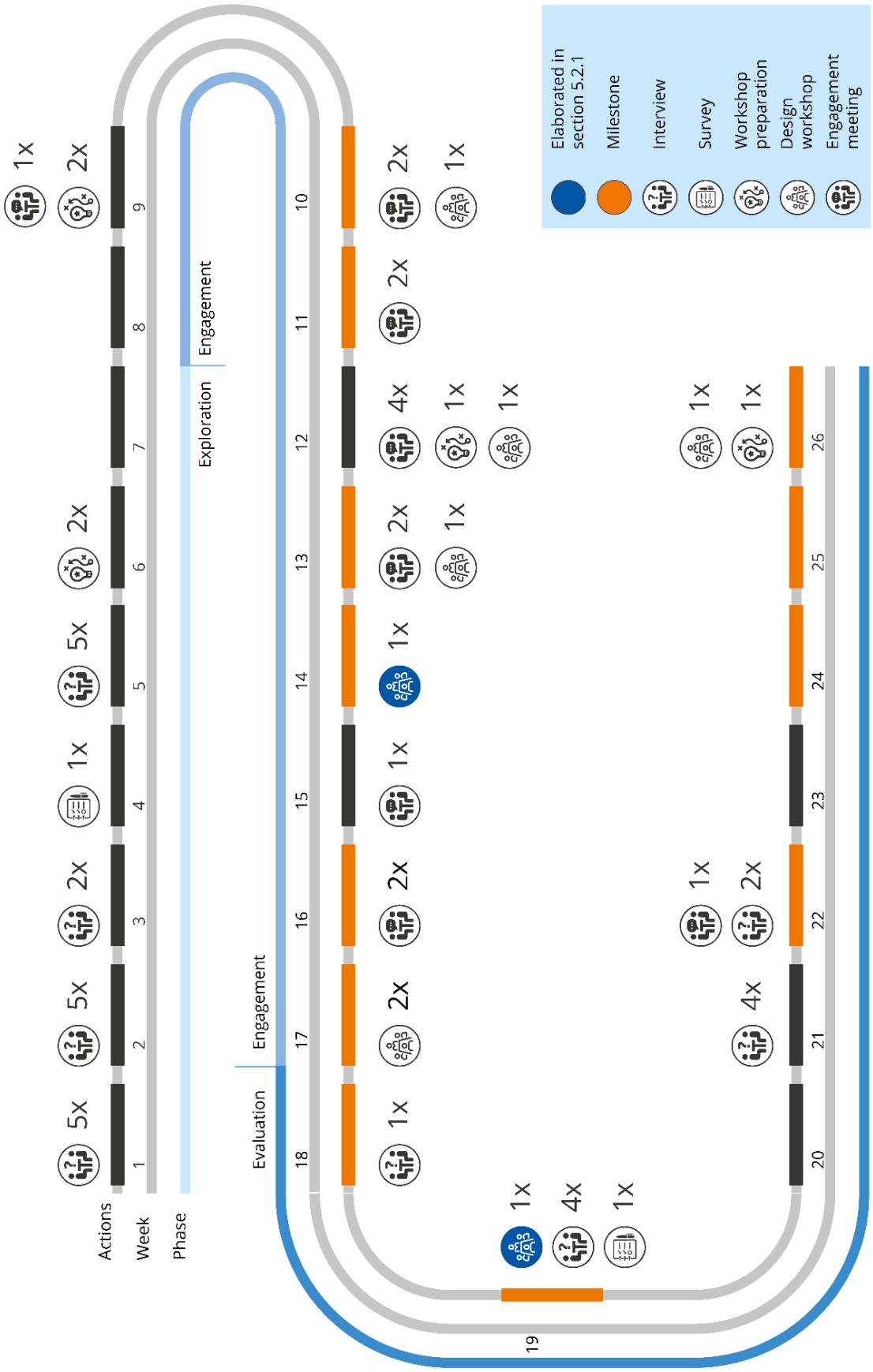

Figure 2 Timeline of design innovation catalyst's activities over 26 weeks

Table 2 Details regarding the activities of the design innovation catalyst over 26 weeks

Week	Activities	Description	Focus
1	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
2	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
3	Interviews (2x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the company culture, understand barriers to adoption of design practices.
4	Survey (1x)	Distributed the first round of the survey. 77 responses were collected.	Explore the way CM perceived its own design capabilities
	Customer visit	The catalyst joined one of the designers to visit a customer that experienced problems in using CM's products (~1 hour).	Discovering the customer's problems and understanding how CM could mitigate these.
5	Interviews (5x)	Interviews to explore the company's culture and approach to product development. (Average length ~1 hour)	Explore the way CM perceived its own design capabilities
6	Workshop preparations (2x)	Together with 2 product managers the catalyst discussed how his work could benefit them (~30 minutes each)	Both focussed on how the team could engage with users to improve usability.
7	Data analysis	Analysing the interview and survey data	Understanding the barriers to adopt design practices that existed in the firm
8			
9	Workshop preparations (2x)	Engagements with a product manager and marketer	Understand how the company could build a more in-context understanding of the product portfolio
	Engagement meeting	Discussed the findings of the data analysis with an employee in the finance department (~30 minutes each).	Find out if he recognized some of the findings done by the catalyst
10	Engagement meeting (2x)	Met with the CMO and a product manager (~30 minutes each)	discuss progress and findings
	Design workshop	Workshop with a product team (1 hour)	Explain benefits of user involvement
11	Engagement meeting (2x)	Presentation to the Marketing team (30 minutes)	Update on progress and findings
		Meeting with product manager (30 minutes)	Build in-context understanding of product portfolio
12	Engagement meeting (4x)	Engagements with 2 marketers, somebody in HR and a product manager (~30 minutes each)	Update on findings. 1 person was asked for feedback on the report
	Workshop preparation	Prepared a workshop with a product manager (1 hour)	Go over the script for the workshop in week 13
	Design workshop	Workshop with a product team (2 hour)	Explain benefits of user involvement
13	Engagement meeting (2x)	Met with product manager (30 minutes) and a financial analyst (1 hour)	Discussed intermediate report with financial analyst, discussed findings with product manager
	Design workshop	Workshop with a product team (2 hours)	Start redesign for the registration of an App
14	Design workshop	Workshop with a project team (2 hours)	Fill out a value proposition canvas
15	Engagement meeting	Met with CM's CTO (~30 minutes)	Find out if he recognized some of the findings done by the catalyst
16	Engagement meeting	Individual meeting with head of software development (30 minutes) Presented progress in weekly meeting of the marketing team (30 minutes, including questions)	Update on progress and next steps.

17	Design workshop (2x)	Workshop with 2 project teams (1 hour each)	Kick-off for DIY usability evaluations
18	Reflective interview	Interview with CM's CMO (30 minutes).	Interview as part of the reflection.
19	Design workshop	Workshop with a project team (1 hour)	Discussed insights from usability tests
	Survey	Distributed the first round of the survey. 79 responses were collected. (full day)	
	Reflective interview (4x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
20	N.a	The catalyst had a brief rest to regenerate energy for the remaining weeks	N.a.
21	Reflective interview (4x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
22	Reflective interview (2x)	Interview with 4 employees, average length ~30 minutes	Interview as part of the reflection.
	Engagement meeting	Met with a senior sales representative (~30 minutes)	Discussed possibilities for Sales – Development meetups for information exchange
23	Data analysis	Processing interview results	Discover changes in attitudes for individuals
24 25	Reporting	Report on the research findings	Make a final draft for proof-readers
26	Workshop preparation	Met with a product manager and a product marketer (~30 minutes)	Prepared workshop for a product redesign
	Design workshop	Workshop with a project team (~1 hour)	Find directions for a product redesign

Second Round of Data Collection

The second round of data collection also used mixed methods to collect data. A quantitative survey and a set of semi-structured interviews were completed. In total 79 employees filled out the survey, which was also calculated to be sufficient according to Barlett et al. (2001). Storvang et al's Design Capacity Model (2014) was again used to make the quantitative assessment, this allowed the catalyst to visualize differences in attitude over the course of the catalyst's presence. A question was added asking participants to list their involvement with the catalyst's work. The survey was distributed as it was done in the first round of data collection. The survey data was collected and processed using SPSS version 22, the results were compared to the data gathered in the first round. The result of this survey can be accessed in Appendix A.

Qualitative interviews were conducted with 11 participants, all of which were also interviewed in the first round. The participants in the second round of interviews were selected for their above-average involvement in the catalysts work. The semi-structured interviews followed an interview guide consisting of three topics, exploring three measures of the design capacity model; the attitude to user engagement in the firm, the organization's awareness of design's added value, and the application of design practices in the organization. The interviews were conducted over a period of 4 weeks in the company's main office in the Netherlands. All interviews except one were recorded. The audio recording was transcribed and combined with interview notes. These were coded through thematic analysis.

Findings

This section introduces the combined findings of the study. The results can be discussed in three main themes reflecting the research questions that structure this inquiry. These findings are; the barriers to adoption of design, how these barriers were overcome to build design capability, and how the company now makes use of design to protect its competitive advantage.

Adoption Barriers to Design

Throughout the first period of the catalyst's embedding in the organization, the catalyst found a number of barriers (visualised in Appendix B) to the adaptation of design practices, the most notable of these include:

- The firm's self-referential approach to product development where internal knowledge was considered valid;
- A low urgency to change given the healthy growth of the firm, and;
- The firm's existing low design capacity with limited designers hired.

The firm's self-referential attitude becomes clear through a lot of interviewees that noted they felt it not yet necessary to engage with users as long as the firm could identify improvements themselves, 'There still is more than enough to do to get all of our 38 products on a decent level' (Marketing). Other reasons why user involvement was not a high priority for the firm included that the firm preferred standardization over customization. 'We must prevent ourselves from doing too much tailor-making for clients' (Software development).

The low urgency to develop design capabilities in the firm was caused by the firm's current growth. The firm's revenue was still growing steadily, and a change might be interpreted that current processes are not effective or valued by the management. The firm's low design capacity meant that designers often had a very fragmented set of tasks and developers had to do a lot of the detailing themselves. 'We now have people for usability; but people are constantly approaching them with requests' (Marketing) and, 'When details are missing from the design, I often fill these out myself' (Software development). Taken together, these results indicate that CM initially had mixed ideas about the added value of user involvement and the role the design professional should play in the organization. Furthermore, the interviews also suggest that there was a growing awareness that the design capacity was insufficient.

Overcoming Adoption Barriers to build Design Capability

The actions that the DIC undertook to overcome the described barriers involved a set of actions that involved both bottom-up engagement with customers, users and developers, and top down engagement with executives and managers. These activities are described in greater depth in relation to each of major barriers identified and include:

- In product development cycles, internal knowledge and creativity was considered valid and sufficient for improvements or new product features. → The DIC demonstrated through workshops that sourcing external knowledge such as customer and user insight can enrich the design and development of software. This involved a bottom-up approach, working with customers, users and developers.
- A low urgency to change given the healthy growth of the firm → the DIC brought to the attention of management, some of the oncoming competitive market forces that were to be expected in the next five years. While the firm was growing now, building design capability was communicated as one way to protect current growth and explore future opportunities that could be the source of the next competitive advantage. This set of actions involved a top-down approach, working with managers and the executive level.
- The firm's existing low design capacity with limited designers hired → the DIC was able to persuade, with the support of direct supervisor, that the company's growth was a great opportunity to change the composition of the organization by hiring more designers. Further, these designers would have formalised into their Key Performance Indicators, a set of actions to build design capability across the organization by for example, conducting workshops and skills training with other employees. In effect, new designers recruited to the

company would continue the DICs role. The DIC would remain involved with the company over this period of transition.

Observations combined with interview data and questionnaire responses show that as a result of engagement with the DIC changed on the level of project teams and individuals. The survey that was conducted and processed did not show any significant effect after 26 weeks of involvement. However, the observed changes in behaviour and attitude was substantial. The changes observed included the mandatory training for all new employees to participate in a usability tests with users and customers. A product manager notes of the effect of these tests, 'Every time I do such a test, I find something new, and I think your presence helped me realize how strong the tunnel vision is when you work on a product' (Product manager). The front-end developer involved in that same project team also acknowledged the DIC's influence on the team's ability to look outside for input on product development. After a workshop on the value proposition canvas, they noted, 'It really helped us what you did in that last workshop, that really helped us get out of the tunnel vision' (Senior front-end developer).

The interview data also show changes in perception with regard to the three interview topics. Especially the attitude towards user engagement in the firm changed strongly. Whereas many argued user involvement to be unnecessary as employees could think of enough improvements by themselves when the catalyst started, interview results from the second round showed changing attitudes and behaviours. *'You see for example in the development of [product] they are involving housing corporations'* (Financial analyst), and*, 'I cannot rely on my gut feeling and say, 'I think this is beautiful and appealing to the customer'. I need a second pair of eyes'* (Product manager). It can also be seen that an increasing number of employees in the firm see design as a tool to improve product usability, rather than a downstream styling tool. *'I think design is thinking about thinking and planning what you are going to do, before actually doing it'* (Product manager).

Following the shift in the definition of design that could be observed amongst those interviewed, the interviewees also saw the role of the design professionals in the organization no longer as merely that of making aesthetically pleasing products, but also of having a responsibility to evaluate usability and develop new value propositions based on customer insights. For example, a product manager notes, *'[they] should ask the right questions I suppose to get the tangibles about what the customer actually means'* (Product manager), and from marketing, *'That also means interviewing users. If they are internal users or really clients of the company'* (Product marketer). These shifts in perception are arguably the result of the catalyst's efforts. They suggest that, as a result of the interactions with the catalyst, people had become more aware of the added value of design to the organization and how user involvement could support product development efforts.

How A Software Firm Makes use of Design

The way in which design is made use of is shaped by the barriers to design identified within the firm. The changed perception was reflected in product teams' behaviours observed by the DIC. The changes in behaviour were reflected along two major lines; managerial behaviours and product team behaviours.

Managerial initiatives to support product development teams.

Based on the awareness created by the DIC's interactions, managers took up initiatives to support the product teams in their processes through actions aimed at increasing design capabilities within product development teams. These actions included; hiring three additional design professionals and to build ties with design consultancy firms to serve as coaches for the designers in the organization and to help create tools that support an in-context understanding of the products, such as customer journeys and personas.

Additionally, the firm's management announced 2018 to be 'the year of design', signalling additional investments in design capacity as well as increased attention to design capabilities over the full breadth of the organization.

Group and personal initiatives to embed design in the product development process.

Product development teams that had been involved in workshops led by the DIC now made design actions a vital part of their development process. Each product team however employed different tools for different purposes.

One product team purchased usability evaluations from an internet-based supplier in order to quickly evaluate the effects of improvements made in development cycles. Another team also employed usability evaluations in order to understand effects of improvements, this team used the steady stream of new employees created by the firm's healthy growth to participate in these evaluations. A third product team with which the catalyst had worked together now used design sprint-like one-day workshops in order to develop prototypes.

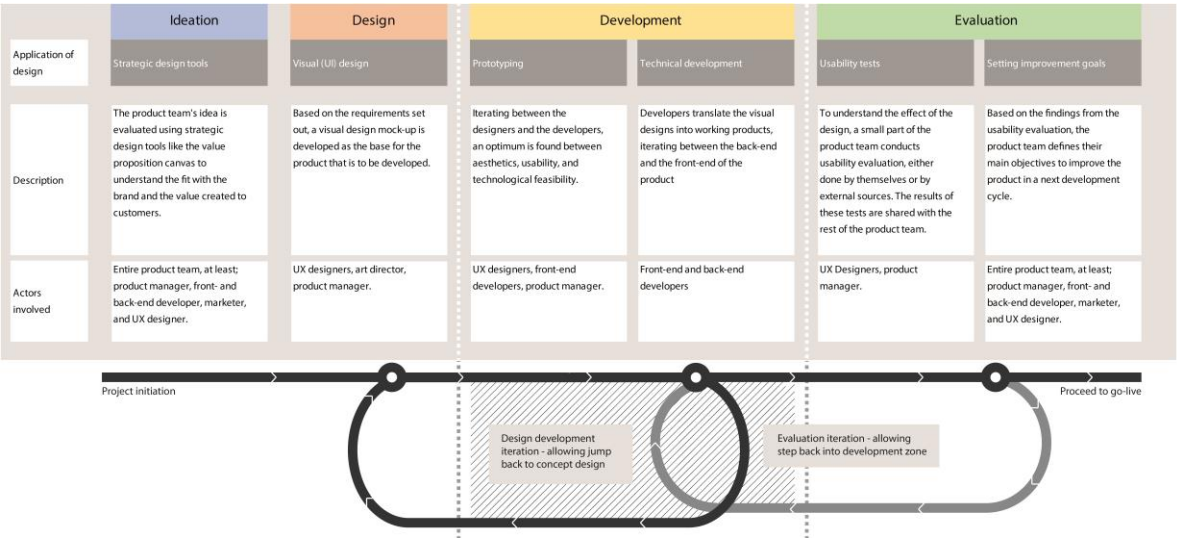

Figure 3: Application of design in the product development process

The way CM now implements design into the product development process can be seen in figure 3 above. A larger version of this visual can be found in appendix C. It shows that the design professionals are involved in all of the stages of the design process, whereas previously they were only involved in an early ideation phase. There are two loops of possible iterations afforded by CM's use of design capability. First, the ability to shift back into a concept phase of design after engaging in software development. Second, the shift back into development after evaluating a design with clients and customers. In both cases, these iterations encourage a software firm to depart from development driven mentality that can be dominant in the development zone (Muñoz at al. 2016). Further, Figure 3 shows how other players in the product team are involved in more designerly actions such as usability testing meaning that design capabilities are not just isolated to 'designers'.

Discussion

The exploration of the firm's design practices indicated substantial differences in the attitudes to design practices between types of people in the organization, where a large part had strong a technology-push view of product development (Verganti, 2008) and a minority of mostly designers and marketers approached product development from a user-centred perspective (Sanders & Stappers, 2008). By the end of the DIC's tenure at CM, it was found that the first group was shrinking

as a result of catalyst actions to raise awareness and build design capabilities, whereas the latter was growing.

In order to overcome the barriers discovered in the exploration phase and build design capabilities, the catalyst engaged with both product teams and managerial stakeholders. A number of aspects were crucial to the success of the DIC's actions. The first was a continuous dialogue with the organization's management as managers may have difficulty understanding the details of a catalyst's work but they are likely interested in the catalyst's work. Next to that, an endorsement by managerial stakeholders helps employees to feel supported in their efforts to experiment with new ways of working. Second, it is important for DICs to engage with employees outside the research scope. The work of a design innovation catalyst also happens outside of workshops and formal engagements through knowledge sharing in breaks. This creates goodwill amongst employees to participate in workshops.

In the case of CM, non-design professionals have taken roles in design actions in order to strengthen the product development process, making all employees a part of the design process. At the same time, the role of the design professionals has been expanded as the perceived value of their work increased over the course of the project. The management's expression to further invest in the organization's design capability and depart from a development driven mindset provides a strong basis for a further integration of design into the business strategy.

The applicability of a DIC in organizations

As developing design capabilities requires habit formation, employees should be engaged with regularly over a longer period of time. The fact that a DIC is embedded in the organization over a longer period supports this. However, in larger organizations, a DIC can't engage with all employees, making achievement of critical mass in the organization more difficult. A DIC is therefore especially applicable in smaller organizations. To larger organizations hiring professional services firms for training and education on multiple moments over a longer time span may be more economical. This hypothesis is an avenue for future research. Another important weakness of the DIC-approach to building design capabilities is that it is reliant on the human dynamics between the DIC and the company's employees. Future DICs should therefore invest in a positive personal relation with employees in the organization, as this will increase the chances employees will be open to the catalyst's proposal rather than opposing them.

Conclusion and Future Research

Design capabilities in organizations can be built if an organization manages to provide substantial freedom to employees to experiment with new ways to approach product development. DICs should combine hands on activities to build capabilities with employees whilst at the same time engaging with managerial stakeholders. Future research could investigate the long-term effects of a DIC to understand what happens after a DIC's presence at the company. This should be based on longitudinal observations of firm and individual actions to embed and employ design capabilities. Furthermore, an overview of barriers to the adoption of design capabilities could be developed. This will help future DICs to understand if the barriers they have found are unique to their organization and find approaches that have proven effective in the past. A final proposal for future research is an investigation of the organizational infrastructure needed to facilitate a lasting implementation of design capabilities to make that design capabilities exist in the entire organization, rather than only in individuals. Existing studies generally pay attention to the professional skills a DIC should poses. But, as the success of a DIC is also reliant a DICs ability to engage employees in the organizations journey to becoming more design-centred future studies could also investigate a DICs personal qualities.

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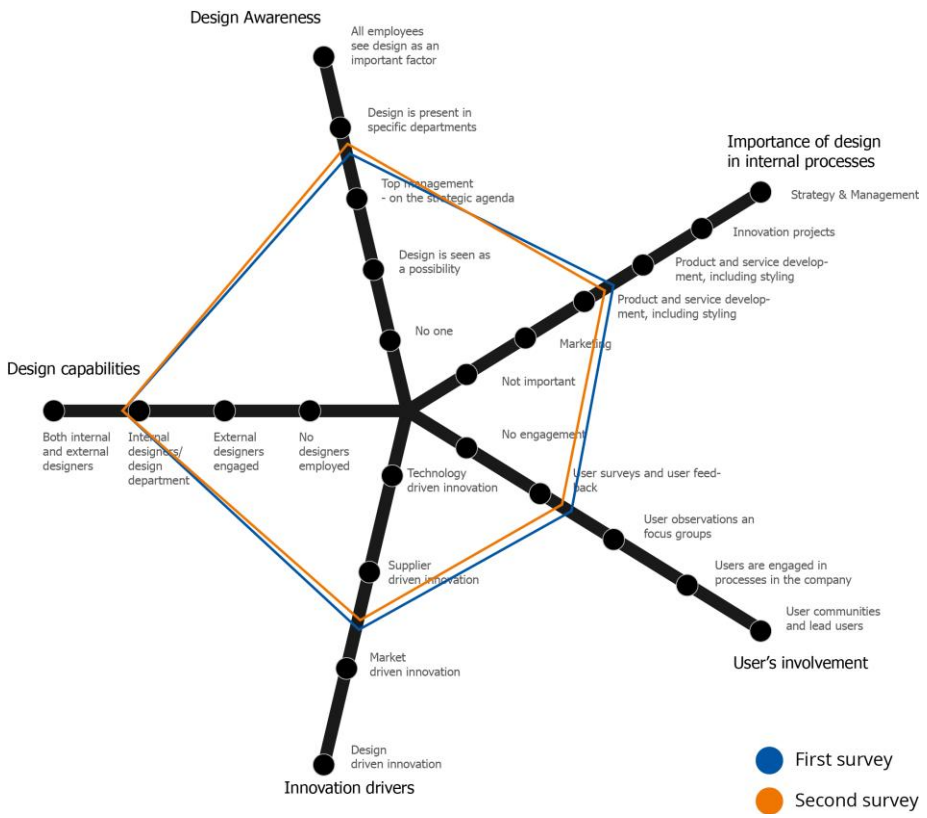
Appendix A

Appendix A: Means for individual departments for the first and second round of the survey

Department	Round	Awareness	Importance	User's involvement	Innovation drivers	Design capabilities
Total	First round	3.79	3.58	2.30	2.53	3.12
	Second round	3.90	3.24	2.14	2.48	3.13
Marketing	First round	3.82	2.64	2.00	1.55	3.36
	Second round	3.88	2.63	1.75	1.88	3.63
Sales	First round	3.80	4.10	2.00	2.40	3.00
	Second round	4.00	3.50	1.80	2.50	3.20
Support	First round	4.13	4.13	2.75	2.75	3.25
	Second round	4.00	3.33	2.00	3.00	3.00
Development	First round	4.04	3.82[a]	2.36	2.77	3.14
	Second round	3.84	3.16[a]	2.16	2.66	3.00
Other	First round	3.30[b]	3.30	2.35	2.75	2.95
	Second round	3.91[b]	3.43	2.43	2.30	3.13

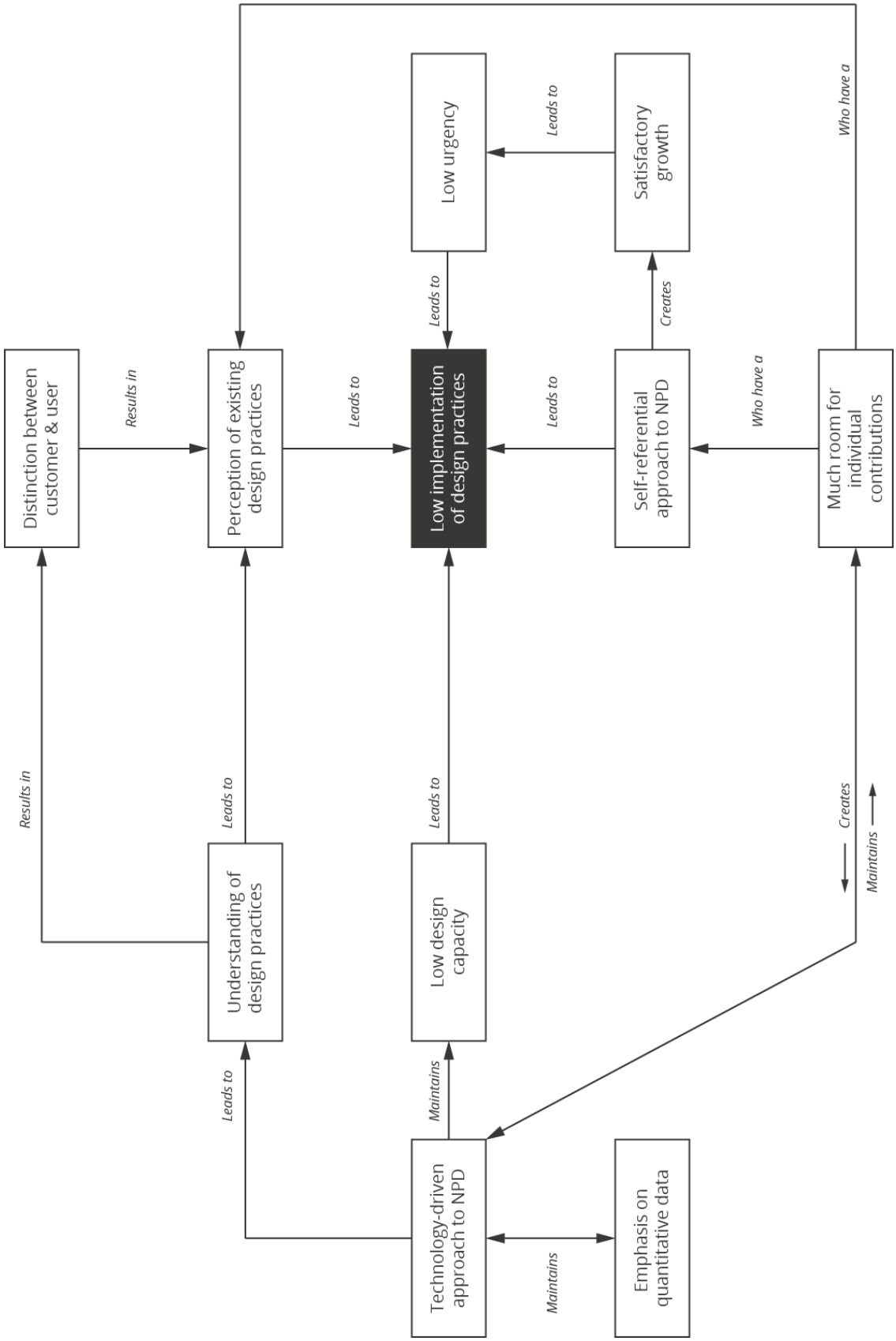
a,b: the difference is significant at the p<0,05 level.



Appendix A: Overall means for the two surveys displayed in the Design Capacity Model. The means contracted in the second round as the knowledge of design increased. The DIC noted this occurred as more stakeholders became aware of the full

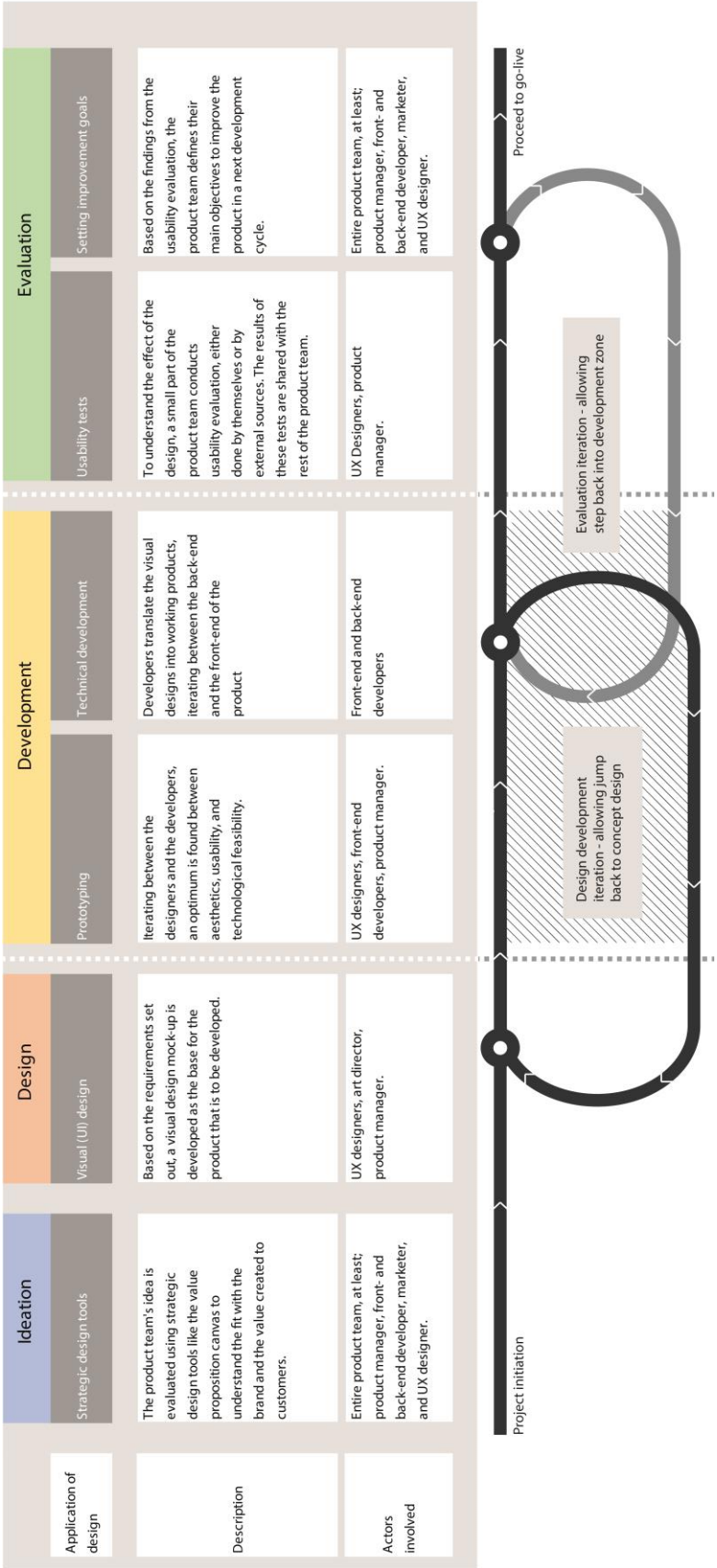
possibilities of design - their understanding of design was self-evaluated. Should the study be repeated, the capacity model should be applied again to raise awareness of design as well as being a technique for collecting evidence of change.

Appendix B



Appendix B: Interactions between the barriers to the implementation of design practices

Appendix C



Appendix C: Application of design in the product development process