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IMPLEMENTING DESIGN THINKING; A CASE STUDY AT EXACT

MSc THESIS

GRADUATION PROJECT
MSc STRATEGIC PRODUCT DESIGN

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We need to collaborate with our customers, engage with them and understand their unique needs and requirements. That will give us insight in all of our roles to do a better job and become even more customer focused.

- Phil Johnson, CEO Exact, internal podcast, 10-11-2017

ABSTRACT

Business is becoming increasingly competitive as companies aim to deliver superior product experiences to their customers. To establish innovative results and compete with smaller, more flexible companies, corporates look for new ways to organize themselves. In the light of these developments, design is moving beyond approach to improve aesthetics, towards a more strategic role in new product development.

The way designers think and act forms the basis of Design Thinking (DT). DT has been introduced in a range of organizations as a problem solving approach that helps teams deliver more innovative outcomes. The concept is represented through cognitive principles, practices, and process steps supported by specific design methods.

Many companies claim to have successfully implemented DT in their organization. Increased innovation is most frequently mentioned as benefit of using DT. Other effects range from reduced investment risk in product development, to increased employee engagement. Anecdotal reports on the value of DT are plentiful but lack detail, for example on the type of innovation output that can be expected. There is still little empirical evidence on the value of DT.

Organizational change, specifically in the innovation domain, clashes with current business processes. Hurdles to implement new management concepts can be expected, but there are no studies that specify how challenges to implementing DT can be overcome.

This thesis describes a case study on implementing DT in project teams at Exact. Exact is a Dutch company with about 1500 employees that delivers business software, with a focus on financial processes, The firm recently founded a new team of internal designers, dedicated to spread DT in project teams. The graduation project is a collaboration between the Delft University of Technology and Exact with the aim to measure design practices and impact and propose focus points to improve DT at Exact.

The study compares projects at Exact that ran during the DT program, with a group of benchmark projects, to track the effects of the DT program on project processes and outcomes. An internal survey was conducted with 43 respondents, evaluating the maturity of the design principles: *user centricity, collaboration, tangibility, ideation* and an *experimental* and *optimistic mindset.*
The survey also included measures for project outcomes. Context specific benefits of design practices were explored through correlation analysis of the design principles and project outcomes. To determine triggers and barriers for project teams to apply DT, qualitative data was collected in eight employee interviews. Common challenges to using DT were prioritized with employees in four sessions.

Most activities in the DT program focused on enhancing *user centricity* or improving *ideation* practices. This led to a significant increase in the perceived user centricity in project teams compared to projects before the DT program, Also users indicated more unique benefits in products that resulted from recent projects. Besides user centricity, other strong design practices are *collaboration* and an *experimental* an *optimistic* mindset.
On the other hand, *ideation* measures scored relatively low and did not improve over time. Organizational barriers, such as subjective scoping and pressured time frames, pose barriers to creating multiple solution options. Also lower scores were found for *tangibility*, which includes visual thinking and prototyping activities.

Multiple positive correlations occurred between design practices and project outcomes. Practices related to ideation showed most positive correlations. Multidisciplinary teamwork and tolerance to failure also showed many correlations, indicating a high impact on project outcomes. The main value of DT in the context of Exact is improved the quality of products and enhanced teamwork. No significant negative correlations were found, underlining that DT does not block planning and budget goals.

Research results are used to design a strategy to improve design practices and their effect on project outcomes at Exact.

Focus points for the short and long term are identifies based on the survey results. Ideation is a focus point on the short term. Due to the low maturity level and high potential value, quick wins are expected in this area. A next step is to invest in increasing impact of prototyping and finally to invest in design as a strategic deriver by creating dedicated spaces and hiring design leaders. These last recommendations are based on an analysis of DT implementation strategies at other corporate firms.

To improve ideation, more detailed recommendations are made on organizational and team level. On organizational level, it is suggested to balance a portfolio of validation and exploration projects. Also, by a-synchronizing research and conceptualization activities with the technical development, more time can be dedicated to DT. For teams, a new standard ideation process is proposed with four steps: *prepare, ideate, concertize* and *select.* Complementary tools are provided to support each process step.

Tho conclude, this thesis work provides insights into the maturity and value of DT in the context of an established software firm. A step-wise approach strengthen DT in the organization is proposed. Other companies can use the measurement tools used in this thesis to identify context specific strengths and weaknesses in design practices and create their own strategy to improve the impact of DT.
The ideation process and tools that are introduced in this project are generally applicable for firms that wish to enhance diverging and converging abilities in new product development.

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TABLE OF CONTENTS

READING GUIDE

Thesis structure

The thesis concerns a case study on implementing Design Thinking (DT).

This report first introduces the project brief, including the research questions and project approach. Following, further contextual information is provided on the concept Design Thinking, and the firm Exact.

After this introduction the three main research topics are explained, including the research methods and results. These topics are:

1. *Measuring the maturity of design practices over time.*
2. *Exploring the value of Design Thinking in the organizational context.*
3. *Defining challenges in implementing Design Thinking.*

As a result of these research topics, a strategy roadmap is proposed for Exact to further develop Design Thinking in the organization.

Finally, reflections are made of the relevance of the project outcomes for other companies and design researchers. The thesis closes with a personal reflection on learnings.

Conclusions are framed in red

Definitions

Key concepts for this thesis are briefly explained.

Design- The creation of a plan for the construction of an object, system or human interaction (Cambridge dictionary of American English)

Designers - People who work professionally in one of the various design areas (usually specifying which area e.g. fashion designer or service designer).

Design Thinking- A human-centred approach to innovation based on the way designers work (Brown, 2008). Design Thinking can be practices by non-designers.

Design practices - Ways of doing that are typical to designers and adopted by Design Thinking (e.g. prototyping and iteration)

Design maturity - The maturity of the design practices, meaning how often and how well these practices are performed.

Abbreviations

UX	User Experience or UX Design
UX-er	User Experience Designer
DT	Design Thinking
PM	Product Manager
PO	Product Owner
PMKT	Product Marketer
SME	Small and medium sized enterprises
BS	Business Solutions (department)
CS	Cloud Solution (department at Exact)
EOL	Exact Online (core product of CS)
ST	Solution Team (multidisciplianry team that works on an EOL package)

1

INTRODUCTION

PROJECT SCOPE AND APPROACH
ABOUT EXACT
ABOUT DESIGN THINKING

1.1 PROJECT SCOPE AND APPROACH

This section explains why the project was initiated, defines the thesis scope, proposes the research questions and methods.

A case study on implementing Design Thinking

This thesis proposes a case study on implementing Design Thinking at Exact. Exact provides business software to Small and Medium enterprises Enterprises (SMEs) and has around 1500 employees globally. At the end of 2016, a new team kicked off at Exact: the UX Boost team. This team consists of four designers and focuses on the implementation of Design Thinking in project teams. Design Thinking (DT) can be described as a user-centred approach to innovation, based on the way designers think and act.

This graduation project tracks the efforts and effects of introducing and improving DT practices at Exact. The project goal is to identify strengths and improvement opportunities. This is translated into an improvement strategy with focus points for the short and long term.

The product has a research focus. Recommendations are based on the analysis of recent projects and a set of projects recently completed in the company. This benchmark group consists of projects that were finished before the UX Boost team started their activities to promote and support DT. By collecting and comparing data on project processes and outcomes conclusions can be made about the maturity level of design practices at Exact and next steps can be proposed to further improve DT. This comparative research approach is visualized in Figure 1.

IMPLEMENTING
DESIGN THINKING

Activities:
What has been done to implement DT?

Activities:
What does Exact need to do next?

PROJECTS
& RESULTS

BENCHMARK PROJECTS → CURRENT PROJECTS → DESIRED FUTURE

MEASUREMENT

Design maturity then   Design maturity now   Perfect score
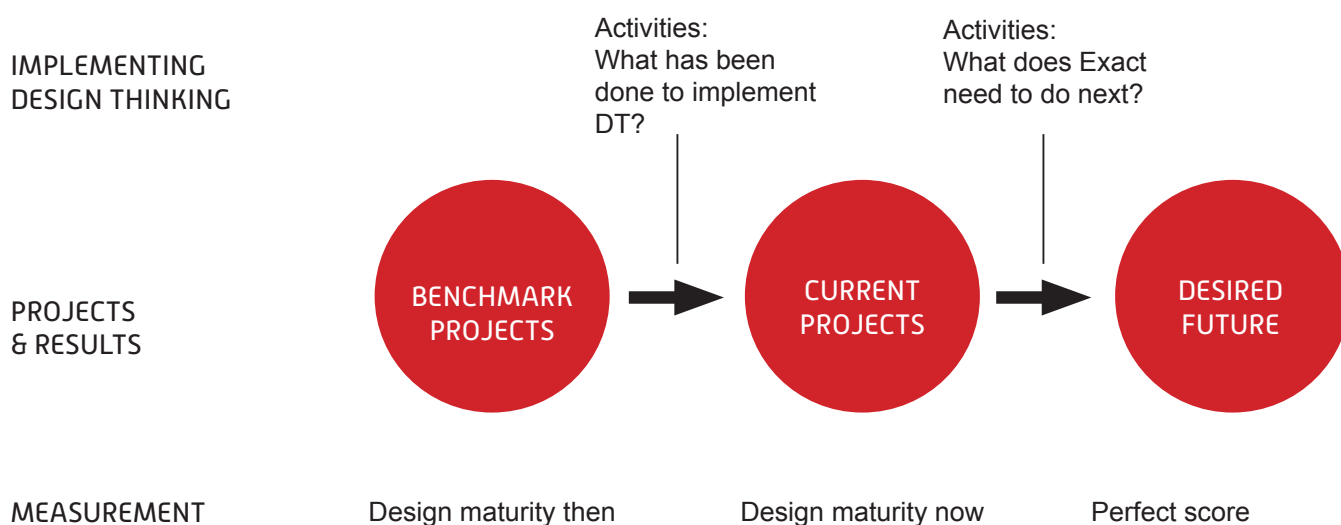
Figure 1. A comparative research approach to identify next steps.

Triple diamond approach

The project approach explains the structured process that was used during the thesis work.

A triple diamond model forms the basis of the project approach. This means that divergent and convergent activities took place at least three times (Figure 3). Many smaller and larger iterations took place in between the process steps. A short description of each phase is provided below.

Explore
During a literature study the topics of DT and change management were be explored. A company analysis provides contextual insight and uncovers needs and wishes of employees concerning working in project teams. Also research methodology is explored.

Define
A research plan is defined, including the scope of the project, research questions and methodology. Combining gaps in literature and needs of employees provides a research focus with high impact.

Execute
In the execution phase, qualitative and quantitative data on project work is gathered by means of surveys, interviews, measurements and observations.

Analyze
Data is analyzed to uncover patterns and correlations. Strengths and weaknesses of current practices are reported. Triggers and barriers to change are identified.

Develop
Based on research results, a strategy to boost the implementation of Design Thinking at Exact is created.

Deliver
Project outcomes are evaluated and communicated to the stakeholders. The relevance of the deliverables to change management models is discussed.
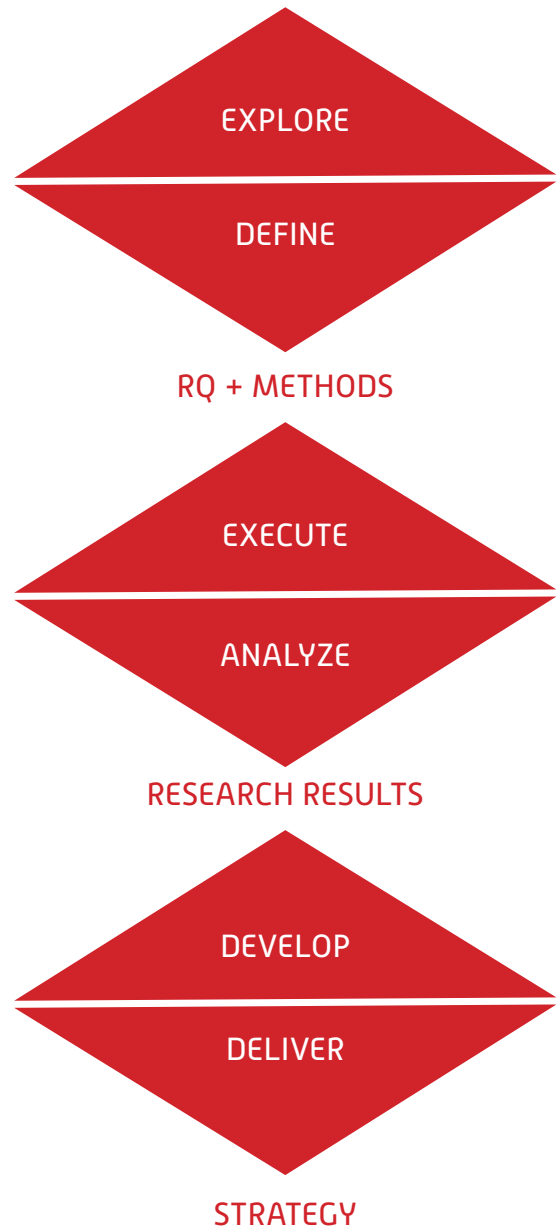

Figure 3 Triple diamond approach

Tracking the implementation of Design Thinking at Exact

- Project brief

De-constructing the project brief

In the explore phase the context of the project was researched. Exploration topics were set up by de-constructing the project brief: '*Tracking the implementation of Design Thinking at Exact'* . Information in was gathered through literature research, desk research, and informal interviews. The results of the research on these exploration topics can be found throughout the thesis report.

Tracking - How can design processes and skill be tracked over time? What measurement tools are available?

See chapter 2.3 Tracking Design Thinking practices, 2.4 Survey design, 3.2 Measuring design impact and 3.5 Business data.

Implementation - Implementing a new mindset and method in the organization might be challenging. What drives people to change? What are common barriers to implementing Design Thinking? How can the organization facilitate change? .

See chapter 4.2 Challenges to implementing Design Thinking, 4.3 Change management and 4.6 Triggers and barriers to Design Thinking.

Design Thinking - What does the term Design Thinking entail? How do companies apply Design Thinking? What are the benefits and potential downsides of using the methods?

See chapter 1.3 About Design Thinking, 3.1 The value of Design Thinking , 4.1 Design Thinking in practice.

Exact - Design Thinking is introduced at Exact, but what is this company all about? What products do they currently offer? Who works at Exact and how is the company organized? What are their aspirations? How is the brand perceived by the market?

See chapter 1.2 About Exact, 2.1 Design at Exact and 4.5 Pains and gains in project work.

Research topics

The thesis makes four main contributions to the field of DT: three DT research topics are explored and an strategy is proposed to improve DT at Exact. The research topics are:

1. Evaluating the effectiveness of a DT program by measuring the maturity of design practices over time.

Many companies claim to have successfully implemented Design Thinking in the organization, but there are little studies to support these anecdotal records (Carlgren, 2013; Liedtka, 2017). This work contributes to literature and practice by elaborating on the steps taken to empower DT in the organization and evaluating the effectiveness of the program. By comparing the activities of the DT program to the improvements in maturity of design practices, aspects of DT that are more or less easily adopted are uncovered.
After an exploration of methods to measure DT in organisations, it can be concluded that there is no standard procedure to measure the maturity of DT. A custom survey is chosen as the main data collection tool to compare project groups.
The measurement approached are evaluated and their validity in other contexts is explored.

2. Exploring the value of Design Thinking in the organizational context.

Additionally this work explores the value of DT in the specific context of Exact. Proponents of DT praise the approach for a large range of benefits, most notably innovation (e.g. Brown, Dunne & Martin 2006, Drews 2009) However often benefits are not further specified. Also, the context of use is rarely defined, implying DT can deliver this value in any organization. Research suggests that the value delivered by DT is context dependent (Carlgren et al. 2014). It is also established that DT is applied in a diverse range of organizations (Schmiedgen et. al., 2015. The question arises: is the same value created in each context?

In this case study the impact of the design practices on specific project outcomes is explored. To determine the impact of design practices, the survey included measures for both design practices and project outcomes. A correlation analysis was performed to determine the contextual value of DT.
The value of DT in the context of the software firm Exact can than be compared to the wide range of benefits that are proposed by practitioners.

DESIGN MATURITY REPORT

Scores on DT practices are gathered per project. Including quantity of design methods used.

DESIGN IMPACT REPORT

The impact of DT is explored through correlation analysis. Results also indicate quality of design methods used.

TRIGGERS & BARRIERS TO DT

Uncovering why employees are willing or reluctant to participate in DT practices.

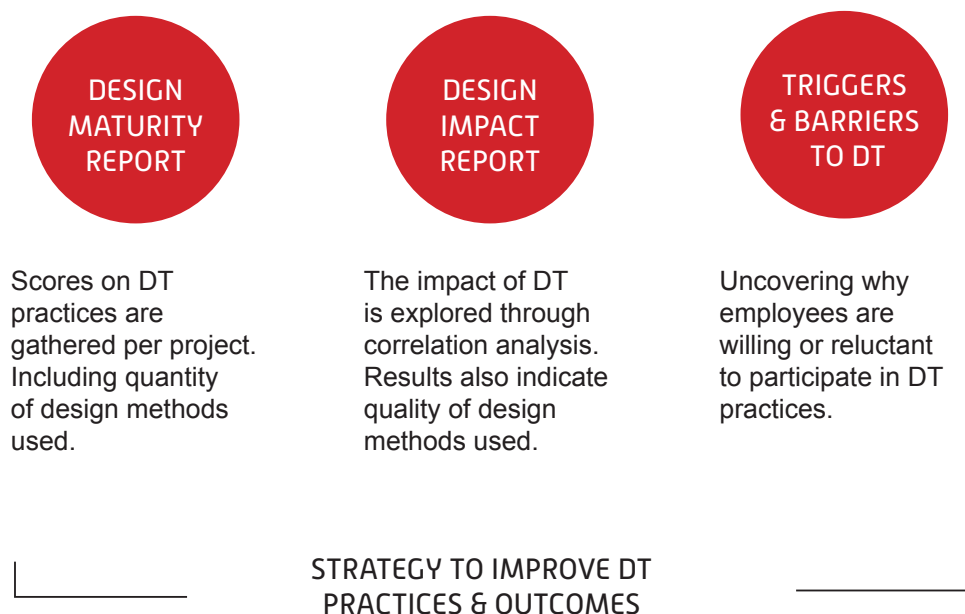STRATEGY TO IMPROVE DT PRACTICES & OUTCOMES

Figure 2. Thesis scope

3. *Defining triggers and barriers to implementing Design Thinking*

Understanding what triggers and barriers to using Design Thinking occur in the project teams, is key to developing an improvement strategy. The focus of this research topic lies *why* questions, whereas is previously *what* topics were discussed.
Example barriers are organizational limitations or practical concerns. Triggers could be personal development and the desire to try new thing work approaches.

To determine triggers and barriers for project teams to apply DT, qualitative data was collected in eight interviews with a diverse range of employees at Exact. Common challenges to using DT were prioritized with designers in four session, sorting the challanges on how often they occur and how large of an impact they have on the project work.

Also, different approaches to implement DT from other organizations are analyzed, as input to further develop a strategy to improve DT at Exact. Additional literature on change management is explored to see how barriers to establishing organizational change are typically dealt with.

Strategy design

By merging the design maturity and design impact results with the triggers and barriers to apply DT in project teams, a strategy time-line is proposed for Exact to further develop Design Thinking in the organization. Figure 2 provides an overview of the thesis scope and research outcomes. The strategy includes focus points for now and later, and proposes steps to overcome challenges to implement DT. The strategy design is the fourth and final contribution of the thesis

Research questions

The scope of the thesis can be concluded with a set of research questions (sorted according to topic):

1. Measuring the maturity of design practices over time

What has been the effect of the Design Thinking empowerment program?
What worked well and where can improvement opportunities for implementing DT be identified?

Sub RQ:
How is Design Thinking used in project teams at Exact?
How can the maturity DT be measured?

2. Exploring the value of DT in context

How does Design Thinking impact the project outcome?
How does this compare to expected outcomes, based on the value of DT in other firms?

Sub RQ
What measures and measurement instruments are suited to determine the impact of DT?

3. Triggers and barriers to implement Design Thinking

What motivates project teams to participate in DT?
What barriers to implement DT can be identified?

Sub RQ:
What are other companies doing to implement DT in the organisation?

4. Strategy to improve DT at Exact

How can Exact improve the maturity and impact of DT practices in project teams?

1.2 | ABOUT EXACT

This chapter provides contextual information about the firm, for example their products and company structure.

A Delft enterprise

Exact was founded in 1984 by six students from the Delft University of Technology. They introduced administrative software to companies that just started working with computers.
The Exact headquarter is still in Delft, but the company has grown to a large tech company with over 1500 employees, divided over ten global offices. They continue to offer their clients innovative software.

Business units and product offering

Exact has two main business units, each operating with their own business model and target group: Business and Cloud solutions. Each unit has several products or product variations.
Business Solutions (BS) focuses on business processes such as collaboration and communication within a company (Exact Synergy) and finance solutions (Exact Globe). These software products predominantly work offline and are targeted at larger companies with internal finance departments, typically with 50 -1000 employees.
The other business unit is Cloud Solutions (CS). This unit offers the product Exact Online (EOL): an online solution for bookkeeping and other finance related tasks, used by accountants, SMEs and entrepreneurs. This thesis focuses on improving DT in the CS project teams.
The department Corporate Infrastructure provides services such as legal and finance to the business units and assures the units are aligned with the corporate vision.

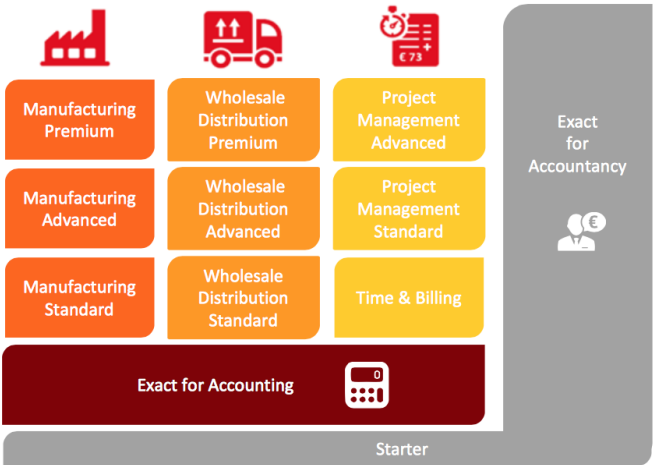*Figure 4. Business units and Solution Teams*

Figure 5. Different packages of Exact Online

More about Exact Online

This project focuses the way Exact Online this is developed and managed by the CS department.

The SMEs that use EOL for their financial processes have up to 100 employees. It is common for these companies to hire external accountants to handle (part of) their finances. EOL is a key tool for these accountants and the product helps SMEs communicate with their accountant and vice versa. Accountants work together with their clients in the Cloud.

Tasks that can be performed in EOL are accounting tasks, invoice processing, project management, salaries processing and support of production or trading practices. Users can upgrade their basic account to advanced or premium, according to their needs.

EOL has separate packages assigned to specific target group, for example the entrepreneurs, wholesalers or accountants. An overview of the EOL packages can be found in Figure 5. This diverse product offering is made to fit the needs of the different groups of users.

Structure Cloud Solutions

Within CS several multidisciplinary teams, called Solution Teams (ST), work on the different packages of EOL. They operate in their specialist field such as Accountancy, Mobile or Wholesale. For an overview of all teams see Table 1.

A ST typically consists of a Product Owner (PO), UX Designer (UX-er), Product Marketeer (PMKT) and Tech Lead. The PO has a managing role. The UX-er is most close to users, performing user research and testing and designing fitting solutions. The PMKT provides information about the market. Often marketeers work with several teams.

The Tech Lead represents the development team. The ST work closely with the technical staff that create the software. Depending on the project team, the Tech Lead is more or less involved in conceptual processes. The software developers spend around 80% of their time on maintenance of the products and 20% on new product development, in assignment of the ST.

Next to the STs, Exact started experimental teams, These teams have a more autonomous and rapid approach, with less traditional roles for the employees that work in these teams. They can be seen as 'start-ups' within the company. These teams are included as sample for this thesis, because they are part of the CS and were effected by the DT program.

Three teams of designers work independent from the solution teams, supporting all teams across the unit. These are the Horizontal UX team (HUX), Design System team and UX Boost. HUX develops generic platform components and supports other solution teams with specialized UX knowledge. This is to promote consistency and control quality of EOL. The Design System team is responsible for creating the Design System: a uniform look&feel for EOL, represented in a living style guide that allows automatic and immediate styling updates across products. UX Boost promoted and supported teams in Design Thinking practices. In the beginning of 2018, the strategy refocus from diversification of products, to improving core products, led to the design expertise of UX Boost being moved to these core product teams.

Accounting	Focus on accounting tasks for non-accountants
Accountancy	Products for accountants and their practices
Titan	Develops new innovations for EOL
Wholesale	Serves wholesale and distribution processes
Manufacturing	Focus on the manufacturing market
Professional Services	Functionalities for SMEs (e.g. time and billing)
Mobile	EOL for mobile devices
Go	Mobile app for entrepreneurs
Finance	Focus on financial processes

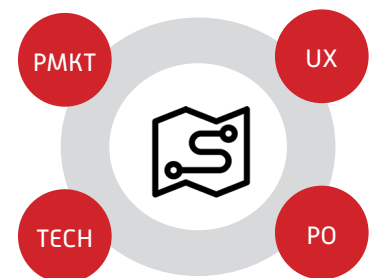*Table 1. CS Solution Teams*

Figure 6. Solution Team structure

Market position

Exact has a leading position in the Dutch market, offering software to around 50% of accountants. With the acquisition of Reeleeezee in 2017, a competing bookkeeping solution for SMEs and entrepreneurs, Exacts market position strengthened (Reeleezee.nl, 2017).

Two main competitors are AFAS and Twinfield. Their products are offered at similar prices. Distinguishing are the features and flexibility that are offered. This reflects in Exacts slogan: '*more* than a bookkeeping program'. Twinfield offers a basic, fixed solution for accountants. AFAS is more similar to Exact, claiming to be efficient and enabling collaboration. Main reasons for customers to choose Exact are the perceived reliability and flexibility, such as customized dashboards. Additionally, Exact has a strong brand name, which is enhanced by their success as sponsor of Max Verstappen. Exact also hosts Exact Live, a festive yearly event to strengthen their brand, where they invite their users to network and experience new technology.

In the field of financial technology there are many new developments and start-ups that leverage these trends. A strategy of Exact is to avoid competing with these start-ups, but rather partner with new players in the market by linking them to EOL. This is beneficial for both parties, as Exact adds functionalities to their product and start-ups get access to a large network of users.

Through their marketing channels, Exact positions itself as being innovative and *tech-curious.* The curiosity for tech is represented in internal research teams for technological innovations. For example machine learning is being implemented in their products and the intention is to reflect more of their research portfolio in their offerings to users.

Cloud Solution strategic pillars

Exacts core mission is to '*empower SMEs to be the driving force of the global economy'.* Exact aims to be in the top three business software providers of SME's worldwide.

CS set up five complementary strategic pillars in 2016 that enable the mission (figure x). Some of these goals are internal and have an indirect link with the SMEs ,such as increased employee engagement. Others influence the SMEs that work with Exact directly, such as connecting the companies and offering them greater user experience.

Previous graduation research by Jimena Manteo (2016) uncovered employees perception of the company values and their vision on the company. Manteo interviewed nine employees from different teams. Employees indicated focus points for a future vision: creativity and user-centricity.

EXACT EMPOWERS SME'S TO BE THE DRIVING FORCE OF THE GLOBAL ECONOMY

Employee Engagement
The key to our success

Connect SMEs
Inspire and grow their business

Accountancy Advice
Empower accountants in adding value to their clients

Customer Experience and Engagement
Deliver great customer satisfaction, increase usage and relevance

Market Reach
Develop a partner community to accelerate growth

Figure 7. Five pillars to support the CS Vision

Visions development

To strengthen their market position, Exact is continuously working on renewing the organization. This paragraph provides an overview of developments at Exact, illustrating how the company is growing and reacting the market.

1995 - A global company

In the nineties, Exact started to develop their business abroad, in search of growth. (Marlet, 1995). Over the years, Exact established in foreign markets such as Spain and the UK.

2012 - Business units

Back in 2012, Onno Krap and Erik van der Meijder were appointed to establish growth in Exact. They split up the business in the business units with separate business models.

2016 - An exponential organization and diversification strategy

The approach of Krap and van der Meijder led to successful growth, but by 2016 the game had changed. In CFO magazine, the CEOs explain a new focus on achieving exponential grown (Harmsen, 2016). To support exponential growth, internal processes such as IR and HR are standardized and atomized, which makes it easy to scale up (Ismail, 2014). The Design System team and their adaptable living style guide is part of this new strategy. In the same article, Krap and van der Meijder discuss the switch from EOL as a 'system of record' to a 'system of engagement' with an offer of additional services besides bookkeeping. This product diversification strategy has the goal to increase customer experience on their product. The CS strategic pillars support this strategy.

Design Thinking and company goals

It is briefly discussed how Design Thinking can complement company goals.

Design Thinking could support Exacts strategic goals as it is a human approach to product development that has the potential to improve the user experience for Exact customers. Also, the employee engagement might increase due to the collaborative and inclusive nature of DT. Also, DT can help improve the quality of core products. DT involves creativity and user-centricity, making it a great fit with the vision of the board and its employees.

For more about Design Thinking read *1.3 About Design Thinking* ,*3.1 The value of Design Thinking* and *2.2The Design Thinking program.*

Key information about Exact

Key information about Exact is provided to conclude this section.

Exact is market leader in bookkeeping and accounting software for SMEs and accountants in the Netherlands. The firm has over 1500 employees working in offices globally, but most are based in the head quarters in Delft.

The organization is split in two business units: Business Solutions (BS) and Cloud Solution (CS). BS serves larger and international firms by supporting a larger range of business processes. BS is the longer established business unit, creating steady value for the company. Cloud Solutions develops software to support financial operations of SMEs, entrepreneur and their accountants. The CS product is called Exact Online (EOL) and is offered in different packages to fit the needs of specfic target groups.
CS has multidisciplinary project teams, that include a designer, manager and marketeer, who work on products for the specific target segments. In addition two teams of designers support the project teams: *Design Systems* creates a uniform visual identify and *UX Boost* empowers Design Thinking in project teams.

This thesis focuses on the way Design Thinking is implemented in project teams in CS. Research activities took place in the Delft office.

1.3 | ABOUT DESIGN THINKING

The term *Design Thinking* is flooding business magazines and blogs in recent years. Figure X illustrates interest in the concept is steadily growing since 2008. In 2008, Harvard Business Review devoted an issue to Design Thinking and around that time, multiple books on the topic were published, for example *Change by Design* (2009) by Tim Brown designer and director of IDEO, and *Design Thinking* (2010) by the Design Management Institute (DMI).

A large range of companies, including renowned corporates such as PepsiCo and IBM, are now implementing DT to improve innovation outcomes (Ignatius, 2015; Hamm, 2016) Traditional consultancy firms, such as Accenture, are purchasing design agencies to acquire knowledge on design processes to serve the needs of their clients (Hurst, 2013). Design Thinking has also been adopted in education programs of renowned universities such as Harvard Business School and Rotman . A key example is the d.School from Stanford University.

Design Thinking is hot and happening. But what does this innovation approach entail and why are companies so keen to use DT? What has been published about DT in terms of academic studies? This chapter provides an introduction of the concept.
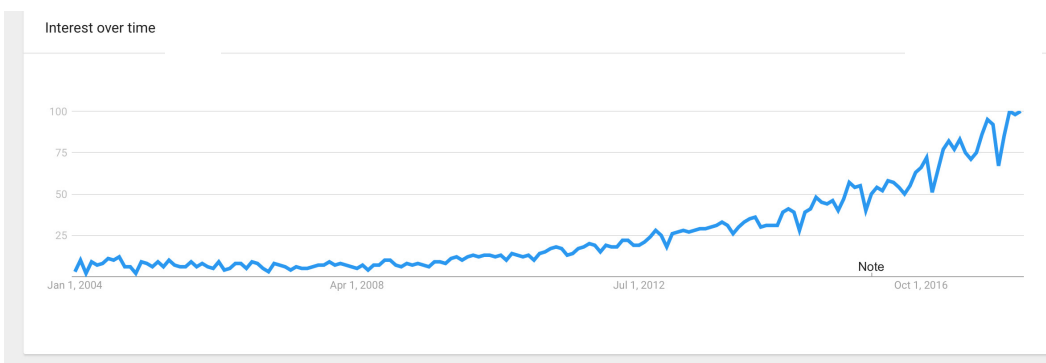

Figure 8. Google trends analysis showing increased interest in Design Thinking over time (retrieved from trend.google.com, April 2018).

A multidisciplinary, human-centered approach to innovation, inspired by the way designers think and work.

Why?

Business is becoming increasingly competitive and innovation is seen as a way to survive in the market (Tushman & O'Reilly, 1996; Crossan & Apaydin, 2010). To establish innovative results and compete with smaller, more flexible companies, corporates look for new ways to organize themselves. In the light of these developments, design is moving beyond an approach to improve aesthetics, towards a more strategic role in new product development (e.g. Verganti, 2008; Seidel & Fixson, 2013; Calabretta, Gemser and Karper, 2016).

What?

The way designers think and work forms the basis of Design Thinking (DT). In the DT program at Exact, the concept is communicated as a user centered approach to problem finding and problem solving, to deliver products and services that will improve lives.

DT as a problem solving approach to innovation is a common description of the concept (Jahnke, 2013). A more detailed description of DT is a multidisciplinary, human-centred approach to innovation, inspired by the ways designers think and work (Brown, 2008; Kimbell, 2011; Johansson-Sköldberg, Woodilla & Çetinkaya 2013). Brown (2009) adds that the approach integrates the needs of people, possibilities of technology and requirements for business success. In this way DT links the three lenses of human-centred design: people, technology and business (IDEO, 2009).
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Who?

Promoters of DT in the managerial discourse consider the approach suited for non-designers and designer alike (e.g. Brown 2008; Martin 2009). Brown makes a distinction between 'being a designer' and 'thinking like a designer' and mentions that for successful DT, certain character traits (e.g. empathy) are required.

Diverse interpretations in practice

So generally, DT is promoted as an approach that can be applied by diverse people to solve a large range of problems. These common descriptions of DT leave room for interpretation, because general terms such as 'approach', 'innovation' and 'problems' are used. Kimbell (2011) and Johansson-Sköldberg, et al. (2013) also came to the conclusion that DT is a rather loose term.

Research by the Hasso Plattner Institute illustrates how perceptions of the approach differ amongst DT practitioners (Schiemdgen et. al, 2014). Practitioners are not aligned around one common understanding of DT. Most commonly practitioners would describe DT as an iterative process, followed by a problem solving approach and finally user empathy is mentioned in the top three common understandings of DT.

"What is Design Thinking?"

Perceptions of 421 DT practitioners (Schiemdgen et. al, 2014).
In order of occurrence:

1. an iterative process,
2. a 'special' way of understanding and creatively solving so-called wicked problems,
3. user empathy,
4. a tool for collaboration,
5. a mindset,
6. a toolbox for user research and group creativity,
7. prototyping, or
8. a culture.

Level 1	Principles				
	User focus	**Problem framing**	**Collaboration**	**Experimentation**	**Visualization**
Level 2	**Mindsets**				
	Be empathic. Be curious. Be unprejudiced. Be interested in people.	Think without constraints. Think holistically and cross-linked. Be comfortable with complexity and ambiguity. Be open to the unexpected.	Be open to differences in personality type/background. Think integratively. Pursue a democratic spirit.	Be curious and explorative. Be playful and humorous. Value both analytical and intuitive thinking. Be optimistic and energetic. Be eager to share. Value feedback and be willing to learn.	Think visually. Think through doing. Have a bias towards action.
	Work attitudes				
	Seek to understand the perspective of your potential users as well as their latent needs and pain points, and let this understanding guide all work. Use a qualitative, context-specific approach in user research. Involve users in ideation, prototyping, testing	Challenge and reframe the initial problem to expand both problem and solution space. Synthesize the collected data, find patterns and look beyond what is obvious to see what lies behind the problem. Consider different possibilities and draw abductive conclusions.	Work in diverse teams and let everyone's opinion count. Seek diverse perspectives and inspirations. Develop a common understanding of the challenge within the team. Work cross-departmentally and collaborate with external entities.	Work iteratively and come gradually to better solutions. Alternate between divergent and convergent phases. Prototype quickly and often in order to learn. Test solutions early and share prototypes with users and colleagues Fail often and fail early.	Make ideas and insights visual and tangible to externalize knowledge, communicate and create new ideas. Visually structure data. Make rough representations. Provide experiences to enable understanding.
Level 3	**Methods**				
	e.g., ethnographic research, journey mapping, empathy map, persona, user feedback sessions	e.g., °360 research, design charrette, semantic analysis, formulating the problem statement (point of view), how-might-we-questions	e.g., conscious recruitment, cross-departmental events, teambuilding activities, team check-ins and check-outs	e.g., different brainstorming techniques, creation of rough physical mock-ups (by using e.g. paper, card-board, glue and foam, Lego, or any available artifacts), sketching, storyboarding, wireframes, role-play	

Figure 9. An descriptive model for Design Thinking (Tschepe, 2017).

Specifying Design Thinking

It is clear that in practice, DT can have different meanings to organizations. Many (online) articles can be found with individual views of what the concept entails and what organizational impact can be expected.

Following the interest from practitioners, the research field of DT is emerging. Since there is no single description of DT (Kimbell, 2011; Johansson-Sköldberg et al., 2013; Hassi and Laakso, 2011), researchers shift their focus to synthesize common elements of DT in theory and practice, rather than trying to capture the concept in one sentence. (Hassi 2011, Carlgren 2013, Liedtka 2015). The researchers aim to create a common understand that allows for further research on the topic. This sections explains what can be concluded from these recent studies.

Hassi and Laakso (2011) studied key writings on DT and found that elements of DT fit either of these three categories: practices, cognitive approaches and mindset. You can find their model, including key sources in Appendix 1: *Elements of Design Thinking.* Carlgren (2013) builds on the study of Hassi and Laakso. She proposes DT as a boundary object: outlining the boundaries and content of DT while still allowing for contextual variations in the way the concept is put into use. Boundary objects enable communication and coordination of management concepts (Engwall et al. (2005). Carlgren identifies five principles that form the conceptual boundaries of DT: human-centeredness, problem framing, diversity, experimentation and prototyping.

By combining the work of Hassi and Laakso (2011) and Carlgren et al., (2016), Tschepe constructed an overview of DT and the different levels in which it occurs in organizations (Figure 9). On the first level, principles apply. Those reflect in a certain mindset, that manifest in work attitudes and finally DT is supported by concrete methods such as brainstorming techniques.
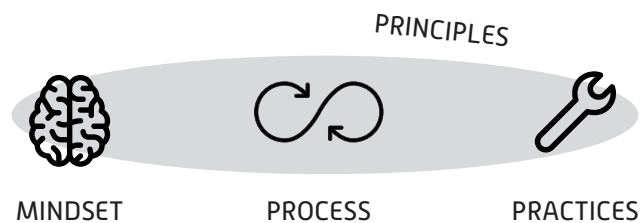

Figure 10 Representations of Design Thinking.

This work

Based on the work of Carlgen (2013), Carlrgen et.al. (2016) and Hassi and Laakso (2011) this thesis proposed a model for understanding DT as a set of six principles: *user centricity, tangibility, cooperation, optimism, experimentation* and *ideation* (Figure 11) These are represented through a mindset, process and practices (Figure 10). Practices include ways of doing, such as making prototypes or using a customer journey map. The process concerns process steps and order. More about the principles is explained in the section *2.4 Survey Design.*

User centricity	Tangibility	Cooperation	Optimism	Experimentation	Ideation
Create empathy	Visual thinking	Co-create problem and	Bias towards	Iterate process steps	Diverging and converging
Focus on user	Prototyping	solutions	betterment	Accept uncertainty	Take different perspectives
experience		Multidisciplinary	See opportunities	Tolerate failure	Create multiple ideas
Uncover user needs		teams			Analyze and select

Figure 11. Design Thinking principles used in this thesis work.

The Design Thinking Process

As the HPI study indicated, DT is most commonly understood to be an iterative process. This could be expected because process visualizations are the most commonly used representation of DT. This paragraph explains key characteristics of the DT process.

Typically the process is explained as an iterative process with three to seven steps. (Kelley and Littman, 2001; Brown, 2009; Brown and Wyatt, 2009) The process steps describe the following activities:

1. Performing user research to understand the problem
2. (re)defining your problem
3. Ideating solutions
4. Prototyping and testing findings

Differences in graphic design emphasize specific characteristic of the DT process. 'Double diamond' models focus on converging and diverging practices (Figure 12). Loops and circles emphasize the iterative and continuous nature of DT (Figure 13 and 14). It can also be illustrated how uncertain is reduced as the team progresses in the DT process (Figure 15).
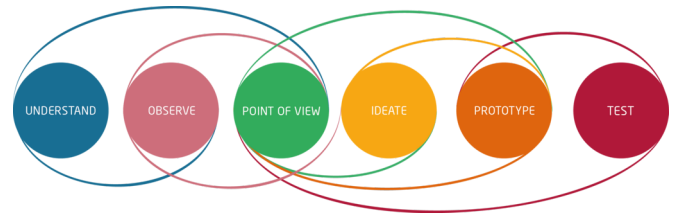

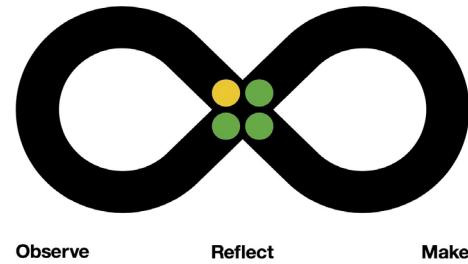*Figure 13. Iterative DT process by HPI*

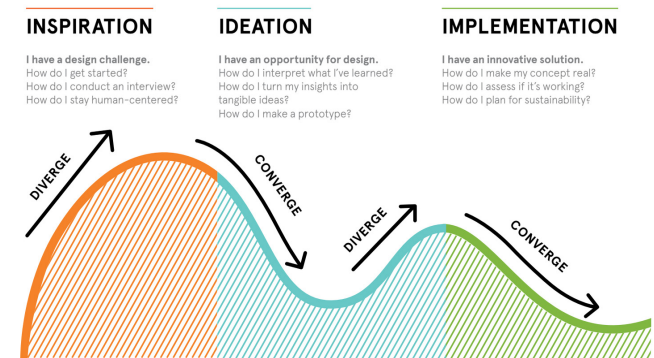*Figure 14. The IBM Loop: a continuous DT process (by IBM Design*
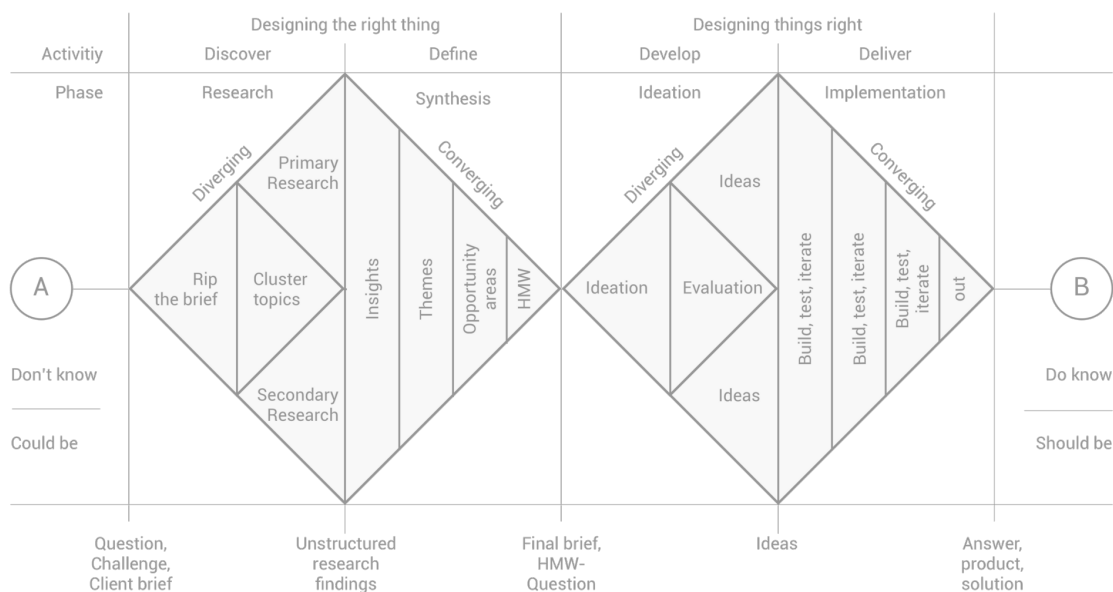

FIgure 15. DT process by IDEO

Figure 12. Double diamond DT process by Nessler (retrieved from https://medium.com/digital-experience-design/how-to-apply-a-design-thinking-hcd-ux-or-any-creative-process-from-scratch April 2018)

The outcomes

Concerning the benefits of using DT, increased innovation is most frequently mentioned by companies that claim to have successfully implemented DT. The are many anecdotal reports of the value of DT, but these often lack detail, for example about the type of innovation output that can be expected (Carlgren et. al. 2014). Besides innovation output, companies indicate that DT contributed to the personal developments, better communication in teamwork and faster time to market. There are many success stories, but still little empirical evidence to support the value DT (Kimbell, 2011; Johansson-Sköldberg et al. 2013).

More about the outcomes of DT is explained in chapter *4: Exploring the value of DT in context.*

Implementing Design Thinking

The implementation of any type of new organizational method entails challenges (De Waal & Knott, 2013). Specifically in the innovation domain, clashes with current business processes and other hurdles can be expected (Assink, 2006). It can therefor be assumed that hurdles to implement DT occur. Carlgren (2016) defines explores what challenges are specific to DT, but no studies that specify how to overcome these challenges and best implement DT.
To gather information about implementation steps, the DT programs of other companies are analyzed in this thesis work.

Further information about the implementation of DT in organizations is found in Chapter 4: *Triggers and barriers to implementing Design Thinking.s*

Key information on Design Thinking

Key information about DT is repeated in this section.
.
A lot is written about DT by practitioners and enthusiasts, that praise DT as an all-round problem solving approach that delivers innovative outcomes. Companies are investing in DT and universities are adopting the approach in curricula.

The approach is based on the way designers work. This translates into key principles of DT: *user centricity, tangibility, experimentation, collaboration optimism* and *ideation*. These principles are embedded in a mindset, represented through a structured process and enacted through DT practices, for example prototyping and customer journeys.

The concept of DT is hard to describe in one sentence and each company is using DT in their own way. This might the reason why there is still little academic research on the concept, the specific value that is delivers, and the way it should be implemented.

2

MEASURING THE MATURITY OF DESIGN PRACTICES

In this chapter, the effectiveness of the DT program at Exact is evaluated by measuring the maturity of design practices over time.

First, it is explained what the role of design is at Exact and what the Design Thinking program entailed.

Next, background information is provided about measuring design in organizations. For this thesis, a survey was the measurement instrument to determine the maturity of design practices. The measures and structure of the survey are explained.

Two groups of projects were evaluated: one from before the DT program and one group of projects that ran during the program.

What follows is a discussion of the survey results, including weak and strong design practices and improvements in design maturity.
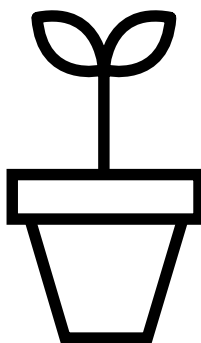
Design maturity

How has the maturity of design practices developed over time?

Design impact

How do design practices influence the project outcome?

Figure 16. The two main survey results: design maturity and design impact.

2.1 DESIGN AT EXACT

At Exact, over 20 UX designers work on the different products and services. As mentioned before, these designers can be found in several places in the organization: in the solution teams or one of the umbrella UX teams. This section describes the role of design, including the activities of UX designers.

UX at Exact

Exact describes User Experience (UX) design as *"a process to enhance user satisfaction by improving the usability, accessibility, and pleasure provided in the interaction between the user and the product."* Good UX design touches upon the three lenses of human-centred design: business, people and technology. It does so by addressing user needs, facilitating business goals and being enabled by technology.

A lot has changed at Exact in the way UX is approached and integrated in the company. Figure 17 offers an overview of this evolution of UX. Exact started hiring designers in 2006 and continued to expand the team. In the beginning, there were not enough designers to match them to one team and designers had to work across teams. As more designers were hires designers were matched to a product team. Recently a hybrid model, with designers being integrated in teams, as well as central teams to support design across teams.

Centralized UX 2009   **Decentralized UX 2013**   **Hybrid UX 2017**
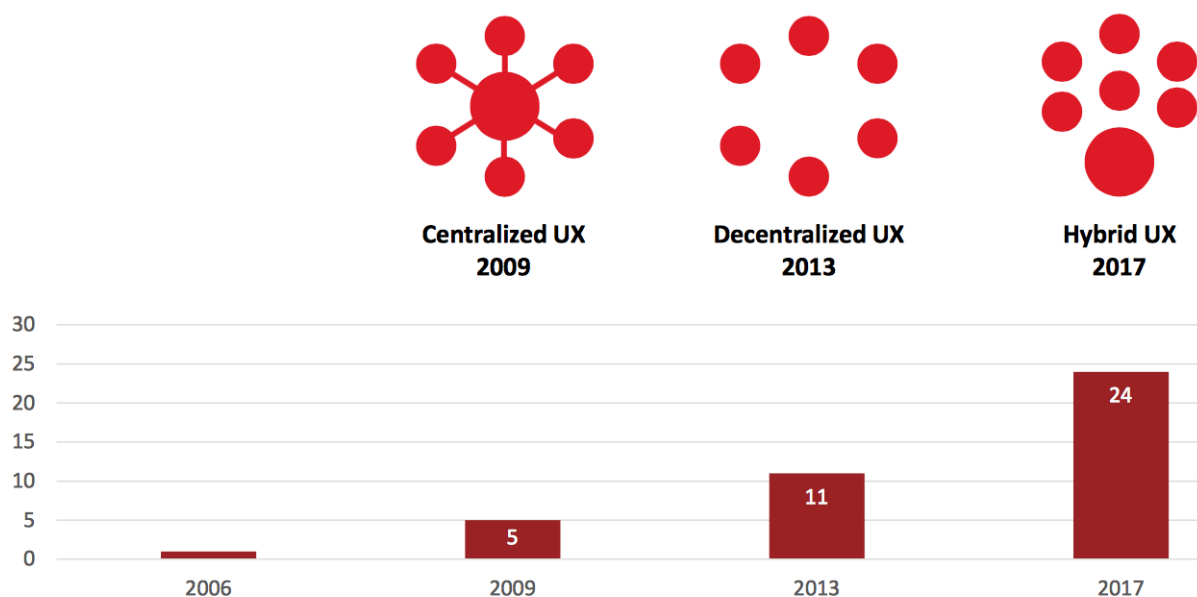
Figure 17. Evolving UX at Exact over time

Figure 18. Five levels of UX Design (Garret, 2002)
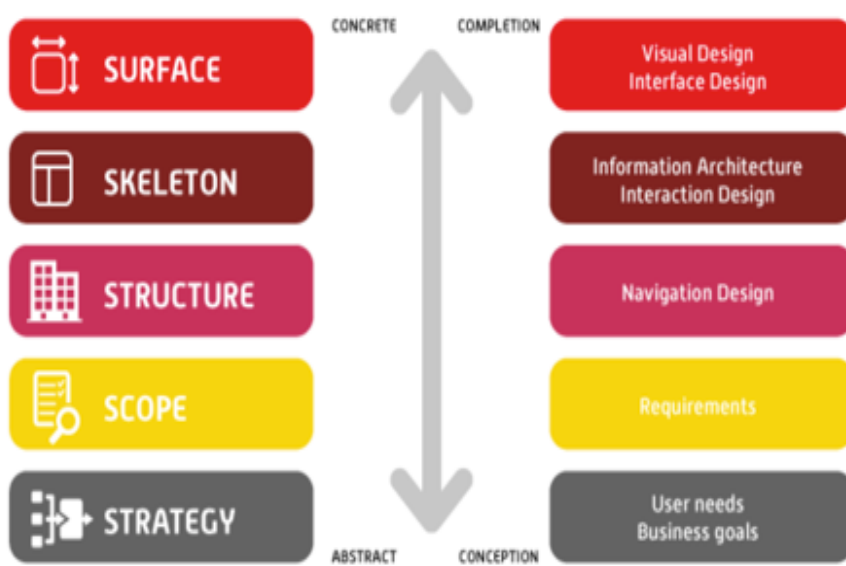
Vision for UX

The term UX is often associated with visual and interface design, but Exact identifies five level of UX design based on the model of Garrett (2002). UX design activities can range from strategic to surface level (Figure 18). At this moment, designers have high influence in the more concrete levels: surface, skeleton and structure, and less influence in conception: scope and strategy. The aim is to have UX designers operate in all levels in the future and use design as a strategic driver. Design as a strategic drivers means UX has an integrated role in business processes (Figure 19)

Figure 19. Towards design as a strategic driver

UX work

A senior UX designer set up a list of challenges that UX-ers at Exact deal with in their work. This provided an idea of the topics and issues UX designers regularly work on. These tasks are:

- Performing target group analysis to choose the right target segment for a project.
- Determining the right level of customization, to adapt Exact Online for this segment.
- Evaluating the impact of changes in the software
- Navigating legacy and technical limitations.
- Balancing simplicity and usability with the business domain complexity.
- Managing a system of multiple stakeholders and organizational silos.

Meeting UX-ers

Most information provided in this chapter were found in existing presentations and reports that were made at Exact. To follow up on these reports, informal meetings were set up with six UX designers to discuss the status of design at Exact.

Questions concerned their responsibilities, how they interacted with their team and their needs ans wishes concerning project work. On the rights, some quotes are presented to provide an idea of the insights that were collected in the meetings.

These meetings can be concluded with some additional insights. It can be said that team members can have different perceptions of the quality of their work and methods used. Overall, there is openness to change at Exact. However there seem to be practical barrier to design activities, such as time constraints. People at Exact are analytical and like to work fact based, rather than feeling based. This results in a need for objective data on design practices, beyond opinions. Finally the UX-ers are an international bunch with different backgrounds in education and experience. They are willing to lead the change to implement DT.

Design at Exact

To conclude, it can be said that design has grown in the company, and there is room to improve design further.

Currently over 20 UX designers work in CS, either in the product teams or in the central design teams. The designers come from many different backgrounds.

Designers perform user research, balance simplicity and usability within the business domain complexity and work in a system with multiple internal stakeholders. At this moment, designers have high influence in the more concrete levels: surface, skeleton and structure, and less influence in conception: scope and strategy. The aim is to have UX operate in all levels in the future and use design as a strategic driver.

Designers recognize a leading role for them in introducing DT to their teams and involving their team with design practices. s

> " *I think an ambassador role for UX-ers to lead design thinking is logical.*
>
> *Some people think they are doing a great job at design thinking, but don't apply the methods right.*
>
> *A lot has changed for UX at exact over the past 7 years* (more involved in projects).
>
> *I just don't have time for that* (to observe a user for a day).
>
> *Maybe I should involve my team more in design activities.*
>
> *My team enjoys customer visits a lot.*
>
> *Fuzzy design activities such as brainstorms don't always get a warm welcome in my team.*
>
> *We have enough opinions and reflections, we need more objective information,*

UX

6x informal interviews

2.2 THE DESIGN THINKING PROGRAM

This section explains the goals and activities of the UX Boost team. This team of designers developed and ran a program to empower and improve DT in the CS project teams. The program ran from end 2016 to start 2018 and this thesis explores the effects of their efforts on the maturity of design practices.

UX Boost goals

UX Boost was initiated by designers who noticed an opportunity to improve team practices. They got support from management to further pursue DT in the company.

UX Boost aims to take DT at Exact to the next level. They want to make DT the standard mindset and project approach in CS teams. They set up a team vision and mission that is explained below.

> **Team vision:** A transformed culture at Exact, where teams have a user-centered mindset that leads them to design products and services that people value, and therefore, bring value to our business too.
>
> **Team mission:** Drive teams towards innovation by empowering their Design Thinking & Doing mindset.

Their message to colleagues: *to be a successful company in this exponential and rapidly changing environment, we need to create and implement ideas that truly empower SMEs. Game changing ideas that impact and engage SMEs do not happen accidentally. They required to be strategically designed, considering business, technology, and humans. Design Thinking is the right approach to combine these perspectives, and guide the strategic development and implementation of ideas.*
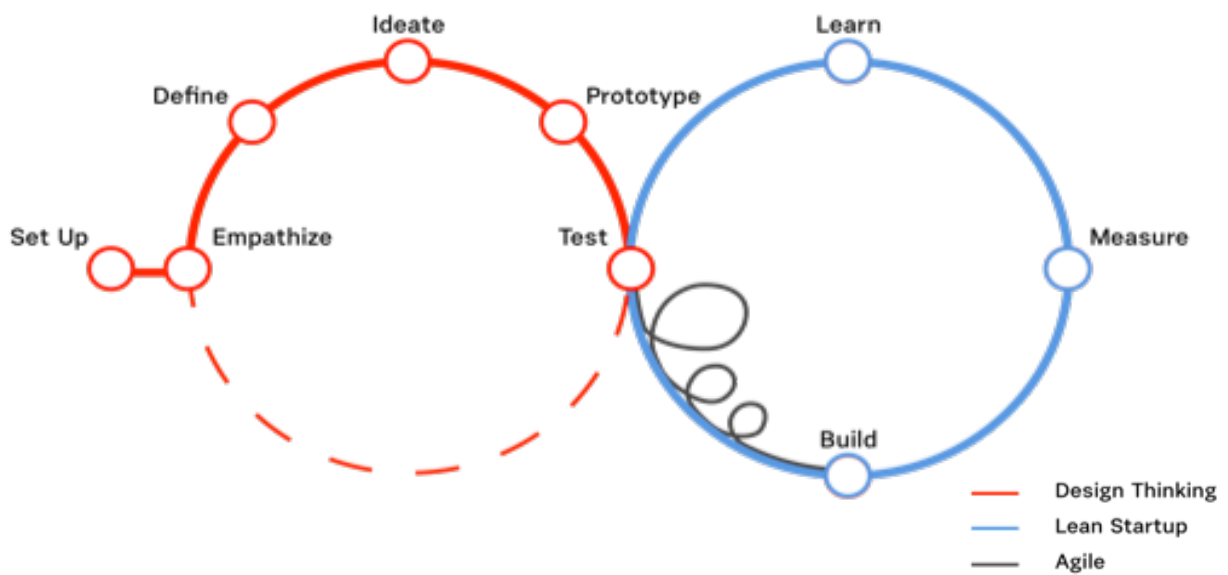
Figure 20 The proposed product development process at Exact (adapted from Nordstrom Innovation Lab)

Process innovation

UX Boost proposed a new way of working through the visualization of the product development process. Figure 20 illustrates how DT, Lean Start-Up and Agile processes are combined in project work.

If the new process is compared to the old way of working, some key differences are found (figure X). The proposed process with DT includes more research in early stages of project work and using results to challenge the project brief. Also users are involved in prototype testing. It is encouraged that steps are iterated when needed.

Key practices

The program at Exact manifests DT in six actionable practices: be user centric, have an open mindset, balance divergent and convergent thinking, collaborate, create tangible artifacts and embrace complexity.
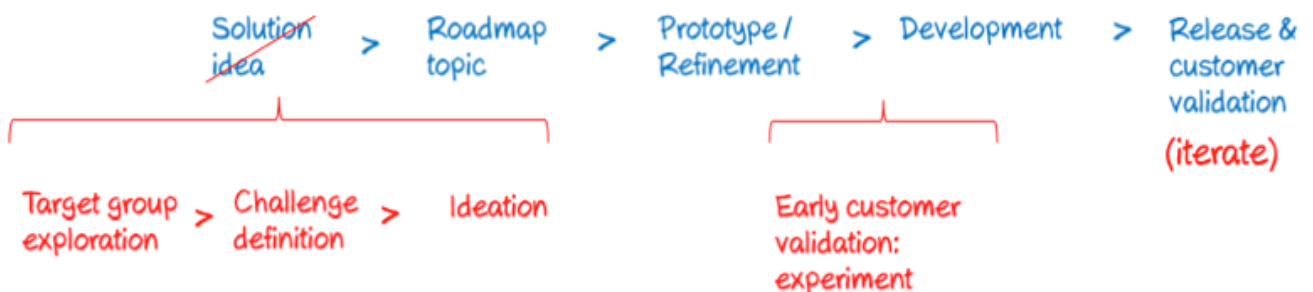
Figure 21. Differences between the old (blue and new (red) process

Figure 22. Overview of activities in the DT program

UX Boost activities

To ensure the adoption of the new way of working, UX Boost initiated a range of activities around four main activities pillars: *sharing & inspiring, providing tools, measuring maturity & impact* and *applying design thinking*.

1) **Sharing and inspiring:** organizing sessions and workshops to share knowledge, create awareness and inspire teams to use DT.

2) **Providing tools and methods**: providing teams with tools, methods and best practices to discover more of their (potential) customers and context.

3) **Measuring maturity and impact:** measuring the design maturity of CS projects to track progress and identify improvement opportunities. This thesis contributes to this activity pillar.

4) **Applying Design Thinking**: guiding teams throughout the DT process. Projects with high potential for DT were identified: star and key projects. The UX Boost team onboarded three star project to apply DT in teams and lead by example. Key projects are chosen by the UXers in the solution teams and UX Boost had a coaching role in these projects, with regular check-ups for to provide support.

Figure 22 provides an overview of specific activities by UX Boost. User Zoom is an online tool for user research and usability testing, that was introduced by UX Boost. By measuring the maturity of design practices over time, this thesis work evaluated the effectiveness of these activities.

When analyzing these activities, it can be concluded that most activities focused on user research and ideation. Some activities concerned problem definition. Not all DT principles were addressed at the same level. There was limited attention for prototyping and visual thinking in the DT program at Exact.

About the Design Thinking program

The DT program was initiated and pursued by a central design team (UX Boost), with support from management. They restructured the development process, with more focus on exploration and iteration. Six key design practices were communicated to illustrate the ideal mindsets and practices for DT,
To implement the content of the program, several activities took place around the topics *sharing & inspiring, providing tools, measuring maturity & impact* and *applying design thinking* Example activities are internal news articles and design sprints. The activities mainly focused on user-centricity and ideation, so this is where improvements in design maturity are expected.

2.3 | TRACKING DESIGN THINKING PRACTICES

To define the appropriate research method to measure the maturity of design practices at Exact, it is explored how the use of design is tracked in practice and theory. This section provides an overview of studies that concern tracking Design Thinking. Specifically objective measurements are researched, to fit the organizational needs and analytical mindset of Exact.

Measuring the outcomes of those practices is further discussed in chapter 3.2 *Measuring impact.*

Prototype iterations

Roth and Royalty (2016) proposed a framework to measure DT by tracking iterations, empathy, value and novelty. The latter is explored in Chapter 3.2. The measurements for iteration and user centricity are discussed in this section. (figure 23)

Iteration is measured by counting the number of prototype iterations per feature. This measure is based on findings from Dow & Klemmer, (2011) who more iteration leads to stronger prototypes and stronger prototypes lead to better products. Comparing prototypes per feature allows for comparison between projects, regardless of the size of the project Developing prototypes in parallel, rather than in series, results in stronger outcomes (Dow et al, 2010).

User involvement

Ideally, users are involved in problem and solution finding during a project. User interactions with the team should be frequent (or ongoing), and with a diverse group of people. To objectively test the performance of the team on user-centric practices, Roth and Royalty propose to measure the amount of user interactions, the number of days in between user interactions, and finally the amount of different user types that are involved.

MEASURING ITERATION

PROTOTYPE **ITERATIONS** PER FEATURE

CONCURRENT PROTOTYPES

MEASURING USER CENTRICITY

DAYS THE TEAM GOES **BETWEEN USER INTERACTIONS** (OBSERVING OR INTERVIEWING)
USER INTERACTIONS OVER THE LIFE OF A PROJECT
USER PERSONAS TO MEASURE DIVERSITY OF USER INSIGHT.

Figure 23. Measures for iteration and user centricity proposed by Roth and Royalty (2016)

Sony: quantify the adoption of Design Thinking

Because of a lack of standard measures to track DT processes, some companies are developing their own approach to measure design. An example is Sony, that aims to quantify the adoption of DT in the organization (Figure 24).

At Sony, they track the time spend 'thinking', 'doing' and the amount of prototypes made. They also track employee engagement and other employee measures. They count the amount of coaches that are trained.

This approach is straightforward, but can also be recourse intensive and it remains unclear how the value of the measures is determined, e.g. if there is benchmarks in place. A comparison is helpful to provide information about e.g. if the amount of time spend thinking is a relatively high or low.

Measure change

quantify the adoption

Move from "operational" to "behavioral" metrics.

DEEP AND HOLISTIC HUMAN UNDERSTANDING

VISUALIZATION OF NEW POSSIBILITIES

CREATION OF A NEW ACTIVITY SYSTEM

employee trained, coaches trained, human-centered projects

time spent "thinking"	time spent "doing"	employee engagement
days without user interaction	number of prototypes per project	employee satisfaction
number of users involved	number of prototype per feature	employee motivation
number of problems reframed	number of concurrent prototypes	employee interruptions
number of hypothesis generated	prototype-insight rate	
DESIGN THINKING	DESIGN DOING	DESIGN ENVIRONMENT

Figure 24. DT measures by Son (Picchi, 2017)

Maturity models

Another measuring initiative for design maturity is proposed by DMI: the Design Maturity Matrix (Figure 25). The model distinguishes design on three levels: aesthetic, system or business design. These different levels of design can score on a scale of 1 tot 5 ranging from initial to optimized. According to DMI, the model can be used as a diagnostic and communications tool to understand design maturity in the organization at different levels of design, communicate with a common language and align investments in design.

The scale for the DMI model is adopted from common UX maturity models (e.g. Figure 26).In turn these originate from the Capability Maturity Model (CMM) (Humphrey, 1988). The term *maturity* relates to the degree of formality and optimization of processes, from ad hoc practices, to formally defined steps, to managed result metrics, to active optimization of the processes. The CMM model's aim is to improve existing software development processes, but it can also be applied to other processes, as is happening with UX design.

By achieving maturity Level 4 or 5, an organization demonstrates a deeper commitment to continuous capability improvement using statistical and other quantitative methods. This is hardly the case with UX design. A study by Berendsen (2014) indicated that in 40% of companies employees indicate level 2 maturity: an interest in UX. 28 % of firms were given a level 3 ranking, meaning they are making investments in UX. This shows that most companies show interest in UX but are not fully committed.

This way of indicting maturity in the organization is more subjective, compared to the measuring approach of Roth and Royalty or Sony. In these maturity models, the terms in the scale are not fixed and are often open to interpretation. This makes this maturity model more based on gut feeling. It does however offer a good starting point for companies and teams to discuss how the maturity of UX is could be approached and improved.

Based on observations in the firm, it is expected that Exact has a maturity level of 3 in the DMI Design Maturity Matrix (Figure 25). UX Boost is introducing the standard process. Organizational and strategy design maturity levels are probably level: initial. In the maturity model of Fraser and Plewes, Exact would probably fit best in stage 3: adopting, because UX design is practices at different levels during the whole process.

Establishing the 'right' score is difficult because it is subjective and each UX maturity model uses different wording.

How do these measuring approaches influence how design is tracked at Exact?

Overall it can be concluded that there is no set measurement tool in place to determine the maturity of specific design practices. However, elements of existing research can be included a custom measurement tool for Exact.

Objective measurements concerning the quantity and quality of prototyping and user involved, proposed by Roth & Royalty (2016), can be applied to the project teams at Exact. This involves counting users and prototypes over the course of the project. Sony also keeps count of the amount of employees that are trained in DT. In the context of Exact it is interesting to measure teams have the ability and experience to plan DT activities wihout help. Comparing projects on these measures shows how *prototyping, user centricity* and DT skills have improved over time.

Concerning the maturity models, such as the DMI Maturity Matrix, it is expected that the Exact projects score similar, because the levels are generically described and subjectively scored. Therefor it can be concluded that this model is not an appropriate tool to compare projects over time.
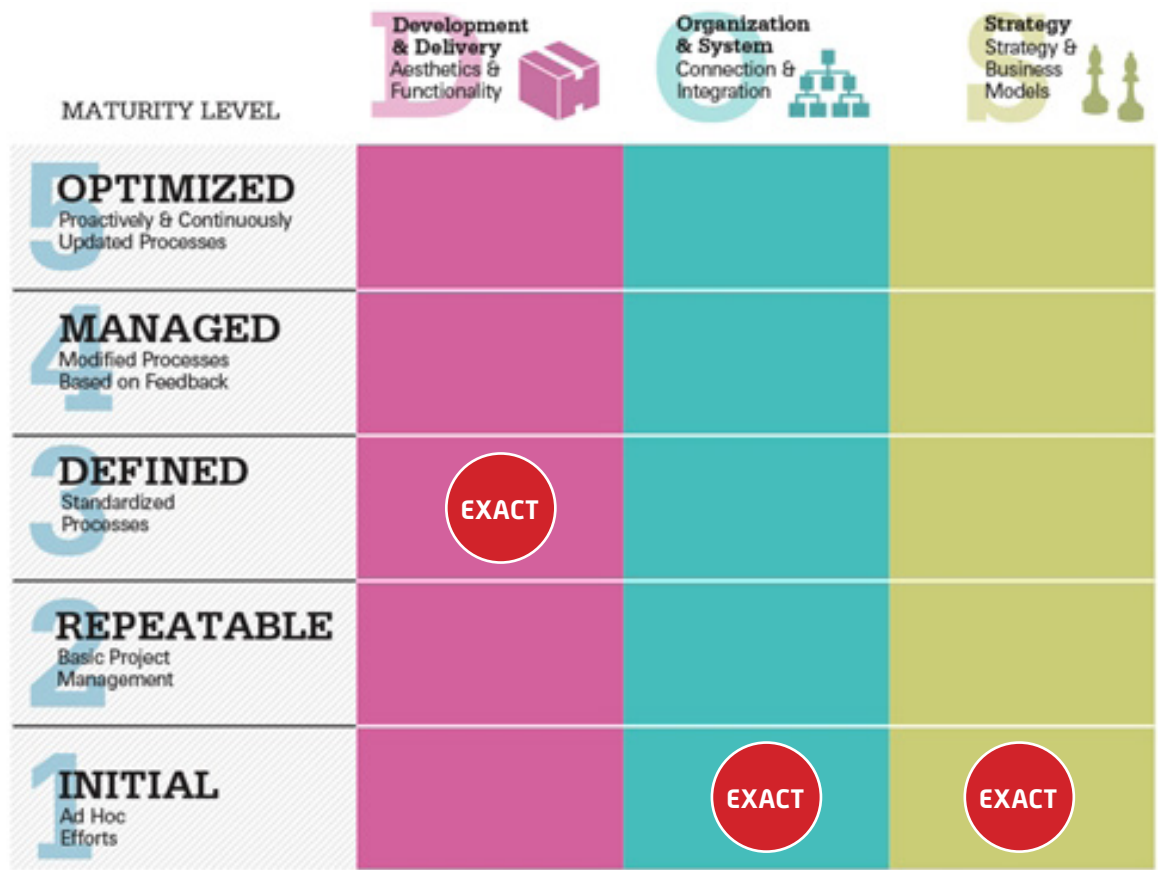
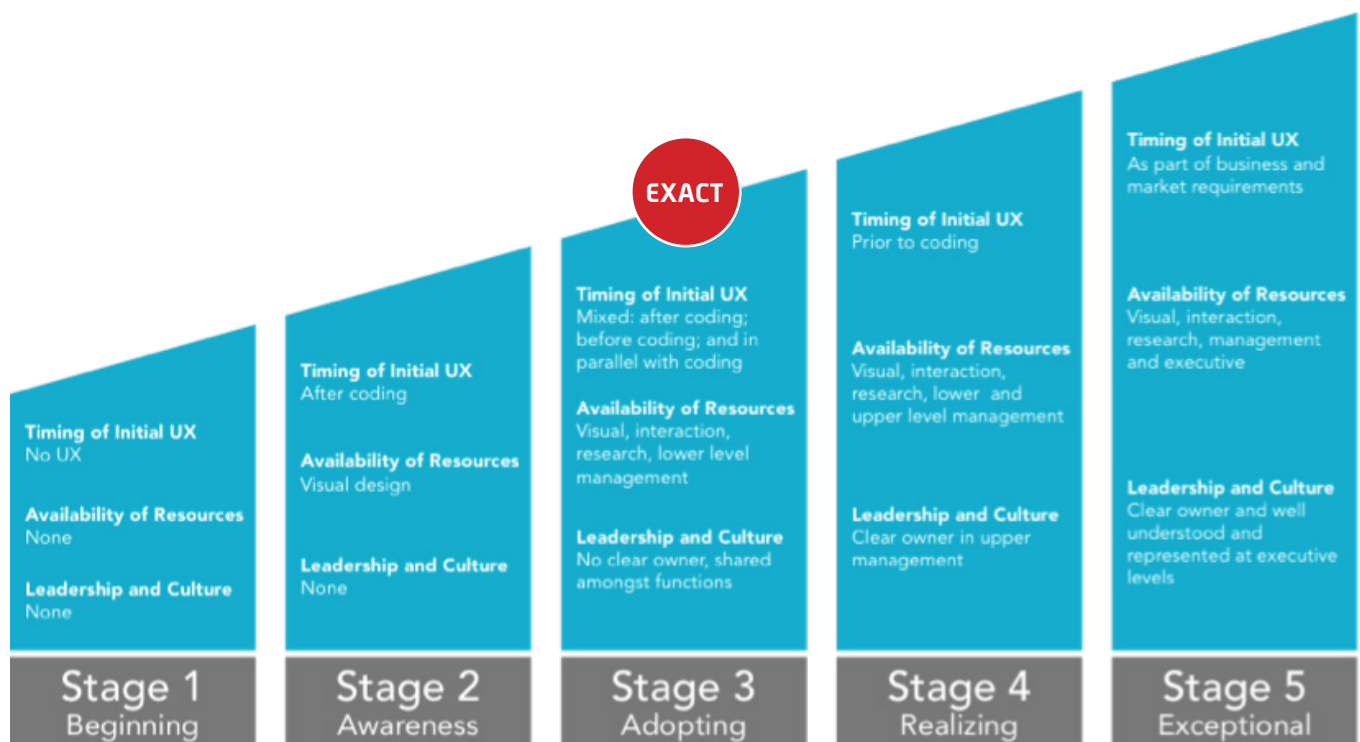*Figure 25. The DMI Design Maturity Matrix (2015)*

Figure 26. UX maturity model (Fraser and Plewes, 2015)

2.4 | SURVEY DESIGN

To measure the maturity and impact of design practices in the organization, a custom survey was developed as part of this thesis. The survey was conducted online via GoogleForms. The survey is based on recent studies that translated the concept DT to principles and practices (Carglren 2013, Carlgren 2016, Hassi and Laasko 2011).
This section introduces the survey topics and survey design. The full survey can be found in Appendix 3: *Full survey.*

Survey topics

The survey includes measures in four categories:
1) project characteristics 2) design maturity 3) project outcomes, 4) employees perception of DT effectiveness and efficiency.

1) An inquiry of project characteristics provide an overview of the research sample, including possible differences between recent and benchmark projects. It also enables exploration of the relation between project characteristics and the use of DT, possibly identifying types of projects that are more open to the DT approach.

2) Design maturity measures include questions about mindset and activities that occurred in the projects. It provides a status report of design thinking practices. Comparing the design maturity of recent and benchmark projects, allows for an evaluation of the effectiveness of the DT program.

3) Project outcomes were evaluated to establish to investigate the value of DT in the context. This allows for a correlation analysis of project outcomes and design practice measures.

4) Employee perceptions and experience with DT are measured. Do they think DT is effective to improve project outcomes and efficient to save time in projects. This section also included questions about the teams ability to perform DT methods without help of facilitators, indicating their knowledge and experience level.

The specific measures and results concerning the value of DT in context are discussed in Chapter 3: *Exploring the value of Design Thinking in context.* Other results are explained in this chapter.

Likert-scale

To determine the maturity of DT in project teams, DT practices were translated to 29 statements, adapted to fit the context of the case study. Respondents were asked to rate statements using a 7 point Likert scale ranging from 'completely agree' to 'completely disagree'.
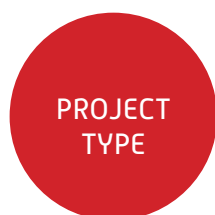
PROJECT TYPE

What kind of projects are in the sample?

DESIGN PRACTICES

How mature are design practices in project teams?

PROJECT OUTCOMES

Did the project have good outcomes?

PERCEPTIONS OF DT

What do employees think about DT?

Figure 27. Survey topics

DESIGN PRACTICES					
User centricity	**Diverging**	**Tangible (visual, prototypes)**	**Converging**	**Cooperation**	**Experimental mindset**
Deep user needs Explicit user needs Important user needs Focus on user experience Creating empathy	Creating multiple ideas Postponing judgement on ideas Taking different perspectives *Different opinions are encouraged* *Build on ideas*	Visual thinking Visual information processing Prototyping 'quick and dirty' Prototype for assumption testing	Creating patterns/clusters Having reflection moments Setting criteria for idea selection	*Build on ideas* *Different opinions are encouraged* Combining expertises (multidisciplinary team) Stakeholders involved in problem finding Stakeholders involved in solution finding	Process steps are iterated Taking risk (doing new things that might not work) Tolerating failure Accepting uncertainty Welcoming change

Table 2. Design maturity measures included in the survey.

Design maturity measures

The survey questions covered six key principles of DT: user centricity, tangibility, cooperation, optimism, experimentalism and ideation (Figure 28).

1) User centricity in project teams is measured by the team's ability to determine explicit and deep user needs (Lockwood 2010; Sanders, 2012). Design Thinking balances intuitive and analytical thinking (Martin, 2009), so teams should be able to filter the most important or relevant user need after research. User centricity was also scored by team's ability to create empathy with the user (Brown, 2009) and whether they considered the entire user experience (Brown 2009, Calabretta 2016).

2) Tangibility is a key factor in design and designthinking (Calabretta, 2016, Carlgren 2016, Brown 2009). It includes the ability to make thoughts and information tangible, either through visualisations or prototypes. Design Thinking empathizes 'quick and dirty' prototyping of ideas and features, to allow for quick and frequent (user) feedback and iterations. (Seidel 2013, Brown 2009)

3) Cooperation covers teamwork and communication within the team, as well as involving stakeholders in the process. Also Design Thinking teams are ideally multidisciplinary and team members are open to discuss differences (Calabretta 2016, Brown 2009, Lockwood 2010, Carlgren 2016).

4) Design maturity also includes measuring optimism in the project group. A characteristic of design also described as " a bias towards betterment" (Calabretta 2016).

5) In an experimental environment, DT can thrive and reach optimal results. An experimental mindset is reflected by a tolerance for failure and iteration culture (Carlgren, 2016). In previous survey research, Grunet and Reinhardt (2016) measured an innovation culture by team's openness to constructive conflict and understanding failure as a natural part of the process. Risk taking and openness to ambiguity scales are adopted from the study of Valentine (2010) exploring the impact of work context on work response. Teams are asked how welcome they are to change and if they encourage each other to try new thing, 'even though they might not work.'

DT is referred to as a combination of analytical and creative modes of reasoning (Dunne & Martin, 2006; Liedtka, 2015). This 6) diverging and 7) converging, often represented in the ideation 'diamond' model, ensured that options are created and choices are subsequently made (Brown, 2009, Martin 2009). Diverging includes a focus on quantity of ideas over quality by postponing judgement and taking different perspectives to the problem. Creating a quantity of solutions to a problem has proven to improve the outcome (source). When converging or selecting ideas, it is key to reflect, look for patterns and create criteria (Carlgren 2016, Calabretta 2016).

2.5 | SURVEY SAMPLE

This section explains how projects and respondents were selected for the survey and the final sample size that resulted from this.

Selecting projects

The projects included in the study were selected based on the development capacity dedicated to them. They all had significant development power, showing a commitment from management to execute the project. In this way both successful and challenging projects in terms of DT were included in the sample, reducing bias that arises from 'advertising' only success stories (Carlgren, 2013, Liedtka, 2017).

Projects selection ensured a time range to enable a comparative study between a group of recent projects, and a group of older projects (used as benchmark measurements), to establish how design capabilities have developed over time.

Sample size

A total of 73 employees were invited to participate in the survey. These employees worked on one of the selected projects. They were specifically asked to fill in the survey to reflect on one project.

42 surveys were completed (response rate 58%) reflecting on a total of 21 projects (Figure 28). Twelve projects were completed recently (25 responses), when DT was actively promoted and supported in the organization. Nine older projects served as a benchmark group (17 responses).

21
SME projects

42
Internal survey

Figure 28: Survey responses

2.6 DESIGN MATURITY RESULTS

Survey results on design practices reflect in the design maturity report. This section explains the results of the survey, indicating strengths and weaknesses of DT at Exact. The survey analysis was run in SPSS.

First results about on project characteristics are discussed, to give an overview of the sample. Then, means and deviations are reported for the group of recent projects, to determine the design maturity. The results are compared to the means of the benchmark project group, to establish how design capabilities have developed over time These results will be used to propose next steps to develop DT at Exact.

An evaluation of quantified measurements, including the measures proposed by Roth an Royalty, can be founs in Chapter 7.*3 An evaluation of quantified measurements.*

The data sheets, on which this results section are based, can be found in Appendix 4: *Survey results*

Differences benchmark and recent projects

A Mann-Whitney test revealed differences between recent projects (r) and the benchmark group (b). Figure 30 shows an overview of the sample, based on the results from the measures on project characteristics. sFigure 29 illustrates that more Design Thinking is purposely applied recent projects (Mdn,r = 6,00, Mdn,b = 4,00, U = 66, p = .000).
Also, recent projects have a more open scope than benchmark projects. Deliverables are not as fixed (Mdn,r =5, Mdn,b =3, U = 123, p = .02) and there is more freedom to redefine the scope (Mdn,r = 6, Mdn,b =5, U = 132, p = .03.). Additionally, recent projects show a greater focus on long term goals, (M=5,20, SD=1,64) than the benchmark projects (M=4,00, SD=2,12); t(40)=--2,07, p = 0,45.
There is no significant difference in time and pacing between benchmark and recent projects. Most projects take between 3 months and two years and are not time crucial.

Figure 29. Level of DT applied in projects.

9 Benchmark projects

before 2017
17 responses

12 Recent projects

2017
25 responses

 More Design Thinking

 More future oriented

 More open scope

Figure 30. Differences between benchmark and recent project group

Design Thinking strengths and weaknesses at Exact

Mean scores for DT principle measures are positive. Acquiescence bias has to be taken into account (Watson, 1992).

Only two measures, related to uncovering deep user needs and creating criteria for idea selection, scoring below 4 on a scale of 1 to 7. Table 3 provides an overview of the design principles and the average scores of measures on design principles. Data concerns recent projects. The benchmark group is excluded because they do not represent the current maturity of design practices.

DT element	# measures	Avg. Mean,r (1-7)
Experimentation	5	5.4
Optimism	1	5.2
Cooperation	8	5.1
User centricity	5	5.0
Tangibility	4	4.6
Diverging	3	4.4
Converging	3	4.3

Table 3. Average mean scores fo DT principles.

Employees indicate a relatively high experimental and optimistic mindset in project teams. Lower scores are found for making concepts tangible through visualizations and prototypes. Also scores for the ideation practices diverging and converging, are relatively lower, indicating that there are not multiple concepts created to solve a problem.

Zooming in on specific the measures reveals more detailed strengths and weaknesses in the project teams (Table 4). Teams are open to change and process steps are iterated. However, teams don't systematically create a multitude of ideas, reflecting in a low mean and high variance. As a logical result limited criteria are set up for idea selection.

Besides these highest and lowest mean scores, there were several measures with high variance in the results. Most variances is found in the category: multidisciplinary teamwork. Teams do not always have the required expertise in the team, to perform the project optimally (M= 4,72, SD=2,02). On average, designers are involved in strategic decisions, but variance is high, indicating that this is not always the case(M=5,20, SD=1,92). The level of experience with DT also varies between projects (M=4,36, SD=2,022).

Highest scored questions	M	SD
The team welcomes change	5.7	1.0
The team is able to identify explicit user needs	5.6	1.0
Process steps are iterated	5.5	1.4
Lowest scored questions		
The team developed criteria for idea selection	3.7	1.5
The team is able to identify deep user needs	3.9	1.4
At one point, the team focused on creating multitude of ideas	4.0	1.7
No frustration in team	4.1	1.5
Stakeholder input influenced project outcomes	4.2	1.7
Prototypes were 'quick and dirty' rather than detailed.	4.3	1.4
The team was able to postpone judgement on ideas	4.4	1.7
The project can be used as an example of excellent communication	4.5	1.5

Table 4. Highest and lowes scores for design practices

Maturing of design practices over time

When comparing the design maturity scores of recent and benchmark project, several significant differences are found. Overall, the maturity of design practices improved compared to the benchmark group (Figure 31).

An independent sample t-test proves that stakeholder impact on project results has significantly decreased (p=.45), compared the benchmark. A Mann-Whitney test indicated that user centricity has improved. Figure 32 shows how the specific user centricity measures improved. There is more focus on the user experience, compared to benchmark projects (U = 105, p = .01). More explicit (U=138, p=0.05) and important (U=128, p=0.26) user needs are identified in recent projects. An independent samples t-test showed a significant increase in the ability to create empathy (p=.19) and a stronger focus on the user experience (p=.01). Additionally the standard variation has decreased in more recent projects, indicating more stable results and maturing of user centric practices.
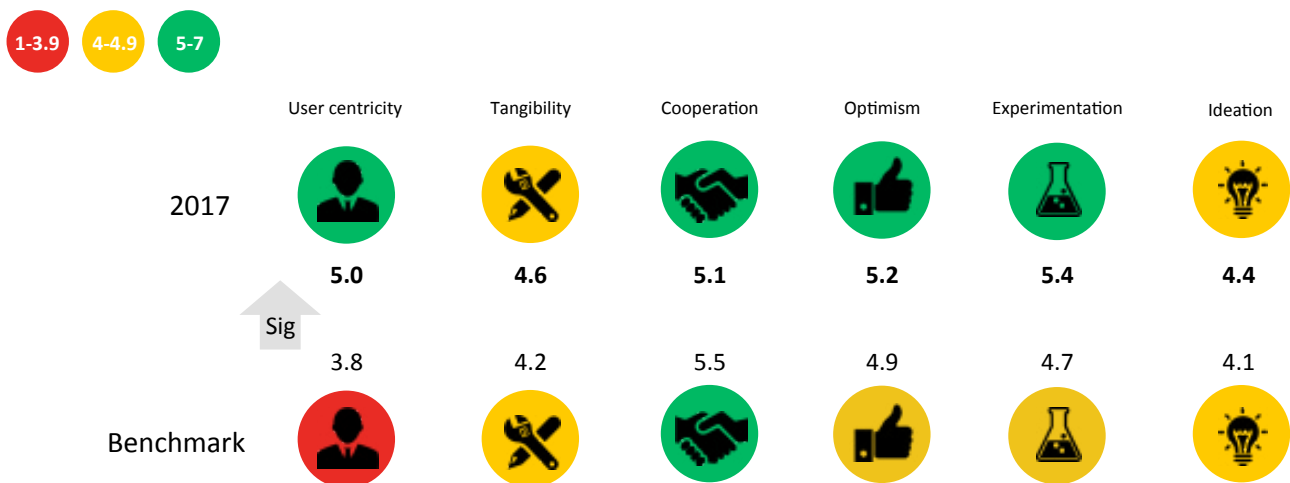

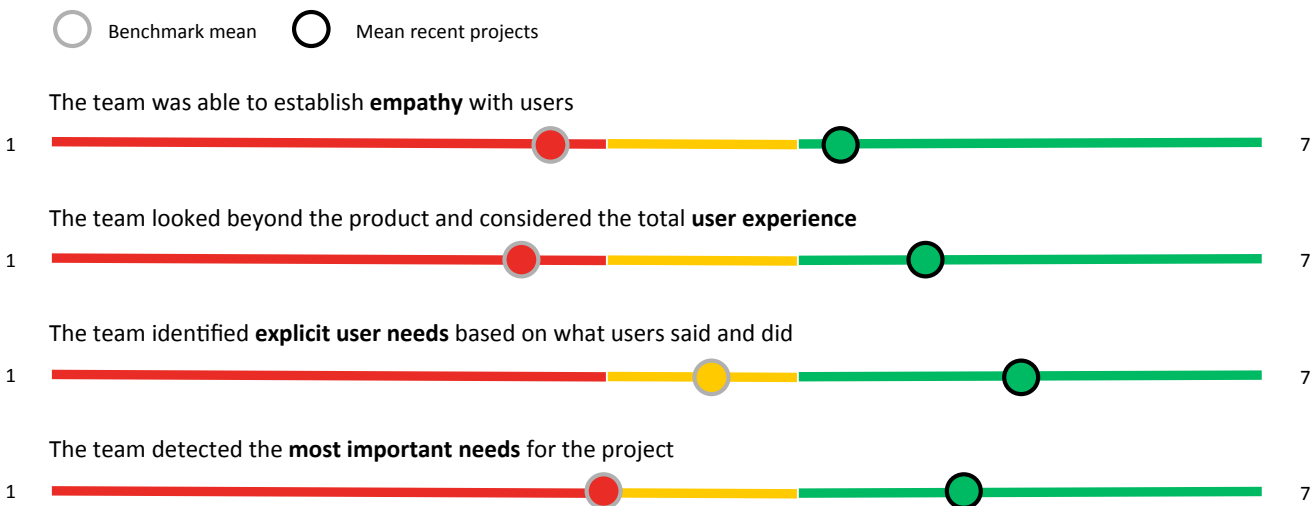*Figure 31. Comparing average mean scores for the design principles*

Figure 32. Significant improvements in user centricity scores

Tools and methods

Table 5 provides an overview of methods used in recent and benchmark projects, reported by employees in the survey. The data sheets for these results can be found in Appendix 5: *Survey results design methods.*

In general, more methods are used in recent projects. Almost all projects use brainstorming and interview techniques.

Laddering (asking *why* questions) and *How Might We* are new methods. Together with a strong increase in the use of problem statements, it is indicated that there is stronger focus on re-framing problems now.

What is also striking all projects use brainstorming and many use sketching and prototyping in their projects. Maturity levels for *tangibility* and *ideation* were rather low, indicating that the quality of these practice can be improved (rather than it being a quantity issue). For example prototypes can be too detailed and brainstorming does not always lead to multiple solution options.

Method	% current projects using the method	% benchmark projects using the method	Difference in usage
Brainstorming	100%	89%	11%
Interviews	92%	78%	14%
Problem statement	83%	44%	39%
Survey	75%	44%	33%
Customer visit	75%	67%	8%
Data analysis	75%	67%	8%
Scribbles and sketching	75%	33%	32%
Competitor analysis	75%	55%	20%
Digital prototyping	67%	55%	12%
Clustering	67%	33%	34%
Business Model Canvas	67%	11%	65%
Idea voting	58%	33%	25%
Solution feedback	58%	67%	-9%
Customer Journey	58%	33%	25%
Laddering	50%	0%	50%
Personas	42%	44%	-2%
User scenarios	42%	44%	-2%
Observations or shadowing	42%	22%	20%
Analog prototyping	33%	11%	22%
Value proposition canvas	33%	11%	22%
Co-creation with users	33%	55%	-22%
How Might We	25%	0%	25%

Table 5. Methods used in at least 25% of benchmark projects

2.7 | DESIGN MATURITY CONCLUSIONS

Results concerning the maturity of design practices are further interpreted and discussed. Conclusion are made about the current state of design at Exact and the effectiveness of the DT program.

A comparative study

Design practices in 21 projects were evaluated by 42 employees. Evaluation of projects was facilitated by an online survey. Each respondent reflected on the process and mindset used in a specific project. The project sample is split in two groups: 9 projects that finished before the UX Boost promoted DT, and a group of 12 projects that ran during the DT program. This allows for a comparison of design maturity scores.

Current strengths in DT: an open environment

From recent projects it can be conclude that strengths of DT at Exact are an *experimental* and *optimistic* mindset. Teams are open to change and process steps are iterated.

Improvement opportunities in conceptualization

Two main improvement opportunities are found in *tangibility* and *ideation.* Meaning the conceptualizations of ideas can be optimized: from diverging into the solution space, to analyzing solution options and visualizing concepts.

The level of experience with DT varies a lot across project teams, indicating that DT is still emerging.

Perceived user centrictiy improved

The perceived user centricity has improved significantly compared to the benchmark. It can be concluded that the program activities contributed to this, since multiple activities that focus on this topic and the importance of user centricity was clearly communicated to project teams.

Ideation practices did not significantly improve

Ideation was also addressed specifically in several activities in the DT program, but there were no significant changes in the maturity of diverging and converging practices over time. This implies that ideation is more challenging to introduce in this software firm.
User centricity was more heavily advertised through communication channels, which might be reason why this is adopted more.
Ideation could be more difficult to implement because it requires more creativity whereas everybody can go talk to users. Typically Exact employs analytical individuals that might not feel comfortable diverging. The survey supports this notion with employees finding it difficult to postpone judgment on ideas. Interview results support the notion that employees struggle with the 'fuzzy' part of design thinking, in which ambiguity and uncertainty occur.

3

EXPLORING THE VALUE OF DESIGN THINKING IN CONTEXT

Proponents of DT advocate a large range of positive outcomes that result from using DT. This chapter explores the value of DT in the context of Exact, to see what is the fruit of the work.

Measuring the results of DT is rarely done, because it is considered highly challenging to single out the effect of DT on the project outcome. This graduation project experiments with several ways to measure DT outputs.

In this chapter, first the proposed benefits of DT in practice and literature are discussed.

The survey at Exact included measures for design practices and project outcomes, to allow for a correlation analysis. The project outcome measures are explained in more detail.

Finally the results of the correlation analysis indicate the value of DT in context. This value in context is then compared to the previous academic studies to point out how the impact of DT at Exact can be improved.

Design maturity

How has the maturity of design practices developed over time?
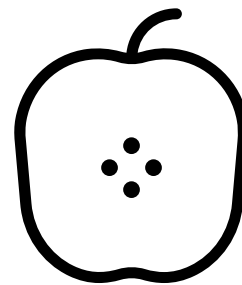
Design impact

How do design practices influence the project outcome?

Figure 16. The two main survey results: design maturity and design impact.

3.1 | THE VALUE OF DESIGN THINKING

This section explains the benefits that are expected from using DT, based on anecdotal reports and studies of DT in practice.

Drivers to implement Design Thinking

Roth and Royalty (2011) identified three main drivers for companies to implementing DT (Figure 33). Organizations are keen to implement DT because they wish to better understand users, enhance their competitive advantage or they want to improve team dynamics. These percieved benefits are most highly valued by organizations.

Anecdotal reports

Based on their experiences proponents of DT, such as Brown, Kelly and Martin praise the approach for delivering positive outcomes, fitting three rough categories. Results can be:

1) user-facing, such as greater innovation output by more 'emotionally satisfying and meaningful' solutions (Brown, 2008);

2) organizational, e.g. improved exploitation/ exploration balance (Martin, 2009; Dunne and martin, 2006), improved collaboration and motivation through empathy and knowledge sharing through prototyping (Martin 2006, Brown 2008) or a shorter time-to-market by "converting learning from the user into viable business outcomes"(Martin, 2006).

3) an enabler for personal development e.g. building the ability to deal with conflicting constraints (Martin, 2009) or create confidence in personal creative ability (Kelley and Kelley, 2013).

However, these anecdotal records lack empirical foundations to support the success claim and lack details, for example on the type of innovation output that is expected (Wyant, 2008; Cruickshank, 2010, Carlgren 2013).
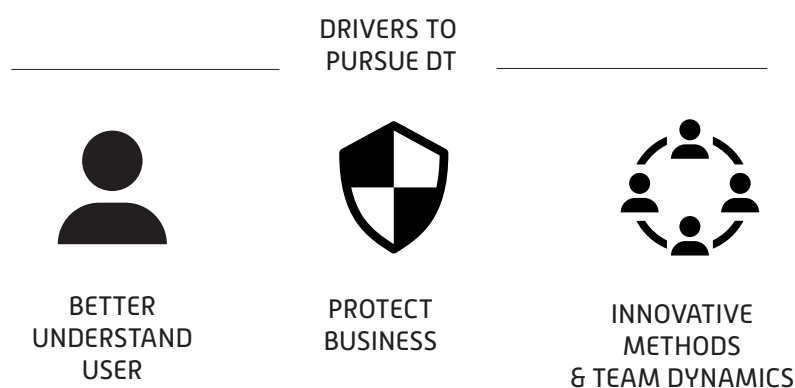
DRIVERS TO
PURSUE DT

BETTER
UNDERSTAND
USER

PROTECT
BUSINESS

INNOVATIVE
METHODS
& TEAM DYNAMICS

Figure 33. Roth and Royalty drivers for DT

Academic contributions

There is still little academic research on the impact of DT on organizational outcomes (Liedtka 2017). Reasons may be the emerging nature of the phenomenon, poor academic conceptualization of the approach and hyped discussion (Johansson-Sköldberg et al., 2013). Empirical research on the value of using DT focuses on understanding parts of the concept such as tools (Seidel and Fixson, 2011), multi- disciplinary teams (Beckman and Barry, 2007) or prototyping (Dow and Klemmer, 2011), Most of these studies are experimental, often involving students. Carlgren (2013) and more recently Liedtka (2017) conducted studies on the impact of DT in organizations on a largerer scale.

Carlgren (2013) finds that firms can build long-term innovation capabilities, because DT effects individual development, processes and business culture. Individual development is empowered by DT because employees get an increased feeling of democratization and the tendency to embrace diversity. Collaborative process builds trust and ownership amongst implementers. The customer-oriented approach sped up the development process by targeting the right users, learning to fail soon and weeding out bad concepts at an early stage through rapid iterations and user feedback. Visualizations and prototyping improved communication within the team and with externals, as well as enhancing creative teamwork by expanding ideas. DT was also perceived to establish cultural change, contributing to changing values and norms in the firm, which had previously been seen as barriers to innovation. Leaders showed increased innovation awareness in terms of becoming less short-term and output oriented.

Liedtka finds proof that DT produces solutions with higher value for stakeholders. This is a result of extensive problem exploration and reframing, user-driven design criteria, multidisciplinary teamwork and co-creation with stakeholders.
DT also reduces risk or visibility of failure in innovation. This is linked to the improved innovation outcomes. Creating prototypes, surface assumptions and seeking disconfirming data, improves decision making through bias reduction. Finally the collaborative process builds trust and ownership amongst implementers.

The model of Lietdka, linking DT practices to specific outcomes, can be found in Appendix 6: *Model Liedtka.*

Figure 34 provides an overview of the benefits of using DT that are put forth by the studies of Carlgren en Liedtka.

Value in context

Anecdotal accounts of value generation by DT often do not specify contexts, implying that outcomes can be achieved in any firm. However, the variety of views about how to describe the concept, inevitably affects how value is perceived (Hassi and Laakso, 2011). Similarly Carlgren (2013) recognizes that the value of using DT is highly context-dependent. In this thesis is it explored what the value of DT is in the context of Exact.

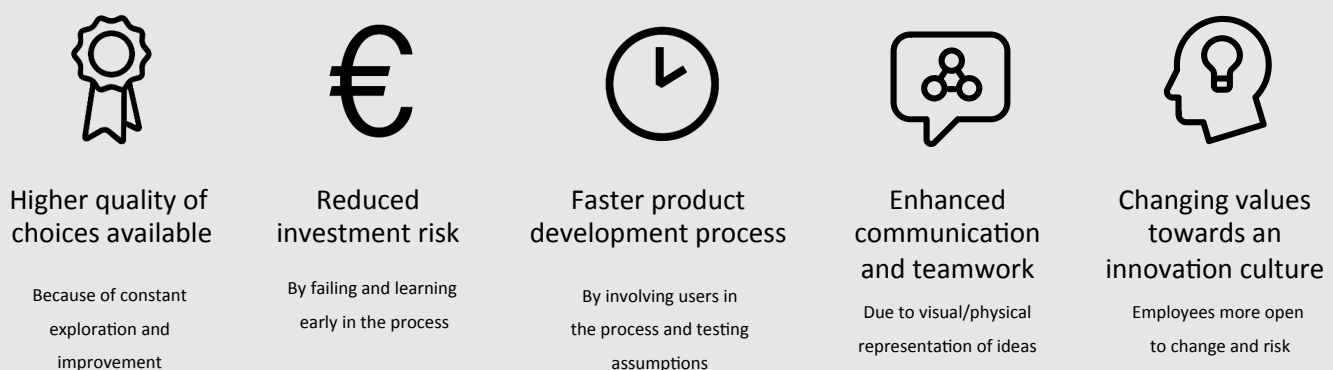| Higher quality of choices available	Reduced investment risk	Faster product development process	Enhanced communication and teamwork	Changing values towards an innovation culture
Because of constant exploration and improvement	By failing and learning early in the process	By involving users in the process and testing assumptions	Due to visual/physical representation of ideas	Employees more open to change and risk

Figure 34. Different types of benefits that can be expected from using DT, based on Carlgren (2013) and Liedtka (2017)

3.2 | MEASURING IMPACT

This section provides an overview of studies that concern measuring the impact of DT. The measures used in this study are introduce to conclude this section.

Challenges to measure Design Thinking

When implementing new business processes, there is an organizational need to measure the ROI to ensure ongoing organizational support. However measuring innovation outcomes has proven to be challenging Key problems in innovation indicators concern the underlying. Conceptualization of the object being measured, the meaning of the measurement concept, and the general feasibility of different types of measurement (Smith, 2005). Simulary, firms struggle to measure the innovation outcomes of their DT efforts.

An inquiry by the Hasso Plattner Institute amongst 403 firms applying DT, uncovered that firms notice the impact of DT, but this impact is hardly measured. 71% percent of respondents (n=181) perceived DT as an effective approach and 69% agrees DT improves project efficiency. However only 24% measures the

Most companies don't manage to measure impact because of a lack of (knowledge) resources to measure DT and clear KPIs (Figure . Firms that do measure DT outcomes, use vaguely coherent metrics. (Schmiedgen et.al., 2014).

Not all of the challenges apply to Exact. Most importantly, a benchmark group is identified to allowing for comparative measurements of the impact of DT. There are no standard measures available, these have to be researched and developed. Active promotion of the DT in the organization ran for one year now. Indeed it could be that this period of adoption is too short to notice notable differences in project outcomes. Research results must show if this is the case. There are resources devoted to measuring the adoption and impact of DT, mainly by means of initiating this thesis project. DT is supported by management en introduced formally with several kick-off events. Exact employs analytical employees that appreciate proof of concepts. There is a need to measure the impact of DT to fnd improvement opportunities. In measuring the impact of DT, not only hard data must be considered. 'Soft' skills and working culture need to be taken into account.

WHAT TO MEASURE?
"no idea," "no tool," "no KPIs available," "no metric," no "test groups" or "benchmarks"

TOO LITTLE EXPERIENCE
"too little experience with DT so far", "too early"

LACK OF RESOURCES
"[…] no time and money".

FLYING UNDER THE RADAR
"DT not fully supported approach by the management" or "DT has never been introduced formally."

WORKING CULTURE
"How do you measure enhanced teamwork?" "it is too much about feelings, soft-skills and culture."

UNNECESSARY OR IMPOSSIBLE
"not needed yet," "Why should we?"

Figure 35. Barriers to measure DT (Schmiedgen et. al, 2014)

Finding the right performance indicators

Respondents in Schmiedgens study indicated they had difficulties finding fitting measures for DT.

" So many factors influencing the success of any given project ... how can one hope to single out one definitive outcome caused by design thinking?"

" If design thinking is embedded in your organization it cannot be measured as a single concept, Therefore we measure our general performance with several KPIs, but we cannot determine specifically to which level design thinking contributed to this."

Figure 36 provides an overview of the performance indicators for DT used by the organizations included in the study. It is concluded that there is no specific stand-alone DT KPI and it is highly probable that there can be none capable of adequately determining the specific contribution of DT in an organizational setting due to the complexity of the situation (Schmiedgen et al. 2014).

To test the innovativeness of the project outcomes, Roth and Royalty (2013) propose the novelty grid (Figure 37). Outcomes must be positions within a matrix, determining how valuable they are to customers and how novel the solution is. Team members vote anonymously and scores are averaged to determine grid placement. This matrix can be used to determine the competitive edge of DT outcomes and it takes the company into new directions.

DMI developed the Design Value Map, in which organizations can score the output of DT on several functional levels: value that is delivered financially, for customers, in the process, developing new capabilities (learning) or social benefits.

CUSTOMER FEEDBACK — customer satisfaction, NPS, response to campaigns, usability metrics, client feedback

DESIGN THINKING ACTIVITIES — number of projects, people trained, coaches trained

QUICK RESULTS— concepts finished, projects launched, projects funded, projects in development

ANECDOTAL FEEDBACK — evaluation forms, qualitative feedback at each stage of the design thinking process, surveys

TRADITIONAL KPIS — Increased Sales, ROI per project, and other financial measures

CULTURE — team efficiency, engagement, collaboration, motivation

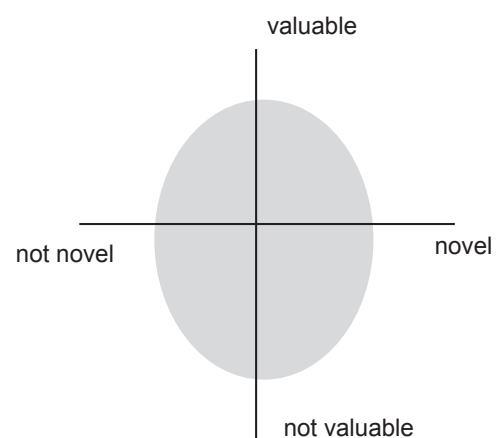*Figure 36. Performance indicators used in practices (Schmiedgen, 2014)*

Figure 37. Novelty grid Roth and Royalty (2013)

PROJECT TEAM

Project efficiency
Satisfaction with outcome
Satisfaction with teamwork
Employee engagement

USER

User satisfaction
Amount of users
Churn rate

EXACT

ORGANIZATION

ROI
Fit with strategy

Figure 38. Project success and possible measures for different stakeholders

Project success at different levels

Research about performance indicators for DT indicate that there is not one single measure that represents the value of DT. Reason for this: DT creates value on different levels. This thesis explores performance indicators on three different levels: the team, the user and the organization as a whole. (Figure 38). A project can be successful from a team perspective if it is completed within time and budget, with good team work. This says nothing about the success on user level. For example, a project can be over budget, but deliver great value to users. At a higher organizational level, success means a return on investment (ROI) and it is often appreciated that the project outcome has a fit with existing business processes and strategy.

Data sources

To determine the value of DT on these different levels, three data sources are analyzed in this thesis work.

First data source is the annual employee engagement survey. As design is regarded as 'fun' and it said to enhance communication and teamwork. this was considered a suitable However the employment engagement survey showed to difference in results between the UX Boost year and previous years. It can be concluded that the DT program did not make a significant impact on the employment engagement in this year.

Second, existing KPI's were explored, with a focus on user data, because user centricity had improvement significantly compared tot he benchmark group. This data includes churn, user satisfaction ratings and NPS scores. Results are found in section 3.5 *Business data analysis.*

Finally, outcomes were scored at a project level by means of self reported measures in the employee survey. This project based data allows for correlation analysis, providing more information about the link between specific design practices and perceived project outcomes.

Survey measures for project outcomes

This paragraph explains the survey measures for project outcomes. They cover value creation at different levels. Teams evaluate the quality of the final product, the company fit, the project efficiency and reflect on teamwork and learnings (Figure 39).These outcome topics are based on the impact that DT can make as discussed in section 3.1 *Value of Design Thinking.* Partly, the outcome measures were based one existing studies on project evaluation.

Teams were able to score the project outcome based on their own satisfaction with the project results and feedback from users. Scales to test user feedback were adopted from previous research by Veldhuizen et.al. (2006) Concerning New Product Development. It was measured to what extend products offer unique benefits and higher quality than previous offerings.

Brettel et. al (2012) previously studied the impact of R&D on project performance. For this project outcome measures were set up for the project efficiency: meeting time and budget requirements.

In the same study, Brettel identified learning factors that determine the success of project outputs. Similarly Mahr et. al. (2014) defined learning success as the degree to which the experience and knowledge gained in a project serves as input and eases subsequent projects. This measure is used in the internal survey to determine the success of project outcomes.

Questions for company fit were adapted from scales of Griffiths-Hemans, et. al (2006), who studied consequences of creation of creative concepts. Company fit is described as the amount of organizational change required to implement a new idea.

The full questions can be found in Appendix 3: *Full Survey.*

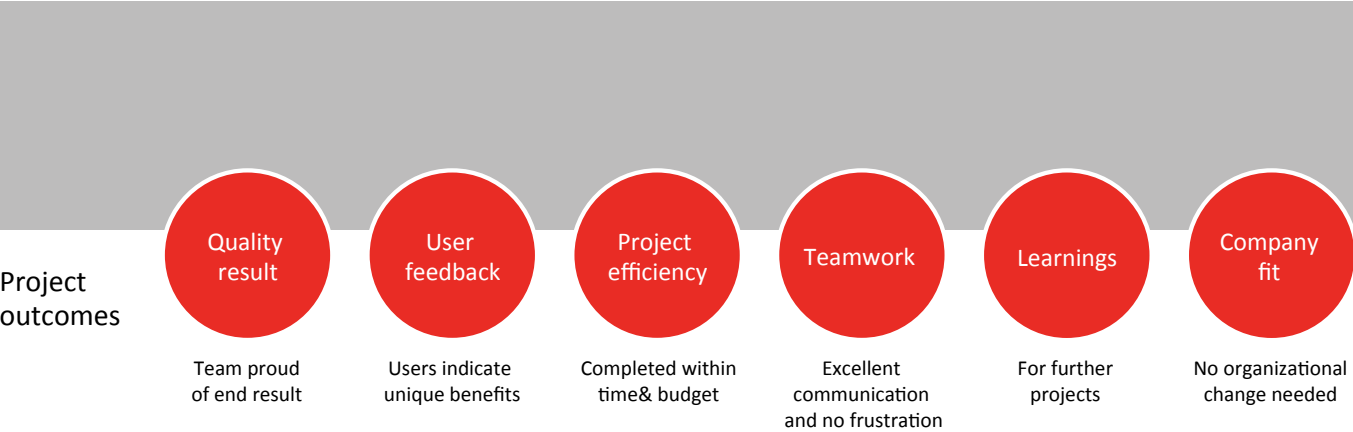| Project outcomes	Quality result	User feedback	Project efficiency	Teamwork	Learnings	Company fit
	Team proud of end result	Users indicate unique benefits	Completed within time& budget	Excellent communication and no frustration	For further projects	No organizational change needed

Figure 39. Outcome measures

PROJECT OUTCOMES MEAN RESULTS

This section explains the mean results that concern the project outcomes.

Employee perceptions of DT value

Survey results show that employees have a positive attitude towards the DT approach. The perception of DT effectiveness (M = 5.93, SD = 1.11) and efficiency (M = 5.29, SD = 1.33) is good. Figure 40 shows that respondents expect DT to make most impact in the quality of the result, compared to efficiency.

Project outcomes mean scores

Overall, result measures scored positive (>4). Two significant differences are found in mean scores of recent projects, compared to the benchmark group.

A Mann-Whitney test indicated users perceive more unique benefits in recent projects (Mdn = 6), compared to benchmark projects (Mdn= 4.5). U = 124, p = .035. This variable measured the perception of employees on what users indicate about the uniqueness of the project concept, in the context of previous offerings. This improved user feedback can be linked to the increased user centricity in project team practices.

An independent sample t-test showed significantly more organizational change is needed for recent projects (Mean difference 1,4, p = 0,015), in comparison to older projects. Team members assessed the level of organizational changed required to enable the implementation of the project idea.

The fact that more organizational change is needed can indicate several things. It could be that outcomes are more innovative, which would be a positive effect. It could also be linked to the recent restructuring of the company. Another option is that teams are not able to balance user needs and business demands properly. Further research is need to make conclusions about this.
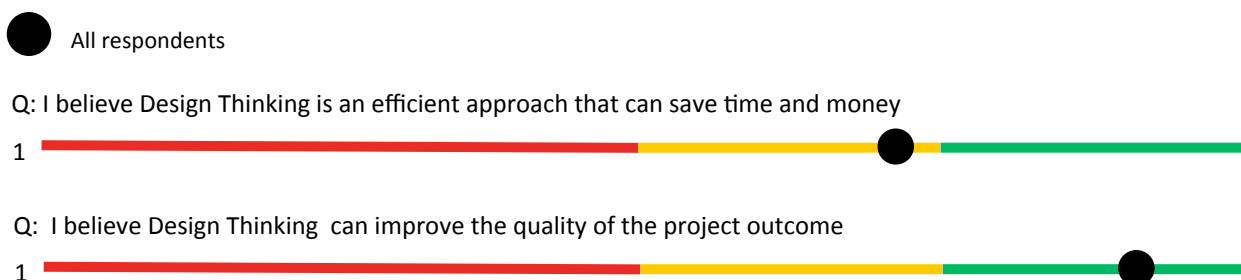
● All respondents

Q: I believe Design Thinking is an efficient approach that can save time and money

1

Q: I believe Design Thinking can improve the quality of the project outcome

1

Figure 40. Employee perceptions of project outcomes

3.4 | CORRELATION RESULTS

Pearson linear correlation analysis was performed in SPSS to explore how design practices relate to project outcomes. The data output of this correlation analysis can be found in Appendix 7: *Correlation data.* Correlations from 0.40- 5.9 are considered 'moderate', 6.0-.79 'strong' and '.80-1.0' very strong (Evans, 1996). All reported correlations are significant at a 0.001 level (2-tailed).

Correlations design principles and project outcomes

The correlation analysis showed many moderate and several strong correlations between design practices and project outcomes. Figure 41 provides an overview of the correlations that occurred between groups of measures for design practices, and project outcomes. The detailed correlations are explained int he next paragraph.

Correlations indicate that if one measure increases, the other one also increases. It does not account for cause effect. In some cases the chicken/egg effect can be discussed: e.g. it is not clear if an optimistic mindset was the cause or result of higher quality results. In most cases however, a cause effect can be assumed. For example a focus on the entire user experience (practice) is likely the reason why users indicate unique benefits in the product (outcome). Or if multiple ideas are created (practice) the final result is better align with company goals and vision (outcome). These correlations don't make sens the other way around.
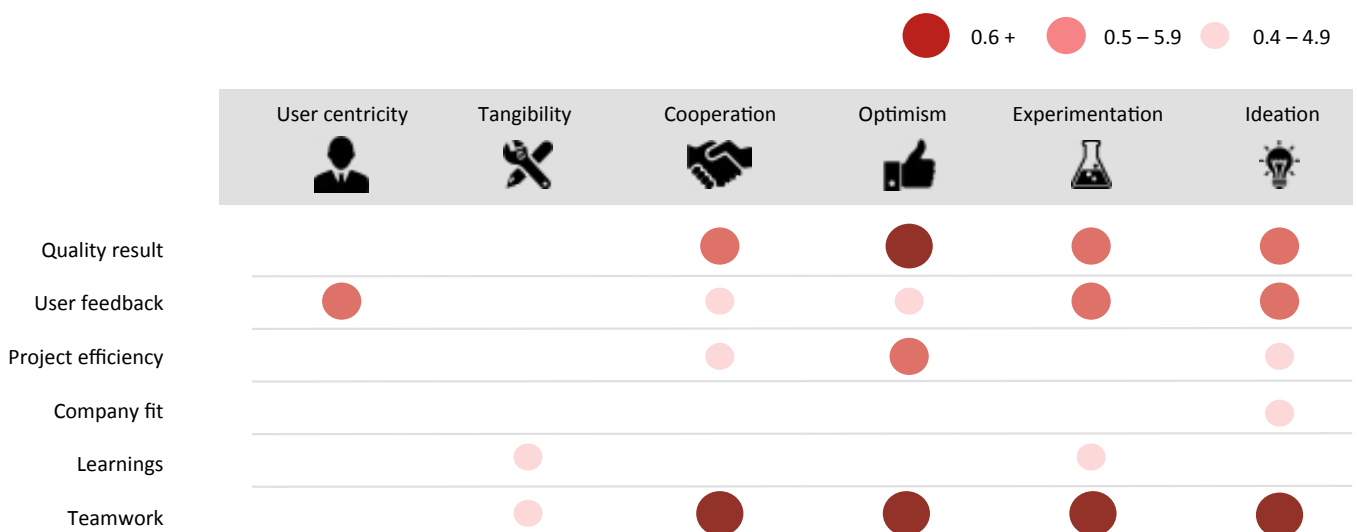

Figure 41. Correlating the design practices measures with project outcomes.

Correlation specific design practices and project outcomes

In this paragraph, the specific correlations between design practices and project outcomes are discussed. No significant negative correlations are found.

Table 6 provides an overview of factors with most influence in project outcomes. Selection criteria were at least two correlations >.50 or four correlations >.40.

Correlation results are discussed per design principle:

User centric practices showed moderate correlations with users indicating unique benefits in the project results (focus on user experience .499, establishing empathy .499, detecting most important user needs .43)

Prototyping 'quick and dirty' correlates with increased learnings (.50).

Involving stakeholders in problem and solution findings showed positive correlations with the teams satisfaction of the results (respectively .42 and .46) and how proud they were on the final quality of outcomes (respectively .49 and .46).

Multi-disciplinary teamwork showed many correlations with project outcomes (Table 6).

Experimental mindsets showed positive correlations with result quality. Users indicating unique benefits in projects outcomes correlated with teams being open to change (.51) and taking risk to try new things (.49). Teams being proud of the outcome quality also correlates with this risk taking (.55 as well as teams being able to accepting uncertainty (.42).

Diverging and converging practices showed many correlations with project outcomes (Table 6). Additionally, postponing judgment correlates with teams being proud of the outcome quality (.42). Criteria for idea selection correlates with teams being satisfied with outcomes (.44) and creating patterns for sense making of data correlates with users indicating higher quality of outcomes (.42).

Ideation is key

Figure 42 shows categorizesthe most impactful design practices to the design principles. It is clear that ideation practices currently deliver most value to project outcomes.

Category	Design Thinking measure	Stayed in budget	Results align with company goals	Team satisfied with result	Team proud result quality	Users indicated high quality	Users indicated unique benefits
Collaboration /ideation	Build on each other ideas	,45		,51	,56	,47	
Multi disciplinary teams	Combined expertise to get maximum results	,47		,46	,52	,43	,58
Strategic Design	Designers involved strategic decisions			,60	,56		,41
Diverging	Taking different perspectives	,46		,59	,59		
Diverging	Creating multitude of ideas		,41	,45	,41		,51
Converging	Established reflection moments	,45		,56	,56	,55	,44

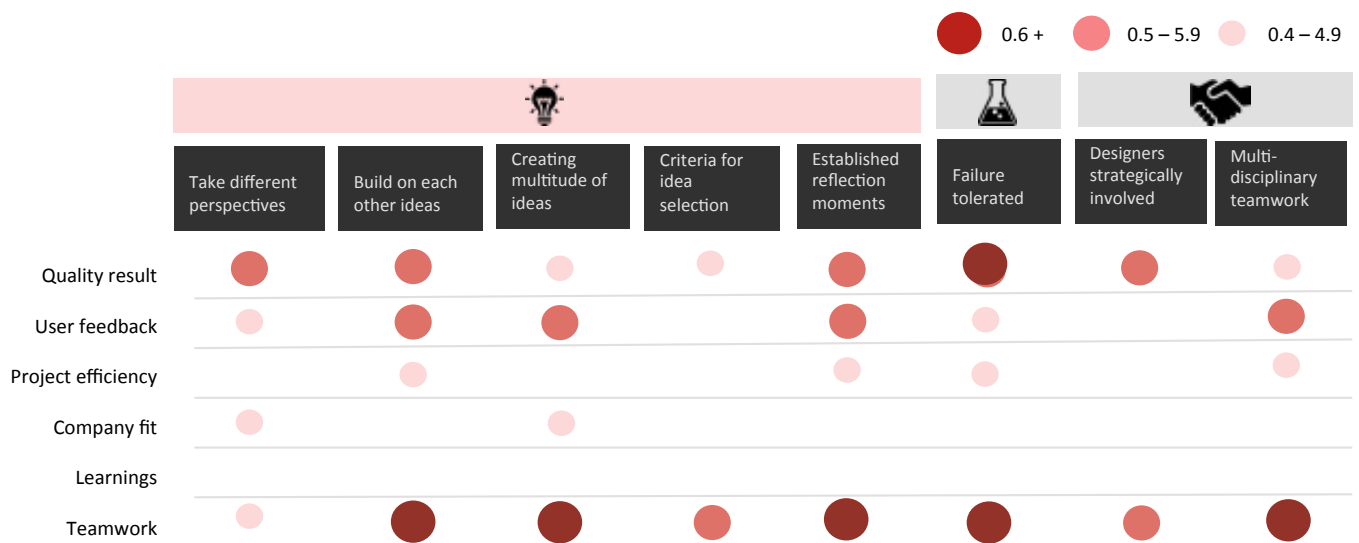Table 6. Design Thinking practices that have most correlations with project outcomes

Figure 42. An overview of the design practices with most impact on outcomes

3.5 | BUSINESS DATA

This section explains the results of the analysis of existing KPIs and how they relate to the survey results.

User centricity

Perceived user centricity scores improved significantly in recent projects, compared to the benchmark. This trend in user centricity is plotted over time to see if this reflects in objective business data.

To determine user centricity scores at one point is time, the average scores user centricity measures score of all running projects for that point of time were calculated. This results in a number between 1-7 (Likert scale).

KPI's

Net Promoter Score (NPS) is an index ranging from -100 to 100 that measures the willingness of customers to recommend a company's products or services to others.

The firm also evaluates customer satisfaction (CSAT) with a customer survey. On a scale of 1-10 customers indicate if the solution meets their needs and if the solution is easy to use.

MRR churn measures the erosion of monthly recurring revenue (MRR) due to churn in %. Churn refers to the proportion of users who leave the platform (Exact) during a given time period.

Perceived user centricity scores improved significantly in recent projects, compared to the benchmark. This trend in user centricity was plotted over time to see if this trend reflected in business data, including Net Promotor Score (NPS), customer satisfaction and Monthly Recurring Revenue churn (MRR churn).

Results of the analysis showed that increased user centricity did not significantly affect NPS, MRR Churn and Customer Satisfaction scores in the studied period. Data is excluded from this report for confidentiality reasons.

3.6 | CONCLUSIONS DESIGN IMPACT

The following conclusions can be made about the value of Design Thinking at Exact.

Positive value

There were no negative correlations found between design practices and project outcomes Although cause/effect is not specified by the correlation analysis, this indicates only positive effects occurred from applying the approach in this specific context. Diverging, converging, (multidisciplinary) teamwork an acceptance of failure show the largest potential value in the organisation, with multiple correlations to a broad set of project outcomes. The largest impact of DT practices is made in the quality of the end results and enhanced teamwork.

Design Thinking is a holistic concept

In this organization, the possible effect of user centric practices is limited to users indicating more unique benefits. (however, this result is arguably the more important for a firm's competitiveness). Other correlations connect a broad set of DT practices with project outcomes. These diverse outcomes highlight the importance of DT as a holistic concept, that goes beyond human centricity, to create a wide range of positive outcomes in the organization.

Comparing contextual value to potential value

The contextual value of DT at Exact can be compared to the five benefits of DT defined in section 3.1 (Figure 44). Some of the benefits occur in the context at Exact. The quality of concepts that result from the project work showed correlations with an experimental mindset and diverging.
To a lesser extend there are indications that DT can help projects stay in budget and reduce investment risk as prototyping correlated with increased learning and multidisciplinary teamwork correlated with projects staying in budget.
There were many positive correlations found with enhanced teamwork. However in some cases the cause/effect cannot be assumed. Prototyping and visual thinking is said to align teams, but no correlations were found with teamwork.
There were no indications at Exact that DT sped up processes.
There were no measures included to measure if employee values were innovation minded. This was regarded out of scope. Results did show that projects were more future oriented and have a more open scope. This might be indication

Higher quality of choices available	Reduced investment risk	Faster product development process	Enhanced communication and teamwork	Changing values towards an innovation culture
Because of constant exploration and improvement	By failing and learning early in the process	By involving users in the process and testing assumptions	Due to visual/physical representation of ideas	Employees more open to change and risk

Figure 44. If the potential benefits from DT were observed at Exact.

KEY RESULTS SURVEY

To sum up the design maturity and impact sections of this thesis, key findings are mentioned.

Design Maturity

- Overall scores on design principles are positive
- User centricity has improved after Design Thinking program
- Tangibility and ideation practices can be improved

Design Impact

- Design practices have a positive impact on multiple project outcomes
- Most impact is made in the quality of concepts and enhanced teamwork
- Diverging, converging, multidisciplinary teamwork and tolerance to failure, have the largest positive impact on project outcomes

4

DEFINING TRIGGERS AND BARRIERS TO IMPLEMENTING DESIGN THINKING

DESIGN THINKING IN PRACTICES
CHALLENGES TO IMPLEMENTING DT
CHANGE MANAGEMENT
INTERVIEW SET UP
PAINS AND GAINS
TRIGGERS AND BARRIRS
PRIOTITIZING CHALLENGES TO DT

In previous chapters more is explained about Design Thinking and Exact. It is evaluated how design practices and outcomes could be best measures and a survey design resulted from this. The survey results are discussed to conclude the maturity and impact at Exact.

This chapter concerns the triggers and barriers to implementing Design Thinking. By talking to employees, the underlying reasons that determine the scores for design maturity and impact of DT are uncovered. The focus of this chapter lies on *why* questions, whereas is previous chapters *what* topics were discussed.

This chapter opens with a collection of case studies of implementing DT from other organizations.

After implementing DT in practice is discusses, existing literature on implementing Design Thinking and change management are evaluated.

What follows is an introduction of interview topics. Results are discussed. The implementation challenges at Exact are sorted and prioritized.

Recommendations to overcome these implementation challenges, are explained in the next chapter Strategy Design.

What challenges does Exact face when implementing DT?

And what triggers the use of DT in project teams?

- Research questions addressed in this chapter

4.1 DESIGN THINKING IN PRACTICE

Exact is not the only company that aims to implement Design Thinking in the organization, Across all industries, organizations are trying to leverage design to improve their business.

This section provides examples of such companies and their efforts to implement Design Thinking, focusing on why and how they approach this organizational change. External cases might provide learning opportunities for Exact.

The overview of companies can be found on the next page and more detailed descriptions can be found in Appendix 8: *Implementing Design Thinking external cases.*

Establishing change in a corporate environment

Although there are multidisciplinary teams at Exact, at its core the company is as a silo organization, dividing the company different departments such as sales, marketing, customer care and development.
For this reason it is chosen to evaluate companies with a similar corporate structure. All companies in this case comparison are corporate, international companies that are expected to encounter similar challenges in implementing and scaling new concepts in the organization e.g. working across silos and competition from smaller flexible firms.

Reflections on external cases

Despite the conflicts that can occur between traditional business processes and DT, large corporates, e.g. Pepsi, Deutsche Telekom, IBM, show commitment to the creative approach. Because success stories are widely reported, it can be assumed these firms found ways to overcome common challenges. However, they rarely elaborate on the implementation process itself.

Most sources are from company websites, making it difficult to get reports of implementation challenges. To the outside world, the companies are broadcasting their success and innovative mindset, resulting in articles with a positive bias and possibly an incomplete picture of their implementation process.

Although it is difficult to identify common challenges in implementing Design Thinking from these company cases, it is possible to identify differences in implementation approaches. It shows that there is not one recipe to success but companies take a custom approach. Some common factors can however be identified. These are: hiring designers at top levels to lead innovation (Pepsi, SAP), creating dedicated spaces (Barilla, SAP), bundling a selection of comprehensive methods for employees (Deutsche Telkom, IBM), training employees at a large scale (Deutsche Telekom, SAP), providing facilitators for DT (SAP, Barilla) and promoting success stores (SAP, Pepsi).

Barilla

Pasta and related foods
8000 + employees

Two non-designers run the DT program as part of a bigger HR/resource development program. The implementation of DT is outsourced to external designers that coach and join project teams if they request DT support. Investments are made in a special space for DT activities. At this time they do not see the need to hire designers internally to lead the program.

SAP

Software
80.000 + employees

The DT transformation started in 2008 by hiring 35 designers in the strategy team. In 2014 DT was made a priority. Everybody participated in a DT event to get familiar with the approach: 6500 people, 3 days of workshops. In past years, about 100 employees are trained to be full-time facilitators, in collaboration with HPI. To promote DT, success stories are spread through internal communication channels.

In four years SAP transformed into a leading role in DT, offering DT services to their clients. Training and recourses are publicly available. They have a strong focus on creating the right spaces (MOSAIC) and opened several dedicated spaces to (co) create with users. They also introduced a prototyping approach to story telling: SAP Scenes.

Deutsche Telekom

Telekom provider
200.000+ employees

Deutsche Telekom worked with seven building blocks for the implementation of DT: communication, enabling (training), providing a toolbox, Labs (facilitating) , community (bringing practitioners together), network (connection with science and economy) and Hub (space).

They targeted different levels in the organizations, from top executive level, to teams and individual employees, with specified DT programs. Additionally they published handbooks for creative spaces and design methods.

Pepsico

Food and beverage
260.000 + employees

Pepsi is driving DT from the top down, hiring designers in senior functions and building strong design teams with designers. They do not believe everybody can be a design (think)er.

Pepsico has a strong focus on prototyping, as they believe it to align stakeholders, facilitate improvement, speed up innovation by unlocking resources and create confidence that what you are designer is the right (or wrong) thing,

Pepsico actively looks for external validation of success by design to validate the new strategy for our organization, e.g. publications and awards. Quick wins are important:: projects where you can show the value of design very quickly to the organization.

IBM

Software
370.000+ employees

In 2013, IBM started to build a design-driven culture at a large scale. The DT program involved 750 designers and affected over 10,000 employees in hundreds of teams. They also hired designers at a large scale (juniors and design leaders).

Before they kicked-off the program they re-designed the DT process. DT was interpreted as a waterfall approach (step-wise) and better suited for smaller teams. The IBM redesign, The Loop, stimulates continuous reflection and addresses tech challenges of scale and geographic distance.

They created a pocket-size field guide to DT with actionable examples of how to use the approach. The change program focused on non-designers. All new employees are trained at design bootcamp, teaching them design and the skill to speak up against established employees. To promote DT they showcase design outcomes rather than design practices.

4.2 | CHALLENGES TO IMPLEMENTING DESIGN THINKING

After discussing DT implmentation programs in practice, this section discusses literature on implementing DT.

Challenges to implement Design Thinking

Kolko (2015) identifies three main organizational hurdles to DT, based on his personal experience as a designer. He feels that companies don't manage to implement DT because they are not able to embracing risk and accept ambiguity, because the ROI is unclear with design. He advises companies to reset expectations: design cannot fix all problems.

In literature, there is one key article by Carlgren (2016) that specifically explores challenges to implement DT. Figure 45 illustrates challenges she identified from a collection of case studies. The challenges relate to using design thinking in large organizations:

Misfit with existing processes and structures.

E.g. conflict between iterative and stage-gate project approaches.

Resulting ideas are difficult to implement.

The business structure is not suited to process innovative ideas.

Value of DT is difficult to prove.

Innovation outcomes are typically difficult to measure.

DT principles clash with organizational culture

Clash of cultures hindering progress.

Existing power dynamics are threatened.

DT promotes a horizontal organization structure and autonomous teams.

Skills are hard to acquire.

For example prototyping techniques.

Communication styles are different.

DT has a strong visual focus.

Figure 45. Challenges to implement Design Thinking (Carlgren, 2016)

4.2 CHANGE MANAGEMENT

Design Thinking can be considered a management concept that is different from the typical way of working. To implement DT, change has to be established. In this context, two change management models are analyzed and their relevance to the case at Exact is discussed.

Kotter Eight steps to Change

Kotter's Eights Steps model to transforming organizations (Figure 46) is based upon analysis of 100 different organizations going through change. His research highlighted eight key lessons which he converted into a practical eight-step model. Although represented in a linear fashion, it is also suggested that it is better to consider the steps a continuous process to ensure that the momentum of the change is maintained. This steps from Kotter are grounded in literature however, the order of the steps is not proven. (Appelbaum, 2012). So it can be conluded that the model can also be interpreted as a checklist to change, indicating the several aspects to take into account.

Reflecting on the situation at Exact, this means there needs to be 1) urgency to transform. This is felt by some employees at Exact, but not by all.
2) A guiding coalition is formed with the emergence of UX Boost (although this is on mid-level) e.g. Pepsi hired a CDO. 3) a vision and strategy is developed by UX Boost. 4) the vision is communicated through events, workshops and media. 5) action is empowered through joining teams. 6) some projects are showcased, but quick wins could be pursued and presented more clearly. 7) Leveraging wins and 8) embedding in culture are yet to be completed at this point.

Implementing and sustaining change

Engaging and enabling the whole organization

Creating a climate for change

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Create urgency / Create a coalition / Develop a vision and strategy / Communicate the vision / Empower action / Get quick wins / Leverage wins to drive change / Embed in culture
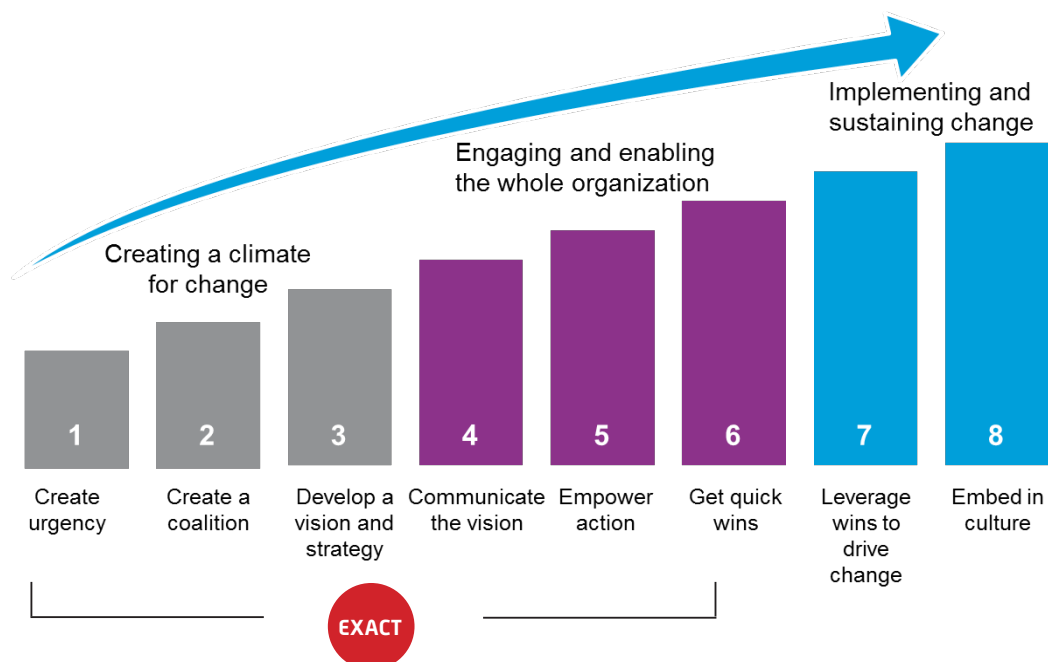
EXACT

Figure 46. Kotter's change management model and UX Boosts efforts.

The change management Iceberg

Another insightful model is the Iceberg model (Krüger, 2004) that focuses on barriers to change, It humanizes change management by mentioning four types of people in the organization: promoters, potential promotErs, opponents and hidden (silent) opponent.
. He shows that only a small part of the opposition argues with rational arguments.

 A large part of change management is not rational, but grounded in perceptions, beliefs and politics. Krüger wants to urge managers to move beyond *issue management,* concerning costs and quality to management of perception, beliefs, power and politics.

These change management models provide contextual information about organizational aspects that need to be taken into account when implementing Design Thinking. They both concern people in the end. Kotter urges to trigger and inspire and enable people and proposes steps to do so. Quick wins and clear communication are important to embed change. Krüger illustrates that opponents to change don't always use rational thinking, but might base their opinion on emotion or unconscious thoughts. This requires a different kind of management: of *perceptions & beliefs, power & politics.*
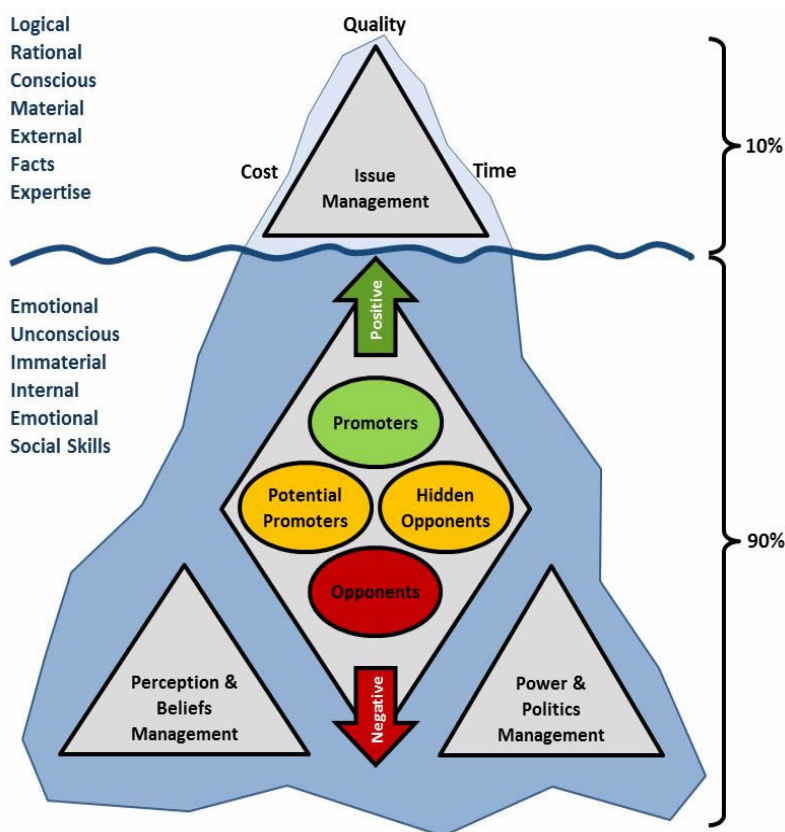

Figure 47. Change management iceberg (Krüger, 2004)

4.3 INTERVIEW SET UP

Survey results provide an overview of the status of design practices in the organization, but do not provide reasons *why* certain practices were able to mature more than others. Eight semi-structured interviews with solution team members were conducted, with the goal to uncover triggers and barriers for DT in the organization.

Appendix 9: I*nterview results,* provides an overview of the quote clusters that were found in the interviews.

This section explains more about the interview participants and findings.

Procedure

The interviews were semi-structured and took an average of 45 min per interview.

The interviews started by constructing a timeline of the project, to recap the memory of participants as well as provide the researcher with rich contextual information. During this part, it was discussed what feelings occurred during the process, to determine what are pains and gains in project work.

What followed was a discussion around the interview results. Respondents were asked to explain the situations that reflect the scores (either high or low scores. The goal of this part of the interview is to explore triggers and barriers for DT.

During the analysis interviews were transcribed and quotes were selected to make clusters .

Participants

Eights employees were selected based on the projects they worked on and their role in the team. All respondents were familiar with the survey, to allow for a fruitful discussion.

Projects that stood out in survey results, either positive or negative, were selected as interview sample, to uncover triggers and barriers to using DT.

Furthermore the sample resembles a heterogeneous group of disciplines: product owners, designer and developers, to represent the different expertise in the multidisciplinary project.

It was chosen to speak to different disciplines to explore role specific pains and gains in project work. Previously Beckman and Barry (2007), linked DT steps to learning styles and character traits. They concluded that in a multi-disciplinary team, employees with different personalities will take on different roles depending on the position in the processes. This raises the question what different types of people are participating in DT at Exact, and how they manage the different thinking styles required for the approach.

Four UX desginers, two technical employees and one PO were interviewed. It was not possible to interview a marketeer in the given time frame. Also, marketeers typically work on multiple projects. They spread their time across projects. This is why it is more difficult for them to do a project evaluation.

5

STRATEGY DESIGN

FOCUS POINTS OVER TIME
OVERCOMING CHALLENGES
IMPROVING IDEATION: PROCESS DESIGN
IMPLEMENTATION
EVALUATION

In previous chapters results from literature studies, case studies, the survey and interviews at Exact are discussed. This has led to insights on the maturity of design practices, the value of DT and challenges to implement DT at Exact (Figure X)

In this chapter these research results are combined to design a strategy to improve design practices and impact. The strategy design translates the research results into an actionable plan for Exact to improve design practices. This includes recommendations on the short term and long term. The recommendations are made on two levels: organizational or team level.

A focus on improving ideation is identified and a structured process for ideation, supported by a selection of tools, is proposed for project teams.

In this Strategy Design chapter, the implications of research results and project deliverables for Exact are discussed. Further implications for other organizations and designers are mentioned in the next chapter: Reflections.

DESIGN MATURITY REPORT

DESIGN IMPACT REPORT

TRIGGERS & BARRIERS TO DT

STRATEGY TO IMPROVE DT PRACTICES & OUTCOMES

Figure 51. Input for strategy design

5.1 FOCUS POINTS OVER TIME

To determine focus points for the short term and long term, the survey results: the design maturity and impact report, are combined (figure 52) The following paragraphs explain how the research results are interpreted to form a strategy.

Design maturity and impact

Lower maturity scores occur in ideation (divergence and converging) and tangibility (visual thinking and prototyping) . This offers room for improvement.

Looking at the design maturity in this firm, it showed that ideation practices correlate with many positive project outcomes. It is implied that increasing these practices in the organization can lead to more positive project outcomes. With currently low maturity of ideation, it provides an opportunity to improve this and create 'quick wins' essential to establish organizational change (Kotter, 1996).
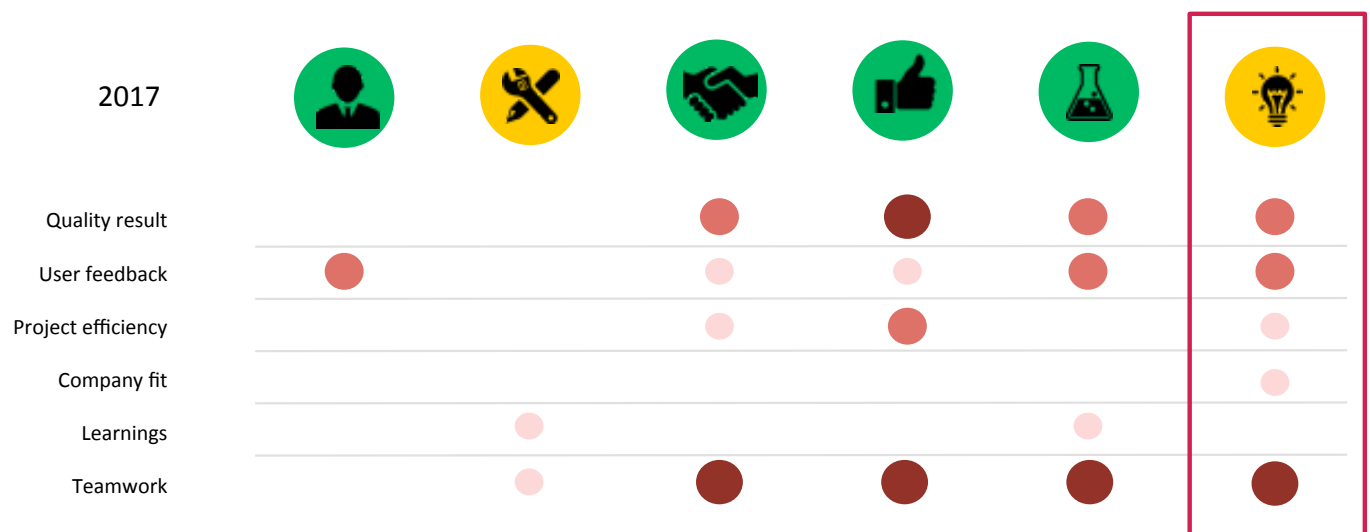
Figure 52. Combining the design maturity and impact results.

A timeline with focus points for now and later proposed. On the right, the steps are further explained.

Ideate

Low maturity

High impact

Get tangible

Low maturity

Low impact

Improve impact through experience

e.g. uncovering deep user needs

Invest in design

e.g., dedicated spaces, people

Quick wins

Do it more!

Do it better!

Figure 53 Focus points for the short and long term.

Ideate more

Ideation practices include diverging and converging activities. The impact report proved that these practices already deliver value to the organization. This means no big investments need to be made to improve ideation, the main message is: ideate more. More about ideation is proposed in
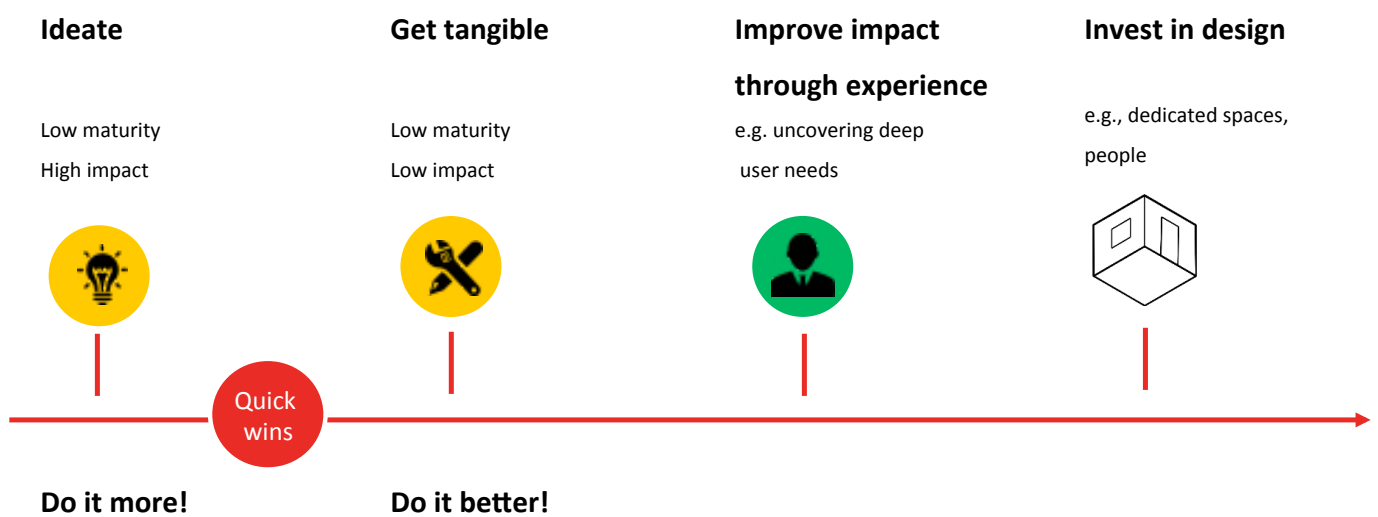
Get tangible

A second focus point concerns visual thinking and prototyping. Prototyping should align the organization around artifacts, speed up development processes and improve the quality of the final product by testing specific assumptions. However the correlation analysis showed that at Exact, projects that included prototypes did not get these positive effects. This means that investments need to be made to improve prototyping practices at Exact. Interviews specifically showed that prototypes are detailed and are not made for continuous assumption testing throughout the process. Visual thinking is another way to represent ideas to align stakeholders, that can be improved at Exact. It is proposed to promote prototyping specifically as it is a form of visual thinking that has proven it's effectiveness (Liedtka, 2017; Dow et al. 2011; Dow et al. 2010).

Improve through experience

The UX Boost program ran last year, indicating that DT is a new way of working. Survey results support that the level of experience with DT varies a lot amongst employees. Through experience, it is expected that both the effectiveness and efficiency of DT shall improve. An example is: at this moment employees indicate that tey are able to identify explicit user needs. With experience in user research and further development of the DT mindset, employees would also be better able to identify deep user needs. These are skills to address and reflect on after another year of DT at Exact.

Invest in design

Steps one to three are expected to create success stories and proof of concept for DT at Exact. Creating and sharing success stories is mentioned as main internal promoting tool to implement DT. When momentum for DT is achieved, Exact can invest in design on a more strategic level. This step is inspired from other companies that successfully implemented DT.

There are several ways to invest in design. The most effective way is expected to be to hire designers, similar to what PepsiCo and IBM did. This ensures people with skill and experience work in the company and this is expected to lift the design maturity, as it is seen that designers lead the DT practices. A more leading role for designers is expected to positively influence innovation results (Calabretta, 2016) Survey results at Exact also revealed that having designers involved in strategic decision making led to better teamwork, higher quality output and an efficient process.

5.2 | OVERCOMING CHALLENGES

The timeline presented in section 5.1 offers focus points for the short and long term, however it does not take into account the details of *why* specific design practices are currently not maturing and *how* improvement should come about.

In this section the triggers and barriers to DT are merged with the focus points identified in 5.1 to create an more detailed steps to improve DT at Exact for Exact int he coming year.

Challenges to conceptualization

The prioritizing of challenges to DT in general led to the following list:

Organizational:

- Development and solution team working parallel
- Discussion culture (many internal stakeholders)
- Project scope: validation vs. exploration

Team level

- DT (research) can be considered recourse intensive (inefficient)
- Little focus on assumption testing and learning throughout process
- No clear structure for DT

Overcoming challenges to conceptualization

These challenges were evaluated in concern to the focus points ideation and prototyping. Based on the prioritizing of challenges, a timeline is constructed to improve ideation and tangibility at Exact. Recommendations for teams and the organization are proposed on the right. Evaluations on both levels is critical to ensure a focus on improvements

In support the maturing of DT practices, this thesis proposes a renewed ideation process for Exact. This is explained in the next chapter.
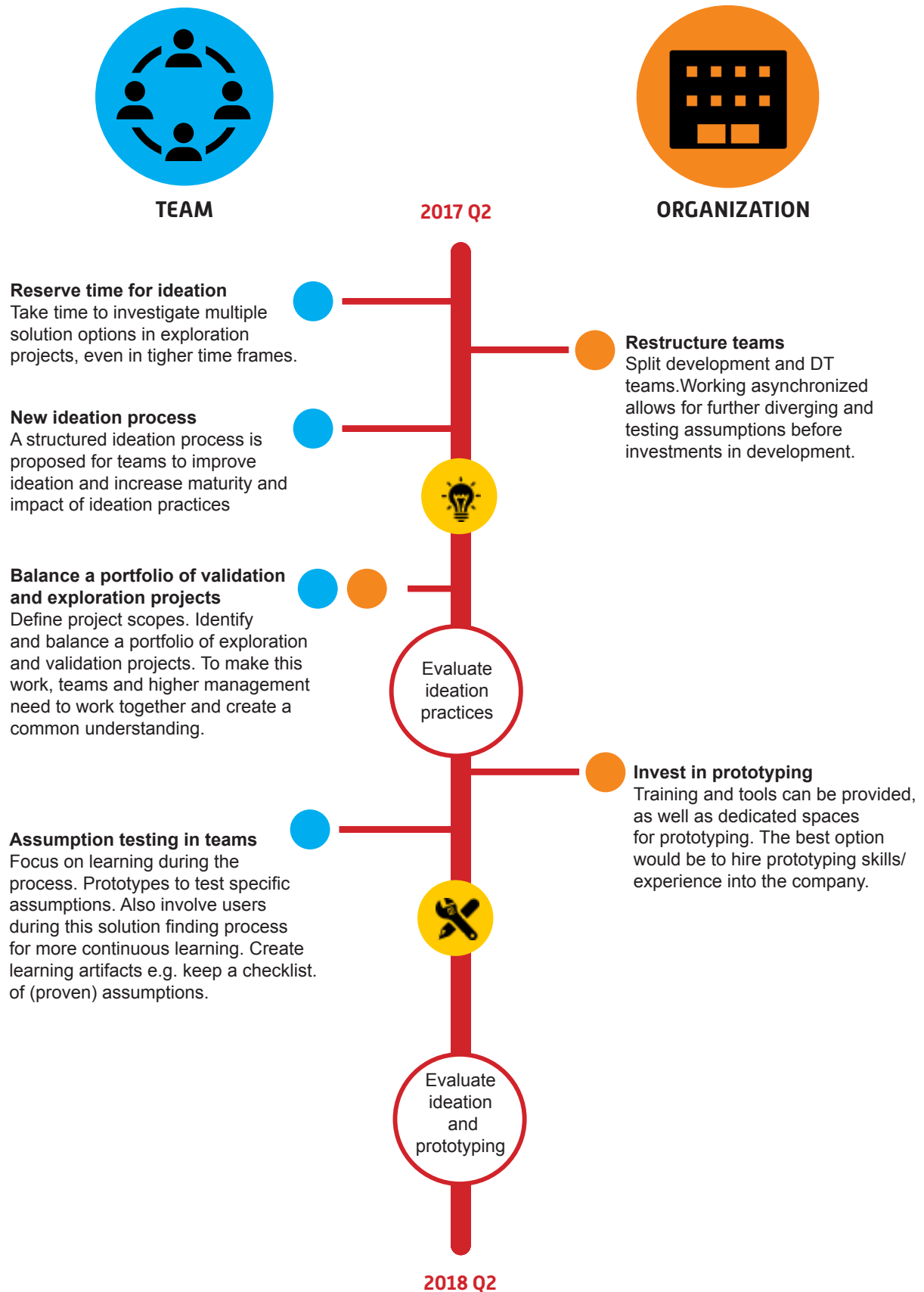
TEAM

2017 Q2

ORGANIZATION

Reserve time for ideation
Take time to investigate multiple solution options in exploration projects, even in tigher time frames.

Restructure teams
Split development and DT teams.Working asynchronized allows for further diverging and testing assumptions before investments in development.

New ideation process
A structured ideation process is proposed for teams to improve ideation and increase maturity and impact of ideation practices

Balance a portfolio of validation and exploration projects
Define project scopes. Identify and balance a portfolio of exploration and validation projects. To make this work, teams and higher management need to work together and create a common understanding.

Evaluate ideation practices

Invest in prototyping
Training and tools can be provided, as well as dedicated spaces for prototyping. The best option would be to hire prototyping skills/ experience into the company.

Assumption testing in teams
Focus on learning during the process. Prototypes to test specific assumptions. Also involve users during this solution finding process for more continuous learning. Create learning artifacts e.g. keep a checklist. of (proven) assumptions.

Evaluate ideation and prototyping

2018 Q2

Figure 54. Recommended actions for project teams and organsation to improve ideation and tangibility

5.3 IMPROVING IDEATION: PROCESS DESIGN

The recommendations for the teams were translated into an actionable deliverable for the project teams. The ideation process was structured and the toolkit was updated. This was presented to the teams. This section explains more about this deliverable.

> ## 'Provide a structured process to improve ideation practices'
>
> *- Design goal*

Towards a design goal

Next to the focus points over time, including ways to overcome challenges, a more detailed approach to ideation was made for the project team employees. A design had to be made to provide a structured process to improve ideation processes. Out of the three main recommendations for project teams, this focus point was selected because this thesis would make most impact in this area.

Understanding ideation

What we understand about diverging is creating a multitude of ideas. This proved to improve the quality of project outcomes. Multiple ideas are typically created by postponing judgment and taking different perspectives. Teams build on ideas. Later typically reflection moments are established and criteria are set-up for idea selection. A process design is made to guide Exact employees. Consisting out of four steps. Each steps is supported by specific tools.
The next pages explain more about the process steps and recourses.

Diverging

Take different perspectives

Postpone judgement on ideas

Create multitude of ideas

Converging

Establish reflection moments

Create criteria for idea selection

1. **Prepare** Scope, space, methods

2. **Ideate** Postpone judgement, Quantity over quality

3. **Concretize** Move from post-it to concept

4. **Select** Define criteria and compare to improve

Figure 55. Key recommendations for project teams to improve ideation

① Prepare

Ideation best practice document created by designers at Exact, based on their experiences wih ideation in the firm.

Scope
Structure
Teaming
Space
Culture

Ideation best practices
A checklist to prepare and run ideation processes

Structure

- Envision and plan your own ideation process. You can use different methods (brainstorm, co-creation sessions, design sprint, etc.).
- Plan ahead so that team members can attend all sessions.
- Include at least 2 moments in your plan: divergence (multiple alternatives are created), convergence (the 2 or 3 most promising ideas are selected to be prototyped).
- Plan clear assignments with clear purposes; don't make it an open discussion or completely unstructured brainstorm sessions.
- Set goals and time limit per activity. Use a clock to timebox activities.
- Plan both individual and group activities.
- Share best practices and procedures with team members before starting to prevent questioning the method interrupts the process (e.g. brainstorming rules, design sprint method).
- Keep a record of the ideation process in a central place (preferably a wall or a room)

Background preparation

- Make sure the team has enough information about the target group; how they feel in relation to the topic (empathy) and a clear problem/challenge to scope your ideation session (definition). This means knowing at least the characteristics of the group of people/customers/users you're targeting, their current experience, and the pains/gains or problems/opportunities in the current experience.

- Make a summary of this together with the team before starting to create multiple ideas. You can complete a template together, create a poster/infographic or create a storyboard summarizing what you have learned about the target group.

Roles and diversity

- Involve a diverse team. Include at least 4 different job roles in the ideation process. Mix backgrounds and people with different perspectives; invite someone external and highly motivated that can bring a fresh view on the topic.
- Define roles for every session: facilitator, participant, expert, decision-maker, observer.
- If there are more stakeholders involved than the number of people that will be part of the ideation team, plan additional sessions for feedback and updates with them.

Ideation vibe

- Create a curious, courageous, and concentrated atmosphere. Be active as a facilitator, or ask someone else with suitable skills to take this role.
- Motivate the team before and during the session to be part of it. Plan energizers, breaks, ice-breakers, and clear assignments.
- Explain to the team that great ideas will come after overcoming the non-innovative, crazy and bad ideas that normally arise at the beginning.
- Run the whole ideation phase or at least part of the ideation (one session, preferably during the divergence phase) outside the office or in a different room.
- Ensure there will be enough room for everyone to work and feel comfortable.

② Ideate

Brainstorm rules to **create the right mindset for ideation**
And specific brainstorm methods to **create mutliple solution ideas**

IDEO Brainstorm rules

Postpone judgement

Quantity over quality

Brainstorm Methods

Take different perspectives

Build on ideas

Step 1 and 2 are supported by current resources

3 Concretize

Moving from post-its to concepts
- Graphic representation
- Core idea: how it works
- Value for user
- Value for business

Create multiple solution options through:
- Idea description template
- Idea napkin
- Storyboard
- Value proposition canvas

This intel template is an excelent example how you can contrize your ideas. There are however multiple approaches that have this impact, e..g storyboarding.

100% of projects do brainstorming, however lowest scores are found for creating and selecting ideas. Disconnect between brainstorming (using post-its) and creating ideas. Step 3) and 4) stimulate creating Mutliple concepts and moving beyond the post-it. Need to concretize ideas.

4 Select

Compare to improve

First brainstorm criteria for your solution as a team. Than use this criteria to compare your ideas, to select important features and improve your final offering.

Brainstorm idea criteria

Specifications (given)
Requirements (has to have)
Wishes (nice to have)

Compare and improve ideas

Value for user
Uniqueness
Value for business

	Value for user	Uniqueness	Value for business	Feasibility	Imitability	Gut feeling	+ Project criteria
	Does is solve a big problem?	Do similar solutions exist?	Revenue, brand awareness, new knowledge etc.	Can we obtain the recourses to implement the idea?	Could other companies also develop this solution?	What idea do you prefer?	
1.							
2.							
3.							
Why it is 1 better than 2?							
Why it is 2 better than idea 3?							

	Value for user	Uniqueness	Value for business	Feasibility	Imitability	Gut feeling	+ due July 20
	Does is solve a big problem?	Do similar solutions exist?	Revenue, brand awareness, new knowledge etc.	Can we obtain the recourses to implement the idea?	Could other companies also develop this solution?	What idea do you prefer?	Can the solution be delivered in time?
1.	A	C	B	A	C	B	A
2.	B	B	C	B	B	C	B
3.	C	A	A	C	A	A	C
Why it is 1 better than 2?	Immediate, personal response by phone	VR is an emerging technology	Bot generates a consistent brand experience	Phone system already in place	We have the partners and investment power for VR	Few 'good' chatbots: improvement gap	Developing the chatbot right can be time intensive
Why it is 2 better than idea 3?	Everybody can chat on their phone, VR less accessible	Chatbots often have flaws, good bot is more unique	VR knowledge generation	In-house development capabilities	Everybody can start a phone service	Phone calls are old fashioned and labor/time intensive	VR is too new to guess implementation time

7

REFLECTIONS

IMPLICATIONS FOR ORGANISATIONS
THE ROLE OF DESIGNERS
EVALUATING QUANTIFIED MEASURES
FURTHER RESEARCH
PERSONAL LEARNINGS

The implications of the research results for Exact translates into the strategy design. This chapter reflects on the work of this thesis and it's implications for other organization or researchers.

First it is discussed whether the research methods and results put forward in this study can be used by other companies that wish to implement Design Thinking.

Second, implications for design researchers and recommendations for further research are made. This sections introduces DT topics that are up for debate, such as the role of designers in DT.

Finally personal reflections are made, explaining what the student learned during the graduation project.

7.1 | IMPLICATIONS FOR OTHER ORGANISATIONS

The thesis proposed a timeline to improve DT at Exact. Is this strategy design also applicable in other organizations? Can similar research results be expected if methods are duplicated?
This section discussed the implications of this thesis for other organizations that wish to implement Design Thinking.

Combining design maturity with design impact

The combination of measuring the maturity of design practices and exploring the impact through correlation analysis, proved to deliver actionable insights to develop further steps for the DT program at Exact.

In similar firms, it can be expected that similar challenges and focus points might found. However, because of the contextual nature of DT, it is not advised for other firms to copy focus points from the program of this specific firm.
But the approach, to combine the maturity and impact reports, can be recommended for companies that look to create focus points in implementing DT, as it distinguishes 'high potential' DT practices for 'quick wins' and longer term focus points.

Measuring in the business context

When setting up the survey, it was assumed that high scores on the described measures would indicate positive outcomes. However interview data indicated that this is not always the case. For example, it was mentioned that sometimes employees experienced 'too much' iteration in projects due to corporate complexity. The employees regarded iterations as a bad thing, whilst DT promotes iteration.

The significant decrease in stakeholder impact was also explained in the interviews. This measure was set up to test the quality of involving stakeholders in problem and solution finding. Through co-creation, the input from stakeholders would resonate in the final project outcome. However a parallel change program at Exact promoted autonomy in teams. Teams considered little stakeholder impact to be a desired outcome, contradicting common beliefs in DT. These examples of underline that not all DT outcomes

are equally desired all firms. Outcomes can even conflict with other internal change programs.
This indicates that concessions have to made when implementing DT, depending on the organizational culture. Focus in change programs can be directed on the most appreciated DT outcomes. Recommendations for the DT program can be adapted as a result of the insights mentioned above. For example, it is not advised to evangelizing the iterative nature of DT at Exact, as in this business context this does not appeal to employees and might be counter-productive to the spread of other DT practices.

The importance of qualitative data

The examples above show the crucial role of the qualitative interview data in analyzing survey results, by creating an understanding of real dynamics and underlying perceptions in project teams. For managers and practitioners that aim to measure DT in their organization, it is therefore recommended to enrich research results with qualitative data.

Implications for other companies

To conclude, this thesis work provides company a structure to measure design maturity for the goal of creating steps to improve DT in the organization
It is highly recommended to enrich the survey results with qualitative data because alternate interpretations of survey results can occur.
Previous research claimed that DT Is contextual (source) Our findings support that this is also true for implementation of the approach, where the design principles must-principles must be promoted in different steps, with different emphasis, to cater to the needs of the organization.
Hence it is proposed to not copy the strategy design fro Exact find the challenges relevant to your firm by 1) identify specific challenges in your organization 2) identify how DT could contribute value 3) prioritize implementation of DT practices according to your organizational needs 4) though not forgetting that DT is a holistic concept with overlapping practices.

7.2 THE ROLE OF DESIGNERS

In this section, the relevance of research results of this thesis are discussed in regards to common topics in DT debate. For example, what is role of designers if everybody can be Design Thinker? Are DT innovations typically incremental, assuming that users are not able to express their needs? And are there no downsides to DT?

The role of designers in Design Thinking

The role of designers in DT is often discussed. The most common view on DT is that everybody can be a Design Thinker (Brown, 2008). The use of DT has been proposed as a way for individuals to release their 'creative confidence' , assuming that everybody has the creative potential (Kelley and Kelley, 2013). At the same time, it is discussed that designers play a central role in spreading DT. If anybody can be a design thinker, than what is the role of professionally educated designers?

Results from this thesis work highlight the facilitating role of designers in implementing DT. A strong relation (.65) is observed between designers being involved in strategic decision making, and the level to which DT is purposely applied in the project. Also teams were more satisfied and proud of the end result. Interview findings support a key role for designers in DT, as employees repeatedly mentioning a 'clear lead' as success factor for DT.

When analyzing other companies, views on the role of designers clearly differ. Some companies adopt DT as an approach for everyone (Deutsche Telekom) and focus on training and education for the masses. Others companies depend on their designers to deliver innovation, and invest heavily in increasing the amount of formally educated design leaders (Pepsi, IBM).

Either way, with the emerging of Design Thinking and the interest in design methods, the role of design in businesses is changing. As a consequence, so is the role of designers. With DT being implemented on all levels, Brown and Calabretta suggest a more strategic role for designers in the future. But when managers are learning design skills and designers are learning managing skills, are the lines not blurring? My view is: yes, they are. And we should not be afraid to identify this. What makes people valuable is their interests, mindset and experience, much more than their formal education. Especially int he context of education becoming more widely available online, lowering barriers to become 'formally' educated.

Observations at Exact also shown that not all designers are necessarily good facilitators. Facilitating does not just require education, but also certain personality traits and of course experience.

So design, designer thinking and facilitations are three separate disciplines that compliment and enhance each other. As managers show interest in design and designers show interest in management, traditional function descriptions are merging. This offers possibility for both disciplines to explore their interest and enrich both the field of management as well as the field of design.

Design thinking and design making

Main critique on the concept from the designers perspective is the simplified representations DT being implemented in organizations ass a ready made recipe of customer journeys and persona's, without a proper adoption of the mindsets that underly the approach. Some reject this notion and explain that special skills and education is required for DT.

I want to share that design thinking is not the same as designing. In my view design also entails detail information about how concepts are made and actually making them. DT is a good way to explore problem space and solution space, and *thinking* about new products, but cannot replace the skill level for *making* new products.

Not everybody can be design thinker, because certain interest and mindset needs to be in place. Designers typically have this mindset and experience in design thinking, and as a result they take a leading role in implementing DT at all levels. At the same time not every designer is a good facilitator, This requires also certain characteristics. DT offers a framework work non-designers to *think* about new products and validate user needs, however actually making (engineering, constructing) products lies within the realms of former education. As managers are showing interest in design, designers can also pursue their interests in management and positioning themselves more strategically in the organization. It is observed that formal roles in organizations merge and as education is becoming more easily available, more focus is put on peoples interests, mindset and experience.

7.3 | AN EVALUATION OF QUANTIFIED MEASUREMENTS

Based on the recommendations by Roth and Royalty, objective questions were added to the survey. This sections evaluates how this measurement approach.

Respondents were asked how many prototype iterations took place during the project (Q46), how many prototypes occurred in parallel (Q47), how many users interactions took place and how many users were involved. Per project, scores for these questions were divided by the project duration. (Table X).

It appeared that per project, there was a large deviation in the amount of prototypes that respondents count. For example, a team member indicates no prototypes and another 30. Reason for this could be that it is difficult to count prototype iterations. Also not all team members are involved in development, or they are not involved in project from start to finish. For analysis purposes, the highest input is selected.

It is expected that project that score high on the Likert scale questions regarding prototyping (Q48 and Q49) also score high scores for objective prototype measurements. This match however is not found, indicating that either of these scores is not representative.

Projects that score high on the 7-point scale questions regarding user centricity (Q56-60) also perform well on the ranking of user involvement data. More users involved and more interaction moments per quarter were indicated for recent projects
However, there is more time in between these user interactions in more recent projects.

Counting in this reflective, individual matter causes to many variation to make solid conclusions. It is recommended not to follow this research design in future research. Rather use the collective memory of the team and create a shared understanding of what counts as a prototype. Preferably count collectively during the project (keep a count) to create trustworthy data.

	# Iterations/Q	max # parallel prototypes/Q	# Users involved/Q	# Interaction moments /Q
Recent projects (AVG)	**5,14**	**2,92**	**75**	**21**
Benchmark projects AVG	6,31	1,67	54	7

Figure X. Results concerning objective scores

7.4 | **FURTHER RESEARCH**

In this section recommendations for further research are made, based on the results of this thesis work.

Some outcomes of the study are not directly actionable for this form or other organisations, but offer leads for further research.

Design Thinking and radical innovation

Companies and evangelists propose that DT is for (radical) innovation. The reasoning is that listening to users will deliver more value, hence innovation. Other view supports that listening to users leads to only incremental innovation. (sources). In this reasoning, DT is rejected as an approach for radical innovation. The discussion whether DT is suited for radical innovations is fueled by the lack of empirical evidence for the effects of DT on project outcomes and organizations as a whole.

The survey results showed an increased perception of the organisational change needed to implement project results. Several explanations can be hypothesized. No significant correlations are found with design practices, so other reasonings apply. It might be that the more open scope of recent projects require organisational change. Another possibility can be found with respondents referring to a recent reorganization in the company.
Finally, increased organizational change required could indicate that project outcomes could be more radically different than before. This would suggest that increased DT can lead to more radical innovations. These results can also be linked to a common discussion amongst DT practitioners, whether user centric research would lead to radical innovation, or more incremental innovation as users are not able to express latent needs (source). More research is recommended on exploring the role of DT in radical and incremental innovation.

After writing this thesis, I see opportunities for DT mostly in incremental and 'medium' innovations. . DT is way to identify needs and solve problems. This also depends on what is considered 'radical' innovation. What is 'radical' to one firm might be incremental to another. (sources). If 'radical' innovation means that users are surprised by the product, it concerns a need they were not able to express and this is also typically not uncovered by DT. If 'radical' innovation means that big probnlems are solved, DT could be a solid approach.

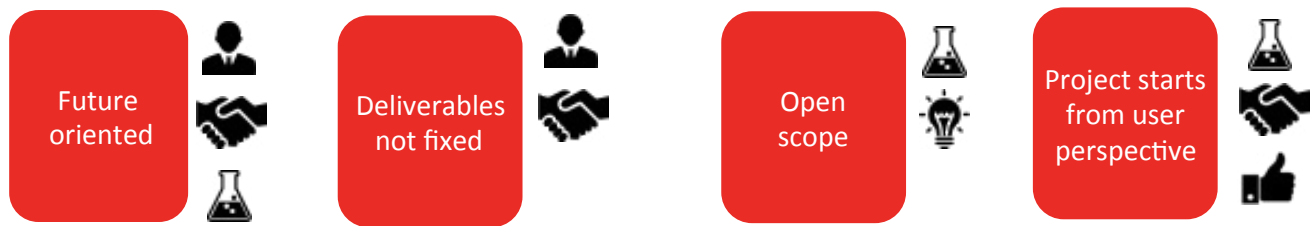### An ambidextrous organization: exploration vs. exploitation

DT is described as an approach to solve 'wicked' problems, that need exploration of the problem space, as well as the solution space.
Some projects however, might not benefit from the iterative non-linear DT concept, but are better suited by a linear process. Often these problems are not 'wicked' but rather straightforward. Applying te explorative DT approach in this case would probably not benefit the organization.
More research could be done on possible negative effects of using DT, to explore those cases. A company must balance their exploration and exploitation activities, to sustain current business as well as create new business. This involves balancing risk avoidance and risk taking. The role of DT in these 'ambidextrous' organizations must be explored as well as possible mis-use of DT an the effects of mis-use.

Project types and Design Thinking

In the inernal survey, respondents were asked to what level they perceived DT to be used in the project. They also answered questions about project characteristics. This allowed for a correlation analysis, exploring the realtion between project types and design thinking. An overview of corerlations between design practices and project types is found in figure X;.

Future oriented	Deliverables not fixed		Open scope	Project starts from user perspective

Linear correlations (Pearson), sig. at a 0.01 level

Three project characteristics showed moderate correlations with this perceived level of DT. More DT is applied if project deliverables were not fixed (.49), the team is free to (re)shape the scope (.53) and the project is triggered by user needs (.55).
Projects initiated from user needs also show moderate positive correlations with specific design practices: multidisciplinary teamwork (having all required expertise in the team .50, combining expertises for maximum results .41) an optimistic mindset (.50), tolerating failure (.44) and detecting the most important user needs (.44).
Out of all project characteristics, the freedom to (re) shape the scope showed most positive correlations with design practices, relating to diverging (taking different perspectives .49, building on each others ideas .48), user centricity (identifying explicit (.51) and important (.47) user needs, establishing empathy .452 and an experimental mindset (accepting uncertainty .45, willing to try new things that might not work .442, tolerating failure .42).
Fixed project deliverables negatively correlate to uncertainty acceptance (-.53), user centricity (less able to identify explicit (-.52) and important (-45) user needs) and stakeholder collaboration (stakeholders less involved in problem (.43) and solution finding (-.48).
A focus on long term goals positively correlated with user centricity (focus on user experience .567, establishing empathy .404), collaborative ideation (ideas result of team effort .481, encouraging different opinions .459, building on each others ideas .416) and an experimental mindset (tolerating failure .424, welcoming change .406).

That projects that start form a user centric perspective, apply more DT, can be no surprise, considering the focus on ethnographic user centric methods that is inherent to DT (e.g. Brown, Carlgren). In sharp contrast, no correlations are found between business and technology triggers and DT practices. DT could however, create large impacts specifically in these business and technology projects, by offering a way to balance business goals, technological viability and users needs (Brown, 2008).

Organization must be aware that a user centric trigger is not a requirement to apply DT as user centricity can be introduced at any stage in the process. For this particular organization, it shows that the full potential of DT it not yet fulfilled, as design principles seem mainly applied in user-driven projects.

In this study, projects with an open scope correlates to design practices. The findings are in line with Browns view (2008) that a scoping is important to the application of DT practices. DT is often described as method to navigate the 'fuzzy' front end of design (Carlgren, 2013) which can be related to projects with an open scope.
Research results show multiple moderate correlations between project characteristics and design practices. However cause/effect cannot be specified in correlation analysis.
If indeed project characteristics trigger these DT practices, it provides companies that aim to implement DT, an overview of the type projects that (in this context) were most quick to adapt the DT practices. To establish quick wins, essential for the implementation of new concepts (Kotter, 1996 + more), companies are then advised to start with future oriented projects with an open scope and user focus.
The possibility also remains that the described project characteristics are a result DT practices. DT is said to be future oriented in nature, e.g. by creating visual representations of possible futures (source). Diverging practices and user research provide new information that could widen the project scope.
Further research is needed to identify the exact cause/ effect of project characteristics and the use of DT, to provide companies more information to structure DT program steps and allocate resources more targeted.

If radial innovation concerns surprising users, this probably would not be an effect of DT. If 'radical' innovation means that big problems are solved, DT could be a solid approach.
There can be downsides of using DT, because it is an exploitative approach. Companies should typically balance exploration and exploitation of business.
In case of straight forward problems using linear business processes might be better suited. More research must be done on the possible negative

7.5 PERSONAL LEARNINGS

I have explained implications of the research project for Exact, other firms and researchers. This section will provide a personal reflection, to conclude how the project has contributed to my development as a strategic designer.

The graduation assignment initially appealed to me because it provided the opportunity to experience the implementation of design thinking and the role of designers in a corporate environment. In a previous internship I had the opportunity to be part in a Design Thinking transformation project from the perspective of the consulting firm. In this chapter I will reflect on personal learnings gained during the graduation project.

Deeping digger into Design Thinking
The project definitely expanded my knowledge of the concept Design Thinking and how the field is studied in literature and implemented in practice. Through the many different perspectives that an be taken, I can conclude that the concept takes different forms, consists out of several characterizing practices, mindsets and process steps. Combined these characteristics offer most value. In practice however, companies can pick out specific characteristics to fit their organizational needs.

Design Thinking and the role of designers
I already had knowledge about how the concept and how it was marketed in practiced. Also I was also aware of the discussion that the concept causes amongst designers, as it rises questions about the role of designers in organizations, when it is assumed that anybody can be Design Thinker. Design is indeed, attracting attention from a large range of people who did not have a formal education in design. For example, in my previous internship, the Design Thinking program was run by non-designers, from marketing or business study backgrounds mostly. During this project I got to study the implementation of the concept from the organisational perspective. I also observed the role of designers in this process.
I don't think anybody can be a good Design Thinker, as certain mindsets and skills are needed. But

of course this is similar to all expertises, e.g. not everybody can be good hairdresser. With practice however, you can train your cognitive and practical skills, for instance to build empathy and visualize your thoughts. I would conclude that Design Thinking is mostly about practice and experience, rather than formal education. The concept does not however, replace design. The specific skills and experience needed for design fields such as graphic, digital or industrial design require formal education as they have a detailed level of complexity. Educated designers will continue to be needed in organisations. However there is now an opportunity to take on more diverse roles in an organisation. Naturally designers can have a facilitating and expert role in Design Thinking. Even more so, they have an educative role as more employees are showing interest in design. This opens opportunities for designers to take on HR or managerial roles.
I have also experienced resistance to design, with people not taking design serious. In the sales driven organisation, creative exercises were considered fun, but also unserious and silly.
Having these developments first hand in a larger organisation, has helped me realize how I can position myself in an organisation and what resistance I can expect to encounter. I expect this to be beneficial as I start my first professional position.

Organisational structures, processes and roles
Next to a better perspective on the role of designers in the organisation, it provided general insight into how larger organisations work. This concerns the structures, processes and the different types of people that work in the organisation. Each department has their own culture (including wardrobe and language style), with common goals. These goals don't always align across the departments and communication styles differ between cultures. I hope to take these learnings into practice in future work, since I think strategic designers can have a connecting role across departments, due to the collaborative skills we have acquired in our studies and methods.

8

REFERENCES

Bartlett, J. E., II; Kotrlik, J. W.; Higgins, C. (2001). Organizational research: Determining appropriate sample size for survey research. Information Technology, Learning, and Performance Journal. 19 (1): 43–50.

Beckman, S. and Barry, M., 2007. Innovation as a learning process: Embedding DT. California management review 50(1), pp.25-56.

Brettel M., Mauer, R., Engelen, A., & Küpper, D. (2012). Corporate effectuation: Entrepreneurial action and its impact on R&D project performance. Journal of Business Venturing, 27(2), 167-184

Brown, T. (2008) Design Thinking. Harvard Business Review, 86, 84–92.

Brown, T. (2009) Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.

Brown, T. and Wyatt, J. (2010) Design Thinking for Social Innovation. Stanford Social Innovation Review, Winter, pp. 30–5

Calabretta, G., Gemser G., Karpen I. (2016) Strategic design: eight essential practices every strategic designer must master. BIS Publishers

Crossan, M. M., & Apaydin, M. (2010). A multi☐ dimensional framework of organizational innovation: A systematic review of the literature. Journal of management studies, 47(6), 1154-1191.

Carlgren, L. (2013) Design Thinking as an Enabler of Innovation: Exploring the Concept and Its Relation to Building Innovation Capabilities. PhD thesis, Chalmers University of Technology.

Carlgren, L., Elmquist, M. and Rauth, I. (2014a) Design Thinking: Exploring Values and Effects from an Innovation Capability Perspective. Design Journal, 17, 403–24

Carlgren, L., Elmquist, M. and Rauth, I., 2016. The Challenges of Using DT in Industry–Experiences from Five Large Firms. Creativity and Innovation Management, 25(3), pp.344-362.

Carlgren, L., Rauth, I. and Elmquist, M., 2016. Framing DT: The concept in idea and enactment. Creativity and Innovation Management, 25(1), pp.38-57.

Drews, C. (2009). Unleashing the full potential of design thinking as a business method. Design Management Review, 20(3), pp. 39-44.

Dunne, D. and Martin, R. (2006) Design Thinking and How It Will Change Management Education: An Interview and Discussion. Academy of Management Learning & Education, 5, 512–23.

Evans, J. D. (1996). Straightforward statistics for the behavioral sciences. Pacific Grove, CA: Brooks/Cole Publishing

Fraser, H. M. a. (2007). The practice of breakthrough strategies by design. Journal of Business Strategy, 28(4), pp. 66-74.

Gloppen, J. (2009). Perspectives on design leadership and design thinking and how they relate to European service industries. Design Management Journal, 4(1), pp. 33–47.

Gurtner, S., & Reinhardt, R. (2016). Ambidextrous Idea Generation—Antecedents and Outcomes. Journal of Product Innovation Management, 33(S1), 34-54.

Griffiths-Hemans, J., & Grover, R. (2006). Setting the stage for creative new products: investigating the idea fruition process. Journal of the Academy of Marketing Science, 34(1), 27-39.

Hassi, L., Laakso, M. (2011) Making sense of design thinking, IDBM papers vol. 1, pp.50-63

Ismail, S. (2014). Exponential Organizations : Why New Organizations Are Ten Times Better, Faster, and Cheaper Than Yours (and What to Do about It). Diversion Books

Jahnke, M. (2013) Meaning in the Making: Introducing a hermeneutic perspective on the contribution of design practice to innovation. PhD Thesis. University of Gothenburg.

Johansson-Sköldberg, U., Woodilla, J. and Çetinkaya, M. (2013)Design Thinking: Past, Present and Possible Futures. Creativity and Innovation Management,22, 121–46.

Kelley, T. and Littman, J. (2001) The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. Currency/Doubleday, New York.

Kimbell, L. (2011) Rethinking Design Thinking: Part 1. Design and Culture, 3, 285–306.

Köppen E, Meinel C, Rhinow H, Schmiedgen J, Spille L (2015) Measuring the impact of design thinking. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research. Springer, Switzerland, pp 157–170

Lavrakas, P. J. (2008). Encyclopedia of survey research methods Thousand Oaks, CA: SAGE Publications Ltd doi: 10.4135/9781412963947

Liedtka, J. (2015) Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction. Journal of Product Innovation Management, 32, 925–38.

Liedtka, Jeanne. Evaluating the Impact of Design Thinking in Action.Academy of Management Proceedings. Vol. 2017. No. 1. Academy of Management, 2017.

Lockwood, T. (ed.) 2010c), Design Thinking. Integrating Innovation, Customer Experience, and Brand Value. New York, NY: Allworth Press.

Mahr, D., Lievens, A. and Blazevic V., (2014.) The value of customer cocreated knowledge during the innovation process. Journal of Product Innovation Management 31(3): 599-615.

Martin, R. (2009) The Design of Business: Why

Design Thinking Is the Next Competitive Advantage. Harvard Business Press, Cambridge, MA

Muller A., Välikangas L, Merlyn P., (2005) Metrics for innovation: guidelines for developing a customized suite of innovation metrics, Strategy & Leadership, Vol. 33 Issue: 1, pp.37-45

Northrup, David A. (1996). The Problem of the Self-Report In Survey sResearch. Institute for Social Research.

Sanders, E., Stappers, P.,(2012) Convivial toolbox, generative design research for the fuzzy front end. BIS Publishers.

Schmiedgen, J., Rhinow, H., Köppen, E. (2015) Parts Without a Whole?:The Current State of Design Thinking Practice in Organizations Meinel Hasso-Plattner-Institut für Softwaresystemtechnik an der Universität Potsdam.

Schwarz, N. (2007). Retrospective and concurrent self-reports: The rationale for real-time data capture. The science of real-time data capture: Self-reports in health research, 11, 26.

Sato, S., Lucente, S., Meyer, D. & Mrazek, D. (2010). Design thinking to make organization change and development more responsive. Design Management Review, 21(2), pp. 44-52.

Seidel, V.P. and Fixson, S.K., (2013). Adopting DT in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. Journal of Product Innovation Management, 30(S1), pp.19-33.

Tushman, M. L., & O'Reilly III, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. California management review, 38(4), 8-29.

 Valentine, S., Godkin, L., Fleischman, G.M. et al. J Bus Ethics (2011). retrieved 4 April, 2018, from https://doi.org/10.1007/s10551-010-0554-6 https://medium.com/swlh/mindset-process-method-a-comprehensive-descriptive-model-for-design-thinking-27a501bf80cf

Veldhuizen, E., Hultink, E. J., & Griffin, A. (2006). Modeling market information processing in new product development: An empirical analysis. Journal of Engineering and Technology Management, 23(4), 353-373.

Walters, H. (2011) 'Design Thinking' Isn't a Miracle Cure, but Here's How It Helps. Co.Design, retrieved 26 Apr, 2016, from http://www.fastcodesign.com/1663480/design-thinking-isnta- miracle-cure-but-heres-how-it-helps.

Ward, A., Runcie, E. & Morris, E. (2009). Embedding innovation: design thinking for small enterprises. Journal of Business Strategy, 30(2), pp. 78-84.

Woodruff, R. B. (1997). Customer value: the next source for competitive advantage. Journal of the academy of marketing science, 25(2), 139.