



DEGREE PROJECT IN MECHANICAL ENGINEERING,  
SECOND CYCLE, 30 CREDITS  
*STOCKHOLM, SWEDEN 2020*

# **Implementing Design Thinking principles for increasing customer centricity in a B2B company**

A case study at Mycronic

**BALACHANDAR RAVICHANDRAN**

**HARSHAVARDHAN RAMANUJAM**



# Implementing Design Thinking principles for increasing customer centricity in a B2B company

A case study at Mycronic

Balachandar Ravichandran  
Harshavardhan Ramanujam

Master of Science Thesis TRITA-ITM-EX 2020:511  
KTH Industrial Engineering and Management  
Machine Design  
SE-100 44 STOCKHOLM





**KTH Industrial Engineering  
and Management**

## Master of Science Thesis TRITA-ITM-EX 2020:511

Implementing Design Thinking principles for increasing customer centricity  
in a B2B company- A case study at Mycronic

Balachandar Ravichandran  
Harshavardhan Ramanujam

Approved 2020-09-09	Examiner Sofia Ritzén	Supervisor Susanne Nilsson
	Commissioner Mycronic AB	Contact person Peter Bjornangen

### **Abstract**

Design Thinking (DT) is a customer centric approach for managing innovation. Since its inception, design thinking has evolved from a straightforward approach to solve engineering design problems into a complex umbrella construct for innovation and has over the years been widely accepted as a goal-oriented approach for effective product development.

Several of the practical use cases available in the existing design thinking discourse refer to one off case for solving specific problems or its application in a business-to-customer set-up. The purpose of this master thesis was to critically examine how design thinking could be implemented in a business to business (B2B) company with well-developed product development processes (PDP) to balance customer centricity with product strategy. To understand the impact of design thinking in such companies, barriers preventing design thinking's implementation and the opportunities enabling its implementation were explored using a single case study approach at Mycronic AB office at Taby, Sweden. The material for the case study was gathered through internal and external qualitative interviews. The results from these interviews were used to propose a framework and pilot programs that would facilitate Mycronic to introduce design thinking principles to its existing product development process. The goal of the framework is to empower a business -to-business company with well-developed product development processes to adapt design thinking principles so as to increase their understanding of end customers' spoken and unspoken needs, recognize the needs of internal stakeholders, and improve their ability to secure the right initiatives in the early phase of a project.

**Keywords:** Design Thinking, Business to Business (B2B), Front End of Innovation, Customer Centricity, Visualization, Empathy, Minimum Viable Products (MVPs), Well Developed Product Development Processes, Voice of Customer, Customer Requirements Flow.





KTH Industriell teknik  
och management

## Examensarbete TRITA-ITM-EX 2020:511

Implementering av principer för design thinking för att öka kundfokuset i ett B2B-företag - En fallstudie på Mycronic

Balachandar Ravichandran  
Harshavardhan Ramanujam

Godkänt 2020-09-09	Examinator Sofia Ritzén	Handledare Susanne Nilsson
	Uppdragsgivare Mycronic AB	Kontaktperson Peter Bjornangen

## Sammanfattning

Design Thinking (designtänkande) är ett kundfokuserat förhållningssätt som används för att stödja innovation. Sedan starten har designtänkandet utvecklats från ett rättfram sätt att lösa tekniska designproblem till en komplex paraplykonstruktion för innovation och förhållningssättet har genom åren blivit ett allmänt accepterat och målinriktat tillvägagångssätt för effektiv produktutveckling.

Flera av de praktiska användningsfallen som finns tillgängliga om designtänkande i forskning hänvisar till ett enskilt fall för att lösa specifika problem eller dess tillämpning i business-to-customer företag. Syftet med detta examensarbete var att kritiskt undersöka hur designtänkande kunde implementeras i ett business-to-business (B2B)-företag med välutvecklade produktutvecklingsprocesser för att balansera kundfokus med produkt strategi. För att förstå effekterna av designtänkande i sådana företag undersöktes hinder som förhindrar designtänkandets implementering och möjligheterna med att införa det med hjälp av en fallstudie på Mycronic AB-kontoret i Taby, Sverige. Materialet i studien samlades in genom interna och externa kvalitativa intervjuer. Resultaten från intervjuerna användes för att föreslå ett ramverk och ett pilotprogram för att stödja Mycronic att införa principer för designtänkande i sin befintliga PDP. Målet med ramverket är att skapa förutsättningar för ett B2B-företag att anpassa sin produktutvecklingsprocess till designprinciper för att bättre förstå slutkundernas explicita och outtalade behov och behoven hos interna intressenter samt för att öka förmågan att identifiera rätt initiativ i ett tidigt skede av ett projekt.

Nyckelord: Designtänkande, Business to Business (B2B), Front End of Innovation, Customer Centricity, Visualization, Empathy, Minimum Viable Products (MVPs), Välutvecklade produktutvecklingsprocesser, Customer Voice, Kundkravsflöde.



# FOREWORD

---

*We would like to thank our academic supervisor at KTH Royal Institute of Technology, Susanne Nilsson, whose expertise and enthusiasm for the subject matter played a crucial role in defining the scope of the thesis and providing invaluable feedback that helped to structure the thesis. We also thank, our Master Thesis coordinator, Jenny Janhager Stier for guiding us throughout the process of Master Thesis registration till presentation.*

*Heartfelt thanks to our industrial supervisors at Mycronic, Peter Björnängen and Lars Ivansen, who provided us with the motivation, inspiration as well as the necessary resources that helped with the thesis. Your support and feedback were invaluable for us.*

*We would also like to thank all personnel at Mycronic for investing their time and providing us with valuable inputs through interviews and workshop. Lastly a special thanks to Gustaf Mårtensson who was our first point of contact at Mycronic.*



---

*Balachandar Ravichandran*



---

*Harshavardhan Ramanujam*

*Stockholm*

*Spetember 2020*



## ***Abbreviations***

<i>AS</i>	Assembly Solutions
<i>B2B</i>	Business to Business
<i>B2C</i>	Business to customer
<i>CAD</i>	Computer Aided Design
<i>CFT</i>	Cross Functional Team
<i>DT</i>	Design Thinking
<i>LCD</i>	Lean Concept Description document
<i>LKD</i>	Lean Knowledge Description document
<i>MVP</i>	Minimum Viable Product
<i>NPD</i>	New Product Development
<i>PDP</i>	Product development process
<i>PG</i>	Pattern Generators
<i>PLM</i>	Product Lifecycle Management
<i>RQ</i>	Research Question
<i>SPM</i>	Strategic product management
<i>TD</i>	Technology Development
<i>TRL</i>	Technical Readiness level
<i>VOC</i>	Voice of Customer

---



# TABLE OF CONTENTS

---

<b>1 INTRODUCTION</b> .....	1
1.1 Background.....	1
1.2 Purpose.....	2
<b>2 LITERATURE STUDY</b> .....	3
2.1 Evolution of Design Thinking.....	3
2.2 Why Design Thinking works.....	4
2.3 Design Thinking as an umbrella concept.....	4
2.4 Implementing Design Thinking.....	7
2.5 Leadership in Design Thinking.....	9
2.6 Embedding Design Thinking with Product Development.....	10
<b>3 METHOD</b> .....	13
3.1 Research Setting.....	13
3.2 Research Phases.....	14
3.2.1 Preliminary Study phase.....	14
3.2.2 Literature Study.....	15
3.2.3 Investigation Phase.....	15
3.2.4 Analysis Phase.....	16
3.2.5 Development of conceptual framework.....	17
3.3 Method Discussion.....	18
3.4 Delimitations.....	19
<b>4 RESULT</b> .....	20
4.1 Requirement Flow.....	20
4.1.1 New Product development.....	21
4.1.2 Service/Product Enhancements.....	23
4.1.3 Technology development.....	24
4.2 Restructuring.....	25
4.3 Areas of Improvement.....	26
4.3.1 Highlighted or visible area of improvement.....	26
4.3.2 Identified or hidden area of improvement.....	29
4.4 Card sorting.....	30
<b>5 ANALYSIS AND DISCUSSION</b> .....	32
5.1 Barriers for DT implementation:.....	32
5.1.1 Barriers related to Culture and Mindset:.....	32
5.1.2 Barriers related to Organizational Structure and practices:.....	35
5.1.3 Barriers related to customers:.....	37
5.2 Opportunities for DT implementation:.....	39

5.2.1 Co-creation is a competitive advantage:.....	39
5.2.2 Effective Requirements Flow in an organization with multiple filters/ layers of stakeholders : .....	40
5.2.3 Easier capture of customer value even when designers are not users: .....	40
5.2.4 Better customer engagement to account for the longer development times: .....	41
5.3 Ideology behind answering RQ2: .....	42
5.3.1 Implementation changes with reference to Mycronic’s PDP .....	43
5.3.2 Investigation Workshops .....	44
5.4 Baseline changes to existing PDP of Mycronic .....	46
5.4.1 New Product Development Process.....	46
5.4.2 Service/ Product Enhancements .....	47
5.4.3 Technology Development.....	48
5.4.4 Changes Recommended to bring about a Cultural Change .....	49
5.5 Implementation Roadmap:.....	52
5.6 Implications for theory .....	53
5.7 Practical implications .....	54
5.8 Future work .....	55
<b>6 CONCLUSION</b> .....	56
<b>7 REFERENCES</b> .....	57



## 1.1 Background

Customer centricity is described as placing value creation for customer at the core of business decisions and organizational practices and is progressively regarded as a foundation of sustainable competitive advantage by companies (Hemel & Rademakers, 2016). Around 30% of fortune 500 firms like Dell, Intel, IBM, and American Express have recently taken steps to adapt a customer-centric organizational structures towards this end. Although evidence point to customer centricity helping companies segment and deliver the right value to their customers, several companies like Xerox and Cisco have seen poor results from adapting this ideology (Lee et al., 2015). Customer centricity is often even painted as an antithesis to product centricity (Galbraith, 2005; Shah et al., 2006). This combined with the long duration it takes for customer centricity to bear fruit makes its adaptation less attractive to companies (Carlgren et al., 2016). This sentiment has let to companies searching for a middle ground that would help them be customer and product centric at the same time. To this end, design thinking is pitched as a process that can help companies balance customers' desirability against technical feasibility and business viability of a product (T. Brown & Katz, 2011). Design Thinking (DT) has emerged as human-centric yet goal oriented approach to innovation by instructing innovators to adapt the ways designers think and work (Carlgren et al., 2016). Existing literature on DT is however centered around business-to-customer (B2C) companies or case studies which are one off cases of how companies used design thinking to solve specific problems. There is hence a lack of clarity on how business-to-business (B2B) companies could benefit from design thinking if these companies were to adapt DT into their existing PDP. A standout advantage of implementing DT in a B2B company is the potential to co-create with customers who are experts in their fields (Liedtka et al., 2013).

Mycronic is a high-tech electronics equipment manufacturing company specializing in Pattern Generator machines and Assembly Solutions machines. The company is based in Sweden and operates in B2B setup with a global customer base. During the early years of the company's history, being a smaller company working in high technology sector meant that the employees had the opportunity to work closely with partners in the electronic industry to develop their products. This period was a very customer centric period for the company with numerous innovations stemming from working with customers and external partners. However, as the company developed its core business and ventured into new businesses, with it grew its size. This meant that the company had to bring in structured development processes to let them work efficiently to deliver results. As a side effect, the company gradually moved away from extensive direct customer contacts, particularly the designers and developers who make the products were cocooned by several other internal stakeholders. Such development is similar to any mature company and has resulted in Mycronic becoming more efficient at developing products at the cost of effectiveness towards customer value. Mycronic in the recent years has taken several steps to increase customer centricity and in turn customer satisfaction. Two examples of this shift are,

- The company's investigation in trying to better understand the effective innovation mechanisms used in the company in the past through the work of a master thesis in 2019
- An exploratory project run using design thinking principles with the help of an external consultancy in 2019

These projects highlighted the benefits of design thinking to the company and how it could effectively be used as a front-end innovation management tool. The design thinking project which in addition to help with the exploratory study, was also meant to introduce design thinking principles to the participants of the project. But while the project helped Mycronic understand the views of customer better, the workshop format the project used was very different to the

participants who were used to working in a structured way with their development process. Even historically, legitimizing design thinking in organizations through such consultancy projects and executive training has led to failure of adoption due to the initial hesitation of employees over the new principles (Rauth et al., 2014). Mycronic also understood that understanding the right needs of the end customers is the first part in achieving customer centricity and the second part would be developing products based on the established customer insights. And so, Mycronic wanted to see if they could leverage design thinking to achieve both parts i.e. understand the needs of external as well as internal customers thereby helping them invest in the right development initiatives.

The first step for this would be to investigate if it were possible to adapt design thinking in one specific location, which in this case happens to be the company's business unit located in Taby, as well as try and understand the benefits of doing so for the company. These gave directions for the purpose and initial scope of this thesis project as explained in the upcoming purpose section.

## **1.2 Purpose**

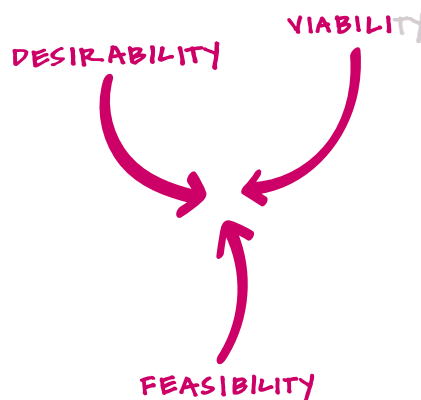
The purpose of this master thesis was to critically examine how design thinking could be implemented in a B2B company with well-developed PDP to improve customer centricity. Several of the practical use cases available in the existing design thinking discourse refer to one off case for solving specific problems or its application in a business to customer setup. There is a gap in design thinking literature with reference to B2B companies. To understand the impact of design thinking in B2B companies, aspects like the barriers preventing design thinking's implementation and the opportunities enabling its implementation were explored. These results were used to propose recommendations and pilot programs that would facilitate Mycronic to introduce design thinking principles to its existing PDP to,

- Understand end customers' spoken and unspoken needs
- Recognize the needs of the internal stakeholders
- Position itself with ability to secure the right initiatives in early phase of a project

### 2.1 Evolution of Design Thinking

Umbrella construct is a phrase used to include and account for a different set of phenomena (Hirsch & Levin, 1999) with the aim to assimilate a large body of seemingly unrelated discoveries (Astley, 1985). Design Thinking by its nature fits into the definition of an umbrella construct as there are significant discrepancies in understanding of meaning and use cases between promoters and critiques as well as researchers and practitioners (Micheli et al., 2019). At the very core of the design thinking construct are the concepts of divergent & convergent thinking, visualization and empathy (T. Brown & Katz, 2011). The beginning of this ideology could be traced back to the late 1960s. Herbert Simon in his book 'The sciences of the Artificial' highlighted the difference between individual importance of critical thinking and design-centric thinking as the processes of breaking down ideas and building up ideas (Michalos & Simon, 1970). Other key influences to design thinking include Robert Mckim's 1973 book titled 'Experienced in Visual Thinking' where the author emphasizes that visualization results in an innate clarity for solving problems (Hester & McKim, 1973). Incidentally, the closest theoretical model to the modern interpretation of design thinking was formulated by David Kolb in 1984, called the 'Kolb cycle' or 'the cycle of experiential learning' with four cyclic phases namely concrete learning, reflective observation, abstract conceptualization and active experimentation (Kolb, 1984). Although Kolb's cycle is related to education sector, it is one of the earlier works to highlight the importance of experiencing something firsthand in learning and development. Other seminal works of influence on design thinking include Peter Rowe's coining of the term 'Design Thinking' (Rowe, 1987) and Richard Buchanan's 1992 research article titled 'Wicked Problems in Design Thinking' where the author advocates the establishment of 'Design as a liberal art of technological culture' to solve complex problems (Buchanan, 1992). A more recent milestone in the design thinking construct is the work of Brown (2008) which sparked the initial foray of design thinking from the field of academic research into the scope of management practitioners (Mootee, 2013).

Figure 1. The intersection where design thinking exists adapted from (T. Brown, n.d.)



Design Thinking over the decades has evolved in terms of the use cases and the variances in definitions of the concept rightly reflects this disparity. For instance,

- Brown (2008), a product designer by profession, defines design thinking as “A discipline that uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunities.”

- Whereas from the perspective of an academic researcher, design thinking is a social technology with an ability to counter the biases of innovators and change the way they take part in the innovation process (Liedtka, 2018).

While the first definition places design thinking as a means of adopting a designer's mindset to create value, the second definition depicts design thinking as a means of eliminating biases in innovators. Such subtle discrepancies are seen throughout the breath of the design thinking literature.

## 2.2 Why Design Thinking works

According to Liedtka (2018), design thinking is a social technology that can help manage innovation in both problem and solution spaces due several advantages such as,

- Helping designers overcome their biases and design effectively by understanding user perspectives.
- Aiding innovators organize user data into themes and patterns through visualizations
- Offering pre-experiences to users with the help of prototypes to gain feedback during development of a product.
- Fostering an entrepreneurial mindset and shared commitment by deferring learnings through active experimentations.
- Building internal alignment by converting insights into design criteria.
- Encouraging the emergence of unique ideas by focused inquiries and building a diverse set of potential solutions.
- Articulating the conditions necessary for an idea's success and guiding with building the right prototypes.

Liedtka has highlighted that Design thinking could do to (innovation) management what Total Quality Management (TQM) did to the manufacturing sector in the 1980s, i.e provide the established structures with robust principles to better optimize the outcomes from the established structures. At the same time, design thinking adaption is not a one way road where management learns to think like designers rather, has pointed out that it is a two way road where designers and business people learn from each other's practices (Liedtka & Ogilvie, 2014). Liedtka & Ogilvie (2014) have argued that while it is important for management person to adapt a designer's perspective, it is equally important for a designers to adapt certain aspects from a business person's way of working such as considering the business viability of something they are designing since novelty alone does not deliver customer value.

## 2.3 Design Thinking as an umbrella concept

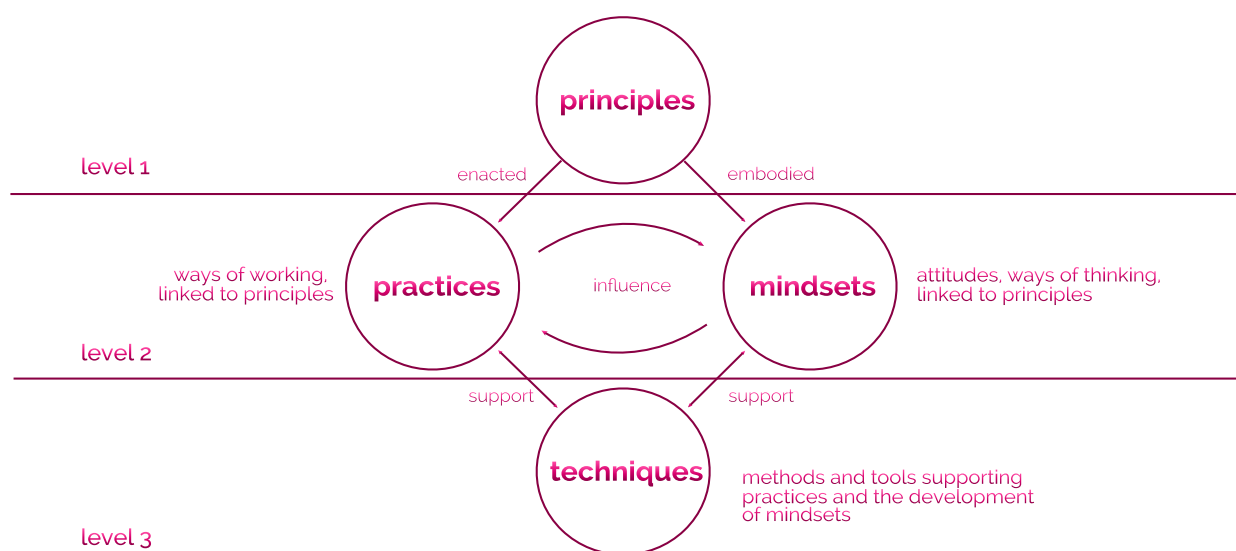
Design thinking discourse identifies five core principles that make design thinking ideal for innovation management (T. Brown & Katz, 2011; Carlgren et al., 2016; Liedtka et al., 2013; Micheli et al., 2019; Mootee, 2011; Rauth et al., 2014), namely,

- *Focus on the user.* Here users are real people with real problems rather than market segments to target and sell. Any design thinking initiative shifts focus on to the users to empathize and understand their needs. Hence these initiatives begin and end with the users.

- *Challenge the problem.* Empathizing with users at the beginning of a project allows innovators to validate if they have understood the user problem correctly if not design thinking helps reframe the challenge to focus on delivering the right values.
- *Include diverse viewpoints:* Design thinking works ideally when innovators work with people from different backgrounds as each person bring with them a unique viewpoint while addressing a problem or creating a set of solutions. For instance, Gallery Walk, a technique where an innovation team walks around a room with posters containing the data from empathizing with customers has been incorporated into design thinking practices as it allow a team to effectively make sense of gathered data through immersion and dialogue (Liedtka, 2018).
- *Tangible prototypes.* Creation of simple prototypes to give pre-experiences to users and obtain valuable feedback before settling on a solution brings in clarity to innovators
- *Experimentation.* Design thinking is a very iterative process that involves constant cycle of building hypothesis in the form of prototypes and validating them with customers in a cyclic manner.

These core principles in order, take innovators through a divergent-convergent thinking process with the aim to help them with an inspiration, ideation, and experimentation (T. Brown, n.d.; Liedtka & Ogilvie, 2014). Despite a general agreement on the core principles, there is a lack of coherence between academic research and the actual way design thinking is practiced within companies (Carlgren et al., 2016). After extensively researching the different academic interpretations along with different reasons companies use design thinking Carlgren et al., (2016) created a conceptual model of design thinking by depicting design thinking as a package of mindsets, principles, practices, and techniques which bear a resemblance to the way certain designers work and approach problems that go beyond a product’s physical appearance. Carlgren et al., (2016) state that depending upon the perspective, design thinking could be viewed as a learning process, a problem-solving protocol, a working culture, a new innovation paradigm, among many other things.

Figure 2. A conceptual model of design thinking adapted from Carlgren et al., (2016)



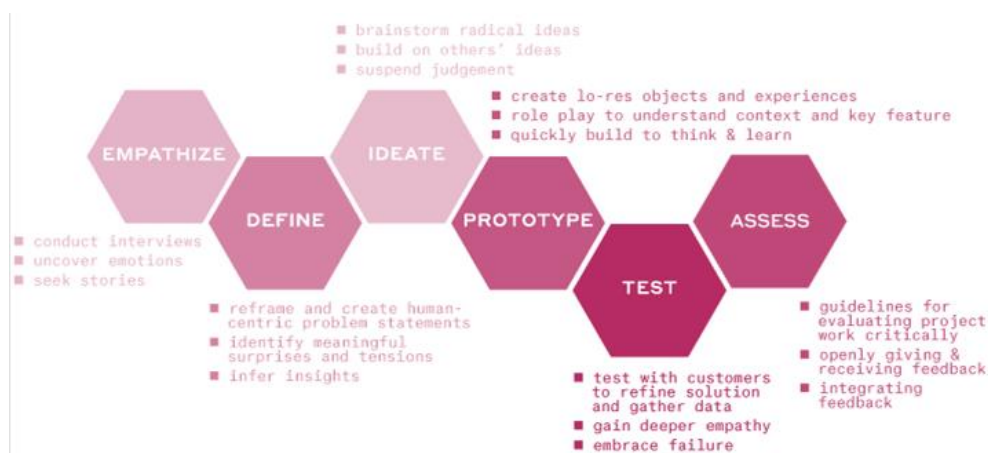
In an effort to publicize and communicate the idea of design thinking to practitioners, fueled by generic descriptions of ideation and concept development, there comes in an inherent assumption

the design thinking practice is always the same (Carlgren et al., 2016). However researchers have identified that this is not the case as some companies that have implemented design thinking view it as a set of processes and tools to help with innovation while other companies see it as principles and mindset to help the people work better with innovations (T. Brown & Katz, 2011; Carlgren et al., 2016; Ingle, 2013; Mootee, 2011). The conceptual model developed by Carlgren et al., (2016) was meant to help managers communicate design thinking to their peers and help introduce design thinking into their organizations with regard to implementation, planning and evaluation. For managers to communicate the concept of design thinking they must understand the core principles and try to develop techniques that would in turn help others get the right mindset to practice design thinking effectively.

Despite this vagueness in how design thinking is used in real world application by companies, several renowned universities around the world like the Rotman School of Management and Stanford University have introduced academic courses and programs that aim to educate students in the principles of DT. The academic programs offered by both these universities are based on frameworks that feature a set of tools with emphasis on human-centered approach to innovation as well as interdisciplinary teams (Both & Baggereor, n.d.; Fraser, 2007, 2012; Seidel & Fixson, 2013). However, even the frameworks developed by universities differ to some extent. The d.school at Stanford with is partly credited with developing and spreading DT to industries has developed a iterative framework with five steps that are done in sequence, namely,

- *Empathize*. Data collection phase for understanding the needs of customers through tools like ethnographic studies
- *Define*. Data analysis phase for gaining a refined understanding of the problem. This phase is also referred to as the redefine phase.
- *Ideate*. Idea generation phase for solving the problem through interdisciplinary collaboration.
- *Prototype*. Phase to come up with tangible prototype that are experienceable representation of selected ideas from the previous phase.
- *Test*. Validation phase to show the developed prototype to users and obtain feedback.

Figure 3. DT model proposed by the Hasso-Plattner Institute of Design at Stanford (d. school)



These five phases are to some extent even considered to constitute a linear process starting with a problem and end with a defined product ready for development. This framework developed further by the School of Design Thinking at the Hasso Plattner Institute in Potsdam, Germany (Stanford's

sister school), which takes an explicate deep dive into the empathize phase breaking it down into two steps: ‘understand’ and ‘observe’.

The Rotman School of Management’s approach depicts DT as ‘Three Gears of Design’ (Fraser, 2007, 2012). While the first two gears, ‘empathy and deep human understanding’ and ‘concept visualization’ are very similar to the initial phases of Stanford University’s framework, the third gear ‘strategic business design’ is not covered by the Stanford’s University’s model.

Figure 4. Designing Businesses framework developed at The Rotman School of Management



Despite these variations, these frameworks are based on a common set of principles attributes and tools that enable those principle attributes identified by (Micheli et al., 2019) as shown in figure 5. These accounts of variations when considered together bring out the ambiguity of existing discourse around DT and justifies the use of the phrase ‘umbrella construct’ to sum up the discourse around DT.

Figure 5. DT attributes and Tools adapted from Micheli et al (2019)

10 Principle Attributes of Design Thinking		8 Key Tools that enable DT Attributes	
Creativity and innovation	Ability to visualize	Ethnographic Methods	Persona Methods
User centeredness and involvement	Abductive reasoning	Journey Maps	Brainstorming
Problem Solving	Gestalt view	Mind Maps	Visualization
Iteration and experiment	Tolerance of ambiguity and failure	Prototypes	Field Experiments
Interdisciplinary collaboration	Blending Rationality and Intuition		

## 2.4 Implementing Design Thinking

The ambiguity and vastness of DT literature gives rise to several challenges with regards to implementing it in an organization (Rauth et al., 2014). Some of the challenges highlighted by Rauth et al. (2014) include,

- Employees’ mindset on design thinking workshops being playful and not serious or value adding

- Difficulty in proving the effectiveness of DT implementation and identifying tangible benefits of implementing DT once the honeymoon period is over
- Designers view the concept of design thinking in the form of a workshop as questioning the formal training and education they received.
- Lack of traceability as to where in the development process DT has added the most value. This in turn makes replicating even a successful implementation tedious.
- Political challenges such as regular teams treating specialized DT teams differently and a lack of interest to learn DT principles from external consultants and felt the external consultants tried to muddle with established company procedure.
- The emphasis DT places on understanding customers through empathy could be awkward and uncomfortable for practitioners who are used to being told work rationally and objectively (Bason & Austin, 2019).

Liedtka et al. (2013) and Mootee (2013) acknowledge these challenges and even add, preaching the gospel of DT and asking people to adapt its principles is least effective when it comes to implementing DT in an organization. Employee buy is one of the three important factors that impacts implementation of any innovation process organization (Liedtka, 2018). The other two factors being the ability of the process to deliver superior solution and lower risks/ cost of change. Building in house competency and trust on a new innovation process like DT is an arduous task against the constant challenges that normally stem from de facto efficiency based management practices in an organization (Yoo & Kim, 2015). Hence implementing and legitimizing design thinking needs several supporting steps for it to be successful. Examples of such steps include (Conway et al., 2017; Dorst, 2011; Elsbach & Stigliani, 2018; Kolko, 2015; Liedtka, 2018; Liedtka et al., 2013; Mootee, 2013; Rauth et al., 2014),

- DT should be introduced with proper structures in place. As using DT involved changing people's behavior, it must be started with a lot of structures to help people not think about it a lot. Over time these clear guardrails would make DT habitual and a part of an organization's customers. This point correlates with the framework proposed by Carlgren et al., (2016) to help managers introduce DT to an organization.
- Effective DT implementation involves providing people with a combination of structured processes as well as tools and individual guidance to take the right steps.
- Manager must advice management to accept ambiguity, embrace risk and reset their expectations on what DT could help the company achieve during the initial stages of implementation.
- Usefulness demonstration by inviting experts and practitioners from other companies who use DT would paint a better picture of the benefits and shortcomings of DT for new adapters. They could also be convinced through experiencing DT first had in pilot programs and special projects.
- Creation of dedicated physical spaces like 'creative rooms with flexible interiors' and 'idea galleries', dedicated digital spaces like 'webpages in the internal company intranet', and 'forums', dedicated artifacts like 'handouts on DT tools' would help foster collaboration and discussion of DT within an organization.
- Implementation of DT alone might not account for much impact on a company's innovation if a manager does not consider the 'systemic complexities' and 'power dynamics' in the organization. The ideal way to implement DT would be to marry its principles with those of systems thinking and embedding it to foster an entrepreneurial culture within the organization. Thinking in systems would bring out the friction between internal systems using techniques like Cultural Theory and help with adapting DT principles considering the complexities of institution and overcome the 'Systemic Policy

Resistance’ which is the resistance to change commonly witnessed while introducing new processes or structures into an organization.

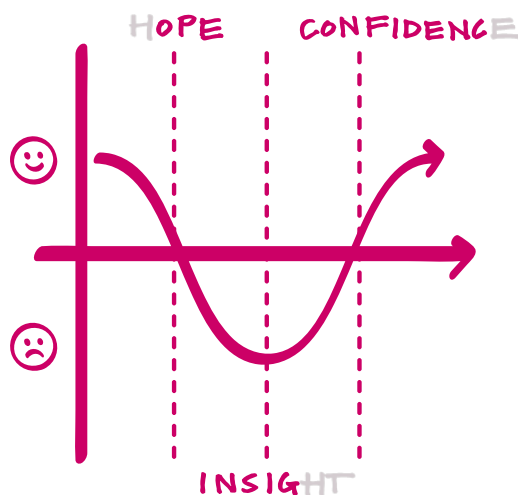
- Creation of ambassador programs (with people who have experienced design thinking) involving top management who advocate the practicality of DT.

These steps when adapted in tandem will make implementation of DT principles in an organization less tedious.

## 2.5 Leadership in Design Thinking

As mentioned earlier, Leaders advocating DT initiatives will help with successfully implementing DT principles in an organization (Rauth et al., 2014). However most DT implementations in companies involving hiring external consultant by leaders who have had no prior experience with DT (Bason & Austin, 2019). Brown (n.d.) explains that the DT journey for designers involves a significant period of the project where there is a likely chance for designers to lose their motivation. Brown describes DT process as a valley as shown in figure 6 and mentions learning to become a ‘dynamic problem solver’ and gaining ‘creative confidence’ are key for practitioners to unlock the full potential of DT.

Figure 6. How a journey of a project feels for a designer adapted from Brown (n.d.)



This trend is evident as DT principles ask people to repeatedly experience failure which is something they historically try to avoid (Bason & Austin, 2019). Brown, Banson & Austin (2019) highlight the influence of leadership here as an import factor to get innovators through this phase by guiding them towards building creative confidence. Leaders could do this by guiding employees on how to deal with distressing emotions that arise when repeated failures question the effectiveness of their work. Bason & Austin (2019) have identified ‘leveraging empathy’, ‘encouraging diversity & navigating ambiguity’ and ‘rehearsing new futures’ as the categories of practice that leaders could use to organize and run successful projects using DT. Leaders could use these categories of practice through initiatives like (Bason & Austin, 2019),

- Asking employees to frame findings as opportunities rather than performance problems or deficiencies in the existing products.
- Help illuminate the real needs of users identified in the empathy phase even if some of the process and initial findings seemed pointless

- Empower brainstorming through divergent thinking. Leaders must also ensure that innovators come up with extreme ideas. Even if these extreme ideas are not used directly, they would act as steppingstones to truly innovative ideas.
- Send over the message that failed prototype should also be considered as learnings and a means to progress the project.
- Set out a clear ‘pole star’ that aligns the employees working on a project on a unified and shared goal.

DT is challenging to leaders and managers as well since managers cannot commission a project and step back. They need to stay watchful of the developments in the project to identify where they need step in to engage with the team. In addition to setting frames for project and engaging with teams, leaders must understand the subtle differences between DT and other innovation processes and validate the need for DT before trying to adapt to their organizations.

## 2.6 Embedding Design Thinking with Product Development

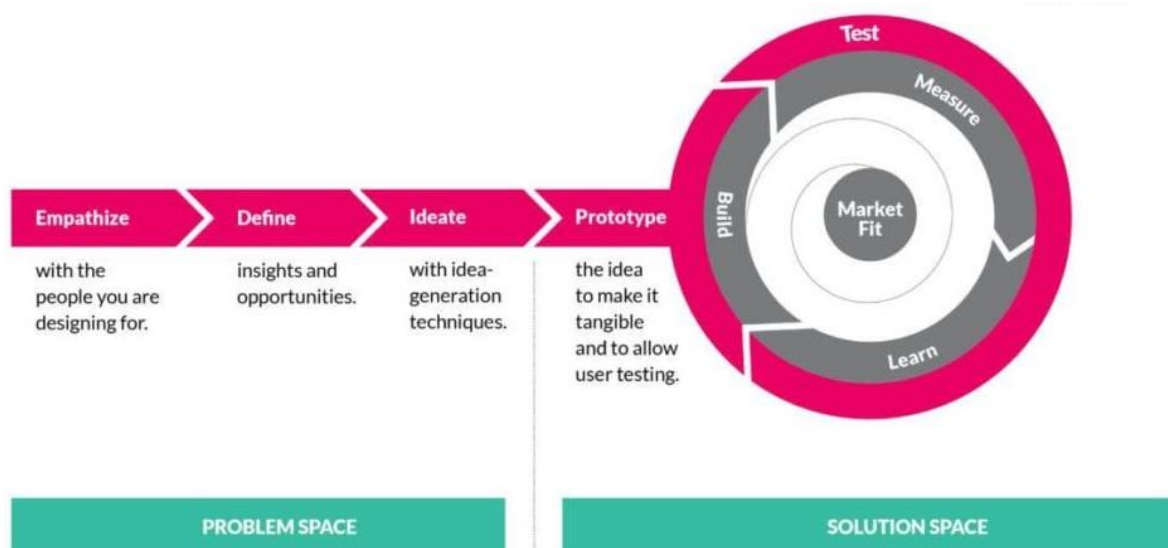
A significant portion of the existing literature on DT is centered around B2C companies or case studies which are one off cases of how companies used design thinking to solve specific problems. There is a lack of clarity on how B2B companies could benefit from design thinking if these companies were to adapt DT into their existing PDP. A standout advantage of implementing DT in a B2B company is the potential to co-create with customers who are experts in their fields (Liedtka et al., 2013). Grafmüller (2019), one of the few studies targeting the B2B context investigates hi-tech B2B companies engaging in co-creation with customers to solve specific issues. The study highlights several points that concur as well as contradict what a B2B companies might face when trying to adapt design thinking to its existing PDP. For instance, Grafmüller (2019) critiques Liedtka et al., (2013)’s statement about co-creation through his investigation. Grafmüller highlights capturing customer requirements and maintaining customer engagement throughout the period of product development as challenges and dictates that these challenges stem from reasons that are different from companies working in a B2C setup. An example of challenge in customer engagement is that there is a high probability that a B2B customer would not have time to actively engage in co-creation workshops with a supplier company. Similarly, an example of a challenge in requirement capture is that customers in B2B setups tend to be experts in their industries and hence might ask a supplier company for a specific solution instead of giving the supplier company with their needs. So, if a B2B company were to adopt DT methodologies through cross functional collaborative workshops as prescribed by the frameworks from the Rotman School of Management or Stanford University, the outcome might still be ineffective due to the challenges involved in maintaining customer engagement as briefly noted by Grafmüller. There could hence be a disconnect between the exploration phase of understanding customer needs (with design thinking workshops) and execution phase where the actual product development occurs (without design thinking workshop). This disconnect could result from several reasons, for instance, the product development people being different from those who actually interacted with customers in the DT workshop will result in the potential loss of information in translation, or in some instances, simple misunderstanding of needs in the workshop phase could lead to the product development heading in the wrong direction altogether, etc. This conclusion is in alignment with the finding of Conway et al. (2017) , Liedtka et al. (2013), Mootee (2011) that implementing DT principles and methodologies alone will not have much impact on the innovation potential of an organization.

One way to overcome such challenges might be using a hybrid innovation management process that combines DT thinking process with another innovation management processes to help with the execution phase of a project. One such hybrid process can be created by combining DT with

principles from the Lean Start up since both processes focus on using prototypes in iterative ‘test-and-learn’ cycles to better understand customers/users as suggested by Ahmed et al., 2019). Ahmed et al. (2019) have referred to this hybrid process as a Lean Design Thinking Methodology (LDTM). LDTM combined empathize, define and ideate phases from design thinking during initial phase and the build-measure-learn cycle proposed by Blank (2007) and Ries (2016). The term lean startup was first proposed by Steve Blank as a blueprint on how to build and operate startups by finding a product-market fit by moving a Minimum Viable Product (MVP) through a build-measure-learn feedback cycle. An MVP is any artifact with the least number of features of a product that can elicit maximum customer feedback while requiring the least development effort (Blank, 2007). The idea behind MVPs is that validation by asking feedback based on something is much more efficient than asking customers answer a set of questions. This would also help with engaging customers during development more effective as it minimizes the effort of participation from the customer’s side. Examples of MVP include low cost prototypes, presentations, videos, simulations, landing page that gauges customer interest for a specific product, etc. These MVPs are to be used by development teams to test hypotheses and validate customer values while developing a product enabling evidence-based decision making. Creating MVPs and running them through several loops of the build-measure-learn cycle help development teams achieve product-market fit before a product is launched into the market ensuring the products they build are in line with customer/user needs.

A simple representation of how the strengths of DT and Lean Startup principles can be combined is shown in figure 7.

Figure 7. Hybrid innovation process that combines strengths of DT and Lean Startup



Such a hybrid implementation may help provide better structure to the solution space (product development phase) which would make assimilating DT principles in an organization easier (Liedtka, 2018).

Understanding the DT discourse made it clear that there were several subjective interpretations of DT principles and hence an ambiguity in relation to effective implementation of DT in industries. One such gap was the barriers and opportunities for implementing DT in an organization. The authors decided to understand this with reference to the case study company and see how these barriers could be effectively addressed while introducing DT in the company. Hence the authors decided to use an exploratory case study to answer two research questions,

**Research Question 1:**

*What are the barriers and opportunities for implementing design thinking in a B2B company with well-developed product development processes?*

**Research Question 2:**

*How could design thinking be implemented at Mycronic to solve their current complications in the product definition phase?*

This chapter describes the methods and tools used in this thesis project. The section begins with an overview of the research setting along with a brief description about Mycronic. The section then continues with descriptions of various phases pertaining to the research design, data collection and analysis methods used in the project. This is followed by a discussion about the validity and reliability of the methods used in the project and finally, the section ends with a short discussion on the delimitation of the thesis project.

### 3.1 Research Setting

The thesis work was proposed by Mycronic, a Swedish high-tech B2B company creating world-leading production equipment for electronics and display manufactures. Mycronic, then known as Micronic Laser systems was established in the early 1970s in Stockholm. The company specialized in developing equipment to draw photomasks for the semiconductor industry. As explained in background section, Mycronic AB has two business areas, one developing assembly solutions for electronic circuit boards and the other developing Pattern Generators machine for display and semiconductor market. Mycronic AB was formed in 2009 by the merger of two Swedish companies, Assembly Solution business area was from MYDATA AB and Pattern Generators business area was from Micronic Laser Systems.

Comparing the two business areas, Assembly Solution business area makes products such as circuit board pick and place machines, jet printing machines, material handling machines, and inspection machines. The Assembly Solutions business area is a high-volume business with a larger customer base when compared to the pattern generator business area. Hence the Assembly Solution business area works by made to stock while the pattern generator business area works by made to order. Both business areas have similar functional departments. Both business areas have similar roles, similar ways of documented PDP and use the same digital tools for managing the product development. Exchanging of resources between business area was also mentioned by the interviewees. Differences seen between the two business areas are with the area of customer interaction and organic way of developing products. Mycronic's key highlight is its experienced Engineers and Managers who have been with the company for over 15 years. Mycronic's experienced employees have opportunities to interact more with customers especially in pattern generator business area; an interaction that was notably useful for Mycronic to develop customer centric products. Mycronic AB is a technology driven company, adapts its way of working and its products as the market evolves.

Aftermarket of Mycronic is important in Mycronic's revenue. It includes service and spare parts. The department of aftermarket is placed closer to customers and hence is rich with customer knowledge. Research of technology for future Mycronic products, market, and technology is handled by a specialized team in R&D called the Technology Development team.

The authors were presented with the following insights to be used to define the scope of the thesis work

- A recent survey identified that Mycronic's customer focus rating was not in line with their ambition, especially in Assembly Solutions business area.
- Internal company survey indicated a low understanding of internal stakeholder's needs.
- Product backlog of reported issues from end customers has not got the attention needed.

Several of the problems Mycronic faces while trying to work closely with their customers are in line with the challenges outlined by Grafmüller (2019) like 'challenges in requirement capturing', 'challenges related to time intensity', and 'challenges related to customer engagement'. Design

Thinking methodology was tested in a pilot project in 2019 with the help of an external consulting agency by the end of which Mycronic realized Design Thinking was a goal-oriented way to achieve customer centricity in the organization. Hence Mycronic sought to use Design Thinking principles/work methods to address the mentioned problems.

The thesis work was carried out at Mycronic Taby office between end of January and end of June in 2020. The authors worked under the supervision of Susanne Nilsson, Researcher and Head of Integrated Product Development and Design at KTH Royal Institute of Technology, Lars Ivansen, System Engineering Expert, and Peter Björnängen, Director of Technology development and Physics at Mycronic.

### 3.2 Research Phases

The project was divided into 4 phases starting with the preliminary study phase, followed by the Literature and Investigation phases and finally the Analysis phase. Total time taken to complete the project was 20 weeks.

At the beginning of the project, the authors were asked by Industrial supervisors at Mycronic to investigate whether design thinking methods could be introduced into the front end of Mycronic’s product development process to improve the company’s customer centricity. In addition to identifying a solution that would help Mycronic adapt design thinking, the authors also decided to study the established research literature in the area of design thinking and identify knowledge gaps that could be closed through the thesis project. With these two objectives, the authors devised a project plan with 5 phases as shown in figure 8.

Figure 8. An overview of the different phases of the thesis project



The activities done in each of the project phase is discussed in the upcoming sections.

#### 3.2.1 Preliminary Study phase

Initially, to get a grasp on the product development process and tools used at Mycronic, the authors with permission from the industrial supervisors, leveraged the internal intranet webpage of the company that housed detailed accounts of all the processes, stakeholders, documents and forums involved in the PDP. This information was compiled and discussed by the authors through whiteboard sessions. During these discussion sessions, the authors compared the PDP at Mycronic to the theoretical models they were based on and tried to identify the changes Mycronic had made to the theoretical models when adapting them. The authors then presented their understanding of Mycronic’ PDP to the industrial supervisors for validation.

Followed by this, the authors conducted educational observations and short semi structured interviews with the ten people from different departments from both business areas of the company. The list of the people interviewed in this phase is shown in Appendix A The primary

objective of these observations and interviews were to understand why Mycronic's process differed from theoretical PDP models as well as to understand the organic interactions and routines among stakeholders which would be harder to understand through Mycronic's intranet webpage. The authors consider these observations as sources of insights allowing deeper understanding of the actual practices as opposed to the perception-based personal views presented in verbal interactions (Polkinghorne, 2005). These observations and interviews were coded and analyzed to get an objective view of Mycronic's PDP. These interactional also helped the authors to identify potential candidates to interview for the thesis. Once this was completed, the authors proceeded to the literature study phase.

### **3.2.2 Literature Study**

A literature study was conducted to establish the theoretical frame of reference for the thesis work. The two key objectives of the literature study were to,

- Gain a thorough understanding of established state of design thinking from the perspectives of academic research as well proven techniques developed by practitioners. The authors realized the need to understand practitioners points of view as design thinking in its present state has been predominantly shaped by several additions from practitioners in the form of books (T. Brown & Katz, 2011; Dunne, 2018; Ingle, 2013; Knapp et al., 2016; Liedtka et al., 2013; Mootee, 2013).
- Identify a gap in the research literature which could be closed through this thesis work.

In addition to the study of design thinking literature, the preliminary interviews also prompted the authors to study areas like knowledge management, idea management, front end of innovation, value engineering, lean start up, etc. Google Scholar and KTH Library database were primarily used for searching the literature. The keywords used for searching include (but were not limited to) Design Thinking, Business to Business (B2B), Front End of Innovation, Customer Centricity, Visualization, Empathy, Minimum Viable Products (MVPs), Well Developed Product Development Processes, Voice of Customer, Customer Requirements Flow. The knowledge obtained through this phase was used to compare with the case study and was used as a basis of motivation when formulating solutions.

At the end of the literature study phase the authors,

- Identified gap in the literature which is explained in section 3.6 of the report
- Presented an overview of design thinking literature to the thesis supervisors

### **3.2.3 Investigation Phase**

A single case study of the company was chosen to understand the dynamics of this theoretical setting, and the data collection was done mainly through semi structured qualitative interviews. The authors took into account the guidelines set by Yin (2009) pertaining to research questions, unit of analysis, and the criteria for interpreting the findings. The authors also followed a highly iterative process between data collection and data analysis as prescribed by Eisenhardt (1989) for a case study based research. An interview guide and a simple card sorting exercise was created by combining the knowledge from the preliminary study and literature study phases. The card sorting exercise was a simple ten-minute activity conducted at the beginning of each interview where the

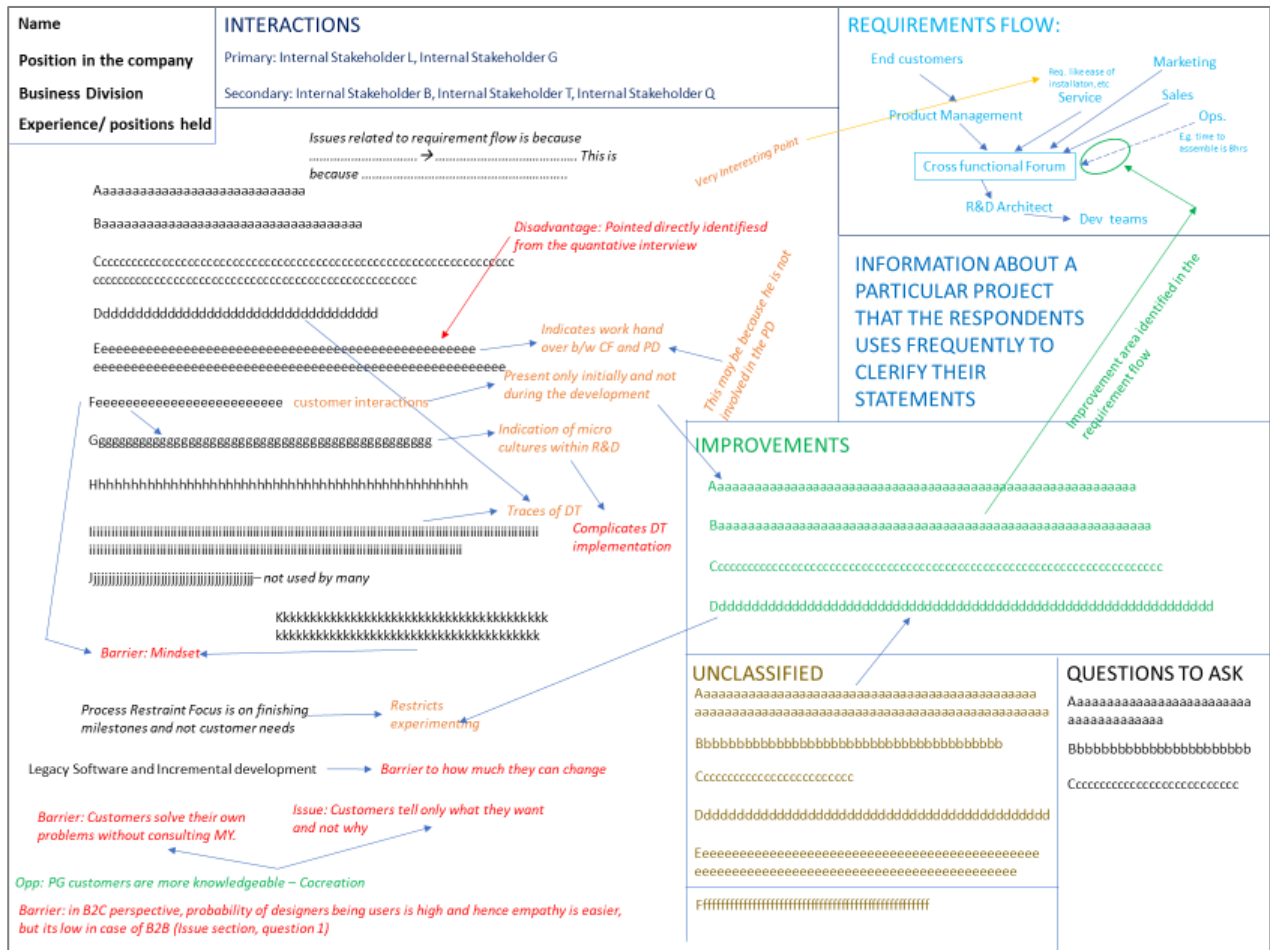
interviewee was shown a list of twenty-five-word cards derived from research literature. The interviewees were then asked to pick the cards that they associated with Mycronic and the cards which they would like to see in Mycronic in the future. The idea behind this card sorting exercise was to capture an uninfluenced mindset of an interviewee before the authors began asking questions from the prepared interview guide. The card sort exercise is elaborated further in Appendix B. The interview guide consisted of four sections (see Appendix C) and each of the twenty-five interviews was about 60-75 minutes long. All the interviews were conducted by video conferencing in Microsoft Teams (on account of a global pandemic at the time of conducting interviews). The interviewees were chosen based on their level of involvement in the PDP and were from different hierarchical levels of different departments. The list of interviews classified by their roles is shown in Appendix A. The interviewees were asked to share any relevant document that came up during the interviews and were also asked to suggest other people whom they think could provide more information relating to the thesis. All the interviews were recorded after getting permission from the interviewees and transcribed to help with the quality of the analysis (Fejes & Thornberg, 2009).

### **3.2.4 Analysis Phase**

The transcribed interviews were coded independently by the two authors to avoid influencing one another. However, to make the post coding discussion efficient, before the coding process, the authors agreed to a set of nine themes to classify their codes under (refer Appendix D) for the list of agreed upon themes. Within each theme the authors were free to code the information they thought were relevant.

After the independent coding process was finished, the codes were transferred into a final transcript document for each interview. If a code was identified by both authors, it was directly accepted, if not the authors discussed the code in question to understand if there was any subjectivity involved when one of the authors identified the code. In some cases where the authors could not agree upon the relevance of a code after discussion, the academic supervisor was presented with the information and the code was selected or discarded based on the feedback the authors received. After each of the interviews had a final transcript document with agreed upon codes, the unified transcripts of twenty-five interviews amounted to roughly six hundred and fifty pages. The authors wanted to visualize certain information such as customer requirements flow in the company, handovers within projects, interactions of interviewees with other people in the company, etc. and having the transcripts in printed format hindered that authors' ability to visualize such information. Hence the authors used the guidelines on how concept maps and mind maps could be used as tools for visualizing qualitative data by researchers presented by Wheeldon & Faubert (2009) to create a unique concept map for each interview, essentially condensing the information from six hundred odd pages into twenty five sheets of paper. These concept maps were used by the authors for deep dive discussion of each theme and for formulating answers for the chosen research questions. An example of this concept map is shown in figure 9.

Figure 9. An illustration of the concept map created by the authors for each interview



The authors mailed follow up questions that came up during the discussions to the interviewees and in some cases, even scheduled and conducted supplementary interviews with interviewees to verify stated information as well as clarify new questions that the authors had come up with during the analysis phases. This verification process at the end of the analysis phases as advised by Adams(2015) and Bryman (2012) was very crucial for the thesis work as Mycronic underwent a major internal restructuring of its business divisions towards the end of the analysis phases. This restructuring had implications on certain information derived from the interviews done before the restructuring and hence the authors made sure the changes to the organizational structure, processes and practices were taken into account while formulating solutions to the identified research questions.

### 3.2.5 Development of conceptual framework

The solutions developed for the research questions are based primarily on the analysis of the data collected through the qualitative investigations at Mycronic. But since RQ1 was proposed to try and close a gap in research literature, care was taken to ensure that points made while answering RQ1 was backed by several points of view from the exploratory study. On the other hand, since the RQ2 was more concerned with solving a problem within the context of Mycronic's PDP, research literature was used only as an inspiration to back up the proposed solutions. Hence the brunt of the solutions proposed for RQ2 was derived from synthesizing the observations and quantitative data collected at Mycronic. For this reason, the authors have proposed general directions and compartmentalized pilot programs that Mycronic could run to test, select, and improve upon the solutions proposed instead of deploying the proposed solution in one go.

### 3.3 Method Discussion

The primary aim of the thesis work was to obtain a deeper understanding of different use cases of design thinking and the various barriers and opportunities that come into picture when trying to adapt design thinking principles in a B2B company with well-developed PDP. So, the research methodology used in the thesis are exploratory instead of explanatory. This exploratory deep dive helped identify some surprising aspects of the design thinking umbrella construct (Hirsch & Levin, 1999).

In order to maintain validity and reliability in this exploratory investigation, several of the guidelines presented by Yin (2009) have been followed. The table 1 presents the case study tactics identified by Yin (2009) to maintain quality in research.

*Table 1. Case study tactics adapted from Yin (2009)*

Tests	Case Study Tactic	Phase of research in which Tactic Occurs
Construct Validity	Use multiple sources of evidence Establish Chain of evidence Have key informants review draft case study report	Data collection Data collection Composition
Internal Validity	Do Pattern matching Do explanation building Address rival explanation Use logic models	Data analysis Data analysis Data analysis Data analysis
External Validity	Use replication in multiple case studies	Research design
Reliability	Use case study protocol Develop case study	Data collection Data Collection

Construct validity has been ensured by using data from several sources. The solutions to each of the two research questions were derived by combining information from the qualitative investigation such as observations, interviews, documentation obtained from the company, qualitative validation from academic and industrial experts and is grounded in theory. A chain of evidence was established and verified by cross referencing the qualitative data to derive consolidated information such as mapping the flow of customer requirements from the point of inception till the point of product delivery back to the customer, identifying the key points of handovers within the PDP and the effect each handover had on the consecutive stakeholders, plotting the impact of the digital tools and documentation on the voice of customer, etc. This was done with the help of the concept maps described in section 2.2.4. Furthermore, the developed case study data was presented to several experts at Mycronic for review and validation to ensure consistency of the work.

There are some complications in verifying the external validity in the thesis work. For instance, fifty percent of the Mycronic employees who were interviewed had been with the company for more than a decade and this could have skewed them to be less critical about the issues at the company. However, the interview guide was designed with this in mind and had several ‘why’ questions that helped identify the root causes beneath the surface level remarks of some of the interviewees. Similarly, the interviewees were also asked to give examples for statements they

made, and this was used to confirm the accuracy of their claims. Additionally, establishing evidence chains by comparing data from all the interviewees, and by using literature to support the conclusions aided in establishing external validity of the thesis.

The methodologies and techniques used in the thesis are clearly documented in this section of this report and detailed database of all the identified literature, interview guide, transcripts, concept maps, documentation detailing the authors discussion sessions have also been maintained. This would ensure the reliability of the thesis work in line with Yin (2009) definition of the objective of reliability as the ability of a later investigator to arrive to the same findings and conclusions by simply duplicating the procedures dictated by an earlier investigation to the same case study all over again. Additionally, all the key documents like the interview guide, cart soring exercise phrases and literature search phrases are included in the appendix of this report.

To increase objectivity and prevent the personal biases from influencing the reliability of the thesis, the data from the qualitative study was analyzed by the two authors separately as explained in section 2.2.4.

### **3.4 Delimitations**

1. The thesis work is carried by two master students at KTH Royal Institute of Technology in collaboration with Mycronic with the time limit of 20 weeks.
2. Information related to processes, product, business, and customer has been removed/modified from this report due to confidentiality.
3. The work did not include speaking with Mycronic's end customers to understand the problems from their perspective.
4. The thesis work results were fully based on the interviews and chats involving Mycronic employees based in Taby, Stockholm.

This chapter explains the results, after analyzing the coded interview. The concept maps from the qualitative interviews are combined to understand Mycronic’s way of working highlighting the differences in their business areas and project teams. Then requirements flow and possible areas of improvements are identified critically and combined to show a gestalt view of situation. This chapter also briefly explains the findings from the card sorting exercise that was conducted before every interview.

## 4.1 Requirement Flow

Traces of design thinking were visible both in Assembly Solutions and in Pattern generators business areas. For instance in the Assembly Solutions business area, some teams use white board sessions to arrive at consensus, developers create throw away codes and low cost prototypes, some projects even used user storyboards to understand the use cases of the product. Similarly, in the Pattern generators business area, managers created a product presentation and landing pages to gauge customer interest in the market, they also test the finished product in customer’s place to understand their needs.

Design Thinking at its core is based on the concept of having the unfiltered voice of customers in hand to develop the right type of product that adds value to all the stakeholders involved in the development. To this end, it was imperative in the thesis to map the voice of customer flow through the different layers of organization before proceeding to identify areas where design thinking could add most value to the company.

Initial analysis of the coded interviews helped to identify the requirements flow seen in the company. Three separate requirements flow was identified inside the company, visually represented in as flow chart figure 10

- a) New Product Development (NPD)
- b) Service/Enhancements
- c) Technology Development.

Figure 10. Visual representation of requirements flow in Mycronic

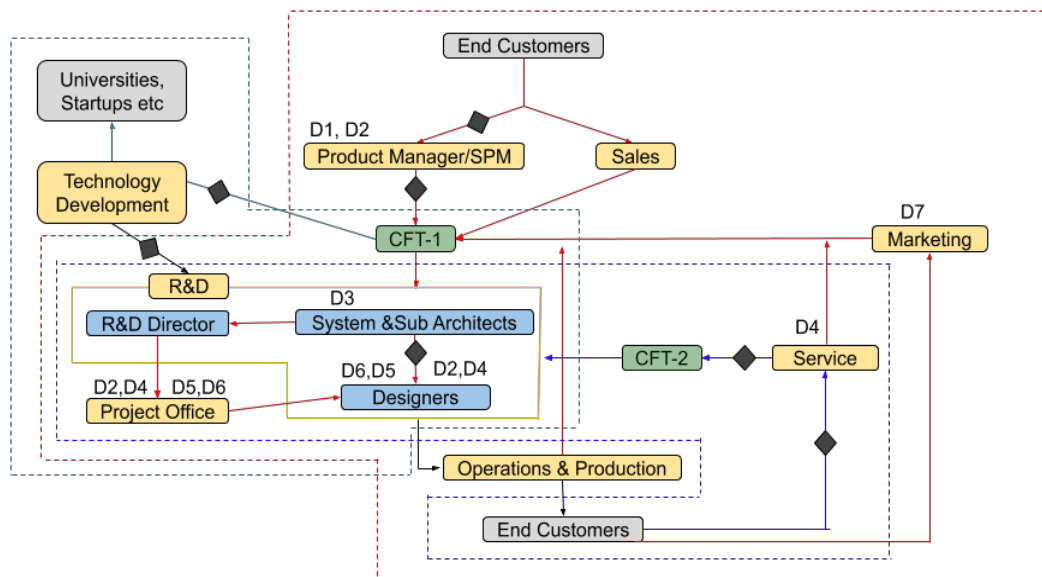


Table 2. Key stakeholders involved in the requirements flow

Area	New Product development	Service/ Product Enhancements	Technology development
Stakeholders	End customers, SPM, Sales, Marketing, Service, Operation and Production, R&D, Project Office	End customers, Service, R&D, Project Office	Technology department, R&D, Project Office, 3 <sup>rd</sup> party companies
Roles	Product managers, Architects, Sub system architects, Designers, Managers from different department, Director of R&D	1 <sup>st</sup> line service contact, 2 <sup>nd</sup> line service contact, Service manager, Architects, Sub system Architects, Designers, Project managers	Director of R&D, Architects, Sub system Architects, Designers, project Managers
No. of Handovers	3	2	2
No. of Digital Tools (D1-D7)	7	5	5
Forum	CFT – 1	CFT - 2	CFT - 1
Key Documents	4	3	1

#### 4.1.1 New Product development

Company’s NPD requirements flow was a combination of technology push and market pull strategies. Product managers and Sales Personnel reach out to end customers to bring in customer needs. The requirements flow between two business area were very similar with some changes in their way of customer interaction. For instance, one of the business areas with has few customers dedicate a lot more time for interacting with customers while the second business area does have the allowance to do the same. End customers are not open to the company and have rules (like pen, laptop, paper not allowed) in their premises. This at times makes the initial capture of the voice of customers tedious and hence this is a critical handover point (Handover 1). Handover points are probable points of loss of requirement information during the requirement flow.

Experienced Product managers in SPM department are responsible for mid and long-term NPD product road map plans. They maintain the NPD document (in Digital tool-D1), which contains all the requirements from different stakeholders. Requirements from customers is brought into the Cross Functional Team - 1 (CFT-1) by SPM and Sales. Here there is a handover (Handover 2) of

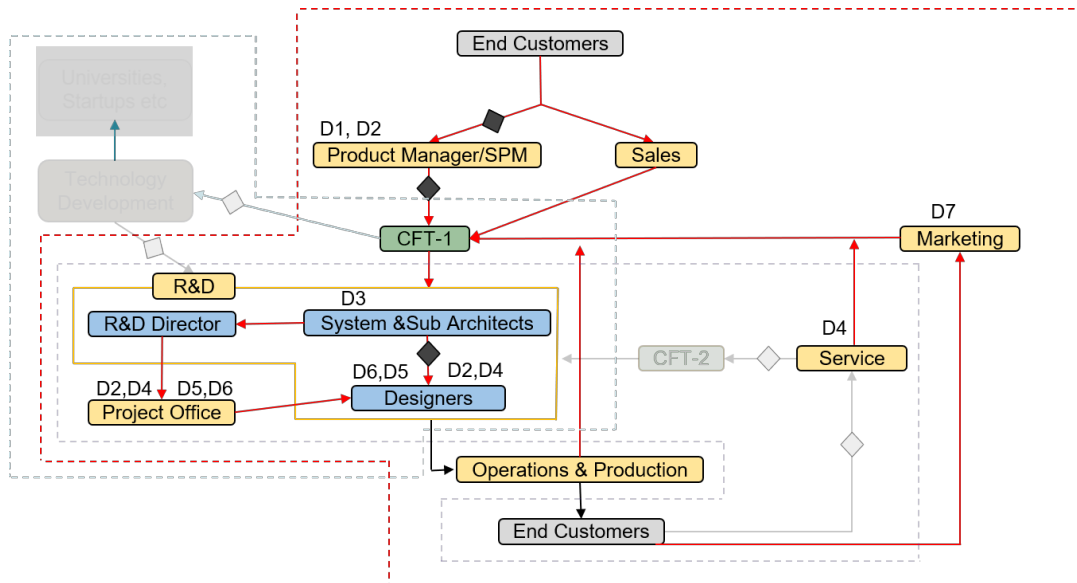
customer requirements to the company, because here customer needs are translated to functional requirement for the new product. CFT-1 comprises of other stakeholders like Service, Operation & Production and Marketing and R&D. The stakeholder needs are discussed in this forum and given a rudimentary prioritization.

This NPD document (in Digital tool-D1) is used by System and Sub-System Architects to break down the functional requirements into technical specification into digital tool Digital tool-D3. The Architects create lean documents (in Digital tool-D2) to communicate the design ambition to the R&D designers they work with. Technical Specifications are grouped into projects and assigned to specific teams comprised of project managers and designers. The backbone of the company is their core R&D team, that works with technology development for the new products. Architecture of Mycronic's products are very complex in nature and need the combined expertise from different spheres of engineering like mechanical, electrical, mechatronics, software etc. Company has a very well developed PDP with modified stage gate model, where Technical Readiness Level (TRL) is used to screen projects through each gate which makes the R&D projects to deviate from the process to adapt with modified ways of working. Tasks are assigned to designers through digital tools D4 and D6 but the briefings on the tasks are verbal in nature in most cases, which also leads to loss of customer voice; a part of this issue is also due to some designers not checking the requirement flow available in Digital tool D3, this is considered as handover (Handover-3). Same set of digital tools are not used by all stakeholders and are not integrated optimally which makes it difficult to manage resources, definition of done, project delivery dates with R&D. Since the digital tools are not integrated effectively, there are confusion in closing tasks and audit work. Designers think that some of the requirements they receive do not have all the necessary customer background information. Designers have different levels of customer knowledge depending on their experience in the company, the longer they have been in the company the better their customer knowledge. Cross functional collaboration is used at its fullest in CFT-1 in the initial stages of a project and, but it gradually diminishes over the course of the development process.

Designers work with the verbal information, information from digital tool and with existing product knowledge. They occasionally contact customers to get more knowledge about the communicated requirements. Prototypes are created if necessary. The decision to prototype also depends on the type of technology and field of engineering (e.g. Mechanical prototyping is more common than optics prototyping). Traces of design thinking was seen in the company's ways of working but they were not strategically driven. For example, software projects used throwaway code as prototypes, they created an internal language (based on symbols) to communicate their idea to other stakeholders and use a documents called Lean Knowledge Description (LKD) (in Digital tool- D2) which acts as a simple communication tool for decision making.

Customers are briefly consulted during PDP in the product definition phase and are sometimes retained during PDP process. Then they are consulted extensively during beta testing in the final stages of the PDP. When the product is ready to be launched after checking all the required readiness level, beta testing contract is signed with specific customers and the products are tested at the customers' production facilities. Then the fully realized new product is launched in the market.

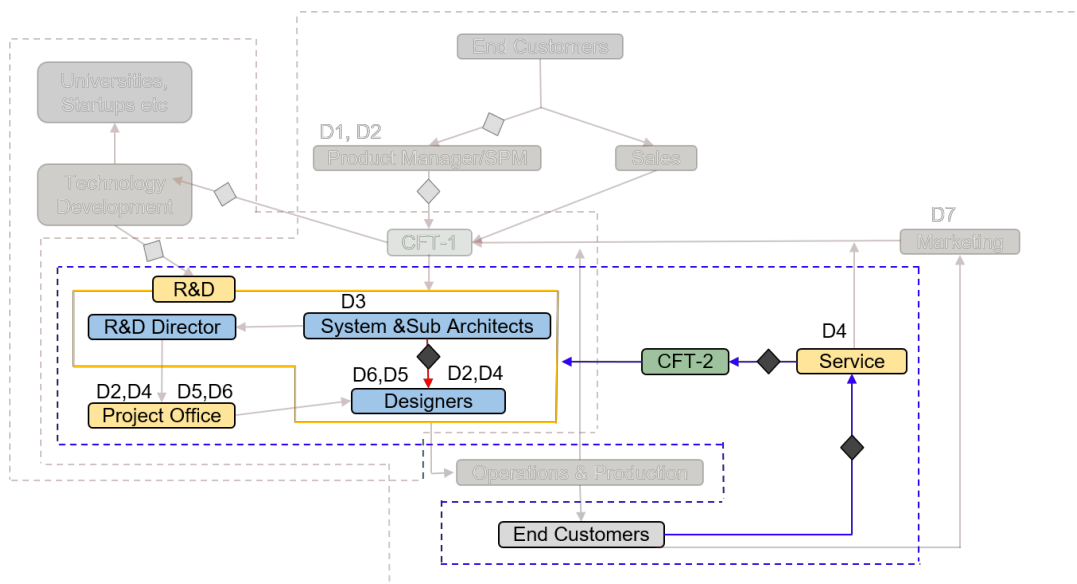
Figure 11. Requirements flow in New Product Development (NPD)



#### 4.1.2 Service/Product Enhancements

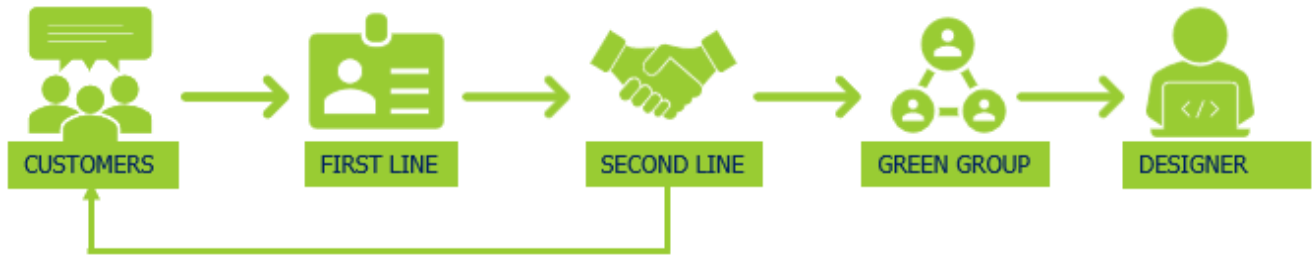
Company has a solid revenue from aftermarket sales which includes service contracts and spare parts sales to end customers. This backflow of requirements from the customers back to the company in terms of improvement request or service complaints plays a vital aspect in increasing the customer centricity. End customers after purchasing the product will be in close contact with aftermarket sales. They contact Mycronic when their machines need service or enhancements. Backflow of requirement to the company is visually highlighted in the figure 12.

Figure 12. Requirements flow in Product Enhancements



When there is an issue or complaint, the customer contacts first line service personal who represents the company in the field. These first line personal are either dealers of the Mycronic machine or employees of Mycronic depending on business area and geographical location. They are usually 3rd party companies that have customer knowledge and basic service knowledge. Escalated issues or enhancements will be pushed (Handover- 4) to second line service who are Mycronic employees. Depending on the type, the issue is fixed by 2nd line service or given to CFT-2. Backflow of requirements is represented in visually in figure 13.

Figure 13. Backflow of requirements from existing customers to Mycronic

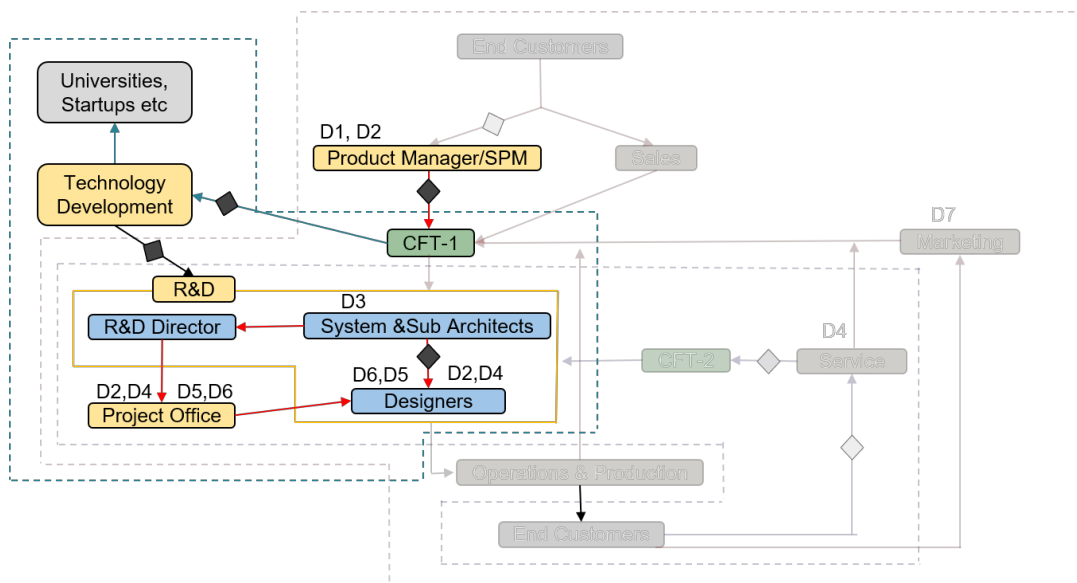


CFT-2 is a cross functional forum with aftersales and R&D working together to solve customer requests. Digital tool D4 is used to communicate the customer requirements from 2<sup>nd</sup> line service to designers through CFT-2 forum. The issues are prioritized in CFT-2 forum and handed over (Handover- 5) to R&D. Processes are handled in a similar way as discussed in NPD section.

#### 4.1.3 Technology development

Technology department works on long term development projects which are technologically driven or strategically driven. The road maps created by SPM for long term products are identified and shared (Handover- 6) with technology development. Director of technology discusses with product managers to identify technology gap and compares with the market using 3 horizon strategy.

Figure 14. Requirements flow in technology development



The department looks for new market with new technology or existing market with new technology. Projects are carefully analyzed by director of department. The progress of the projects is tracked monthly, and budget is allocated related to the progresses level. Mycronic employees can also submit their idea to convert these into full-fledged development projects. Development process in Technology Development is like NPD but is free from deadline pressure and deliverable timeline because these long-term projects are not connected to any customer delivery dates.

Mycronic has tie ups with universities, startups and leverages these partnerships in development. Once the technology is proven or market has become mature, they are added to company’s product portfolio. R&D of NPD takes over the technology project.

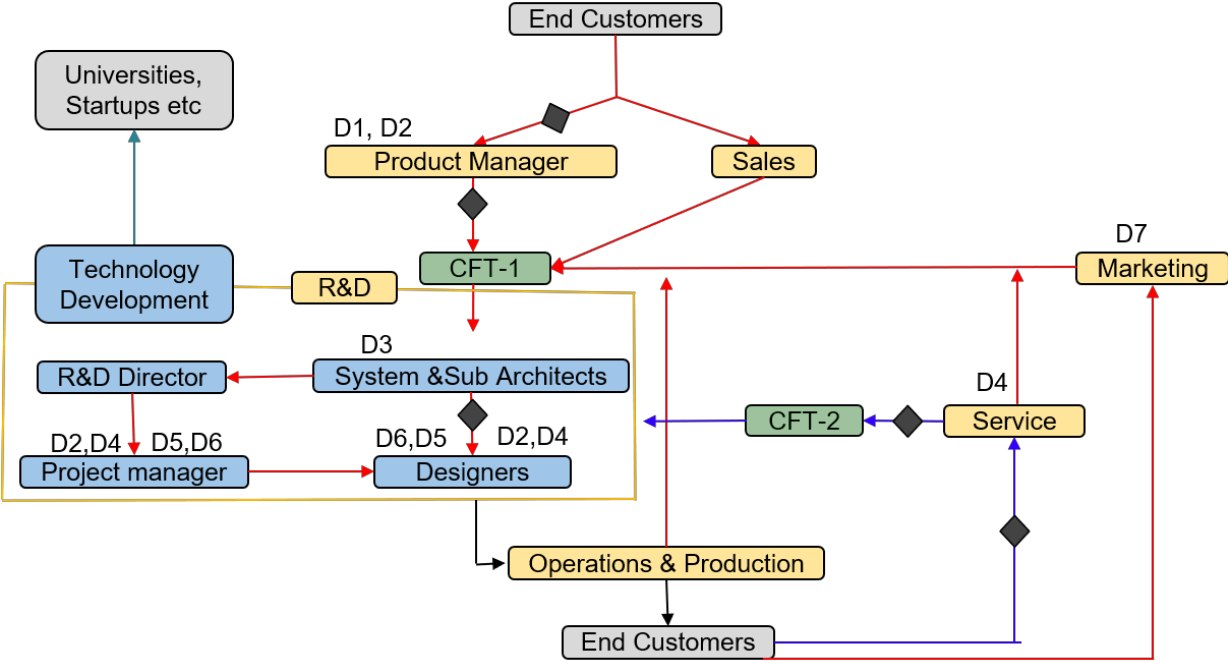
### 4.2 Restructuring

The interviews were conducted before an internal restructuring of the company’s organization at Taby. Employees began shifting to the newer roles from mid-April 2020. Restructuring of the company were also considered while framing solution by comparing the difference between Mycronic structure before and after the restructure.

There has been changes in roles and removal of certain functional departments. The restructuring is related to business initiatives and not to customer centricity initiatives. The responsibility for the long-term strategy has been moved from the global function of SPM to individual product managers for each product family. Also, instead of organizing all Taby project managers within a project office department within R&D, the project managers are now allocated to individual product families and handle projects within that division.

The global function of the technology department has been removed and instead each division is responsible for their technology development projects. The restructured organization is shown in the figure 15.

Figure 15. Requirements flow and stakeholders in PDP after the organizational restructure



## 4.3 Areas of Improvement

The possible areas of improvements in Mycronic which has been highlighted by the interviewees or identified by the authors are listed below. The improvements list can be viewed under two major headings based on

- a. Highlighted or visible area of improvement
- b. Identified or hidden area of improvement

The improvements areas are highlighted in the upcoming sections.

### 4.3.1 Highlighted or visible area of improvement

#### i. Customer Requirement

Requirements from customer are the first information used by designers to understand the customer need. This information is recorded in product directive document (D1). Designers however do not use this document.

*“Product Directive is very high level and is just the very essential idea behind the project, And I generally, don’t look very much into that document”*

- Software designer

Requirement loss can also be due to handover during the product development process. The growth of Mycronic has made the R&D department to stay far away from customer, hence also with customer requirements. So, we see filter of information in requirement flow.

*“I am not really sure where the product managers get the requirements from and how they capture it. For me it comes as a prioritized list of things I need to develop. In some cases, I don’t get the complete background information as to why I am developing something.”*

- Technology developer

Along with requirement, designers must be given the priority of the requirement. This helps designers to view the importance of the requirement. This priority needs to travel from the start. At present designers get very limited information related to requirement priority.

*“R&D job is basically to do what SPM sets up as the roadmap. So, we shouldn't be doing that kind of prioritization by ourselves. But that's kind of how it is right now.”*

- Designer

Mycronic customer are not much open to Mycronic. Although several factors like culture and region impact this a key reason could be that since most of the development is incremental companies don’t find value in being open to Mycronic and are happy with just giving requirements. Presently customers are involved only at the initial and final stage of product development process.

*“Customer openness depends on many factors like region, culture things. Every customer wants a solution that would make them more profitable at the same time would like to ensure their secrets are safe since MY supplier solution to not only them but their competition”*

- Product Manager

*“Confidentiality plays a major role in how open our customers are. The way I see it, our customers in aerospace industry are very tight lipped compared to our customers in say hearing aid business. We are not even allowed to take our computers when we meet with people from our aerospace customers. But I am sure this is understandable to you. But what you should also see is that from my customer’s perspective, Mycronic provides assembly solution machines both to*

*him and his competitor from the same industry. So, as you can see this result in customers being hesitant regarding sharing information with us.”*

- *Systems Sales Expert*

*“Traditionally, ten or twenty years ago, our customers were very involved. But presently most of the customer involvement is mainly in the beta testing which I think is very late in the development.”*

- *Software Architect*

Apart from Mycronic customer not being majority of the interactions the customers have with Mycronic (but always needs). This also creates a cascading issue where some of the designers do not know the full extent of the customer needs and are straight forwardly asked to design specific function for the customers

*” We get inputs from customers as a combination of needs and requirements, I would even say mostly requirements since they know exactly what they want.”*

- *Product manager*

*” Lots of times, developers are asked to design specific functions that the customers have asked for.”*

- *Program manager*

Involvement of customer during the product development process may increase customer satisfaction and reduces requirement change or requirement misinterpretation at early stage. Mycronic customers engage during the early phase and beta testing phase (which is at end of product development). There is customer reference for the requirements which are seen to be not used. This leads to change request from customers at end of Product development process.

*It’s not so much of the customer requirements that change, it’s the product manager’s requirements that change, that happens all the time.*

- *Designer*

Seeing from product manager perspective customer requirement change is natural, but its everyone’s responsibility to closely monitor this area to find out the change as early as possible during the product development process. Literature also highlights that design thinking will work both ways, businessperson can design products as well as designer needs to think in business perspective.

## **ii. Prototyping and documentation**

Mycronic products are very complex in architecture and requires more organic meetings and white board sessions to visualize the system and ideas.

*“I use a lot of whiteboard session with my colleague to orient ourselves on the common goals for the software we are developing. I use specialized symbols to put my thoughts on the board. Most of the software people I work with know these symbols and use these for organic sessions. But the difficulty in this way is it’s hard to document these sessions effectively and hence it becomes*

*very difficult for to explain my ideas to say a mechanical designers who is not completely aware of what the symbols I draw mean.”*

- *Software Architect*

Unique way of prototyping is seen in the company was by using user story boards to keep track of customer centricity however it was observed that such activities were driven individually rather than by management

*“I make sure all the engineers that work in project Omega (name changed due to confidently) use user stories to breakdown the customer requirements. We even have customer centric deliverables in my project. For this reason, I always ask my product managers to not order functions but give us the customer needs. Then my engineers can derive the requirements from them. I have always worked this way even in my past projects like Project Delta (name changed due to confidentiality).”*

- *Program Manager*

Tangible prototyping is one of the five principles of DT. Prototyping helps designers to validate their work (fail fast). In Mycronic, prototypes are developed in a internal workshop or being bought from supplier through sourcing department. It was also observed that all product families can accommodate prototyping. This was a notable difference in prototyping culture between the business area.

*“We don't really prototype in our business division I would say, because mostly our development is very advanced, expensive and make to order and so we end up selling the first prototype we build. We use the knowledge we gain in future development of course but we do not build prototypes. I don't know if you have spoken with someone from the other business division, but prototyping is done more frequently there.”*

- *R&D manager*

*“The purchasing team must be agile enough to use any supplier to do the prototypes instead of going for large scale suppliers. But once we receive the board, it is easy enough for us to test the board.”*

- *Electrical Designer*

*Here we have over fifteen and twenty engineers and we have one workshop guy to help us prototype and he cannot help with everyone's work. So, from a mechanical perspective this a huge pitfall.*

- *Mechanical Designer*

### **Summing up the highlighted area of Improvements**

- Designers get verbal information of requirement and are asked to design specific functions without background.
- Requirement information to designers lack prioritization and clarity regarding validation
- Customers are getting involved only at the beginning and at beta testing phase not in entire product development process.
- R&D is far from voice of customers, apart from experienced employees

- Lack of swiftness and infrastructure for prototyping.
- Loss of information while documenting white board sessions

#### 4.3.2 Identified or hidden area of improvement

Designer's bandwidth is not flexible so that designers has a mindset to develop products without customer interaction or customer interaction is required only in large products.

Mycronic Taby office is well structured but has slight ambiguity in roles, responsibility, and common terms. This may cause knowledge management issue (silos). It is difficult for employees to find the point of contact of the person who is an expertise in the area. This is an exemption for experienced employees in the company. Experienced Mycronic employees have expertise in their fields, and they represent a reserve pool of intrinsic knowledge. Interviewees mentioned it is easy to access this knowledge. Similarly, when asked about DT to one of the experienced people they expressed that it was not their natural way of working.

*"We have deadlines that are so short, that we do Don't have time for two prototype runs"*

-Project manager

*"To me, design thinking is another way of representing the global truth, but it is not my preferred way of working. I prefer working by myself and with structured methods."*

- Systems Architect

Mycronic Product development process is a linear process without room for iteration. Even though we can see iterations in development process, they are organic, and iterations are not structured. It requires lots of experience to understand the need for iteration and quick fail.

*"Within the development process, we have a very linear thinking to develop things and I think that we need to start thinking in another way. So, I think we should improve on being nonlinear"*

- Project manager

In certain situations, depending upon scope of a project certain parts of a PDP were cut short in the early phase of a development project. The trend also affects trends like periodicity of certain meeting during development. This could be seen as process and practice change.

*"Large development projects, you might have a CCB meeting every week. So, if is a small project, you have maybe one meeting during the whole project."*

- Software Architect

*"If there is a very large project there will be a formal study where we will go through if there is a real need for the product, what kind of product will fit the market and doing first interviews with some interviewees to get a basic understanding of what is happening and all this will result in a product directive document where some high-level requirements and needs from product manager is gathered in order to make this opportunity happen. Sometimes the study itself is very short and informal but we still write a directive to maintain a record of where we are going with the project"*

- Product director

Digitalization had been in product development processes and proven its place for more than decade, there are several digital tools available and the use of each tool are very different and are uniquely required in the process. e.g. PLM tool is used to manage CAD design, Parts, and other

documents. Mycronic uses 5 to 6 digital tools, each having its importance in the process. But there is lack of integration between these tools which can be legitimized corrected.

Cross functional working can improve the design of the product. Cross functional working is also one of the key ideologies in design thinking which can make value for the company Cross functional way of working is visible only during CFT-1 and CFT-2. Structuring this process can add value to product improvements. E.g. As service is close with customer, they can help R&D in solving specific design quicker.

*“Because I believe that we have too many handovers that makes time it takes more time. I think if we worked together, more cross-functional teams that were consistent over time. I think that would improve things.”*

*-Project Manager*

Though Mycronic has common product development process, some project’s way of working is different and have shown success. These initiatives have been taken by the team members of the projects or by project managers. These successful projects need to be identified and be implemented in similar projects and can be compared with normal projects. Feedback needs be recorded iterated in next implementation.

*“We will improve on prototyping if we find customers to work with. And the intention is to build small prototypes and iterate them through the customers but right now we don't do it.”*

*- Project Manager*

The requirement issue is seen throughout the PDP as well as during opportunity identification phase and in back flow of requirements. They are not prioritized and visible till the designers. Lack of structured requirements is also due to handovers; it leads own interpretation of customer requirements since the current requirement table lacks ‘why’ column see appendix E.

### **Summing up the highlighted area of improvements**

- Designers mindset about interacting with customers being not necessary
- Product development process is linear without iterations
- Digital tools lack integration, clear usage of individual digital tool.
- Lack in cross functional collaboration during product development.
- Lack of implementing the improvements which is identified during retrospective session

## **4.4 Card sorting**

The results of card sorting exercise were interesting and correlates with the answers given in interviews. These results give an unfiltered perspective of the respondents on specific issues in the company as the card sorting exercise was done by the respondents before the interview. Method for card sorting exercise is elaborated in Appendix B. Results from card sorting exercise for the two question are given below.

*1. Pick and place the words related to present Mycronic.*

The results were seventy-five percentage of participants responded that

- Mycronic as company **is good in Problem Solving**
- Mycronic culture allows **Creativity & Innovation**
- Mycronic is **Technology Centric company**

In addition to above, fifty percentage of participants responded that

- Mycronic work environment allows **Internal Collaboration**
- The product development process has **Iteration and Experimentation**
- There are **Deadline pressure** in the company
- Mycronic employees **visualize their idea and problem**

2. *Pick and place the words which you like to be in future Mycronic.*

The results were fifty percentage of participants wants Mycronic future

- **Customer centricity and User centricity** can be improved in Mycronic
- Employees should have **easy access to knowledge** through digital portal.

### **Assumptions in Card Sort Exercise**

- Words which are not picked by the participants cannot be considered as false. As participants picked words relating their work.
- The pass percentage of words for both the question were set to fifty percentage and seventy-five percentage was considered more reliable.

The data from mapping the requirements flow, identifying the areas of improvement and the card sorting exercise together lead to identifying the answers to the two research questions mentioned at the end of chapter 2.

## 5 ANALYSIS AND DISCUSSION

This chapter presents the answers to the research questions and ponders on the theoretical and the practical implications of findings identified in the thesis. The chapter also highlights areas for future research and authors' reflections regarding the main findings.

**Research Question 1:** *What are the barriers and opportunities for implementing design thinking in a B2B company with well-developed product development processes?*

### 5.1 Barriers for DT implementation:

Upon analyzing the situation at the case study company and comparing the findings with DT literature, the authors have identified twelve barriers that are classified under three major areas namely,

- Culture and Mindset
- Organizational Structure and Practices
- Customers

The barriers identified under each of these three areas are explained in the upcoming sections.

*Figure 16. Barrier areas identified*



#### 5.1.1 Barriers related to Culture and Mindset:

These barriers are linked to mindsets and biases of people and the overarching culture of a company that oppose the implementation of DT,

##### i. DT might reduce R&D Productivity

Several of the respondents mentioned that owing to the nature of the PDP process based on a Stage gate model at Mycronic, they were engaged with their responsibilities throughout the workday and highlighted the significant switching costs they had to account for juggling the different projects they work on simultaneously. From their perspectives, DT appeared tedious and non-serious way to go about doing their work. Some respondents who were part of the design thinking projects done at Mycronic in the past even considered DT as not their regular way of working. From their points of view, design thinking appeared playful and they felt uncomfortable while participating in design thinking projects. Some respondents even suggested that their customers might consider

them unprofessional if they used DT techniques like ethnographic studies or mind maps to understand the voice of the customer.

A systems architect from the company also mentioned that since he and other people similar to him were not comfortable in engaging with DT principles, implementing design thinking would be counterproductive as it will decrease the R&D productivity by forcing people to work in ways they are not comfortable with. These views on design thinking being too informal/ playful and resulting in decreased productivity is in line with the systemic policy resistance (Conway et al., 2017) seen in organization while introducing DT for the first time. According to Conway et al., the open ended nature of design thinking leads way to a cognitive resistance to accepting it as a process for innovation. Mootee (2013) concurs with Conway et al. (2017) and expands upon the reason for this being that DT's association with innovation is often oversimplified by its promoters and this leads to companies viewing design thinking as just a playful way to brainstorm product ideas or a five step process to create successful products. The underlying takeaways is that an organization will be a combination of people willing to accept new processes and people who show resistance to new processes and the vagueness combined with the open-endedness of DT principles add fuel to the flame in the latter's case. Hence the mindset that DT is counterproductive to R&D is a barrier for introducing and implementing DT in an organization.

## **ii. It is not important to interact with customers**

There was an assumption from many of the interviewees that it was not necessary to interact with customers to develop good products. This sentiment is the symptom of reasons such as customers providing sales or product managers (customer's first point of contact in the company) with the technical requirements they want for their machines instead of stating their problems or needs and; this lack of a clear idea travelling throughout the requirements flow where in some designers worked to design specific functions that customers ordered instead of trying to understand the problems and develop the right solutions (refer to quotes in point i of section 4.1.1). From a designer's perspective, this negates the need to interact with customers during the development process. This leads to a situation where designers and other internal stakeholders at Mycronic do not see the value in understanding the customer needs. This is fundamentally at cross with one of the core principles of DT which is 'challenge the problem' suggested by Rauth et al. (2014). In a B2B context, designers assume there is no need to challenge and reframe a problem and hence see no value of using design thinking or any other innovation process to do so.

The second reason many of the respondents gave for the assumption about not needing to interact with customers in a project's development period was that the developers or designers who build products feel that customer would not have anything new to tell them. This was particularly observed with designers working in high technology or futuristic technology development. When asked to elaborate this point, a designer working in a highly specialized field of engineering at Mycronic stated that even if they were to show their work to a customer, the customer might either be too disinterested in such research or might not know enough about the subject to add meaningful value to the conversation.

These cultural inhibitions or mindsets for not interacting with customers contradict advantages of DT principles such as the importance of discovery prior to solution creation, expanding the boundaries of problem definition, and enthusiasm for engaging customers in co-creation identified by researchers like Liedtka et al. (2013) and Micheli et al. (2019) and creates a situation with people trying to get human-centric outcomes without human-centric inputs (Kelley & Radziszewski, 2019). This type of a mindset negates the needs for design thinking principles at the front end of innovation and hence is a barrier to implementing design thinking in an organization.

### **iii. Only large projects need customer interactions**

A unique trend was observed in the case study company. Although the PDP demanded a thorough pre study phase to understand the spoken and unspoken needs of the customers in the front end of a development project, this was not always adhered to in all development projects. Almost all the larger projects had a detailed pre study phase, but the smaller projects were driven through a slightly shorter pipeline with a shorter pre study phase. This discrepancy or deviation from PDP appeared to be very arbitrary and when questioned about the underlying reasons, factors such as making quicker deliveries, managing resources better or in certain cases a better understanding of customer need right up front were started by the respondents as reasons for smaller projects not needing a thorough pre study phase as prescribed in the company's PDP (refer to quotes in section 4.4.2). This phenomenon when combined with the fact that a large portion of the company's development is incremental in nature (refer to quote in point i section 4.4.1), there is a significant lack of communication with the customers in most of the projects undertaken in the company. The company in the recent years has taken steps to involve in the customers more in the front end of the development by showing them mockups of products, CAD simulations, etc., but this as proved to be frugal as issues like lack of resources, disinterest from customers, adherence to delivery deadlines, etc. kept propping up in this endeavor.

These issues summed up have made not communicating with customers in the front end as the unspoken norm in the company by which the employees of the company operate. In other words, not seeking the feedback of customers in the front end has influenced the way projects are handled in the company, resources allocated to the projects, timeline drawn for the project, and the overall culture of the company. Although existing design thinking discourse does not touch upon this aspect of a company creating problems for DT adaption, from an objective standpoint such minor variation between process and practices (in this case different development pipelines based on project's scope which is not stated in the formal PDP of the company) exist in all companies regardless of their size, product areas or customers. And asking employees of such an organization to adapt DT principles will require practitioners to invest significant amount of resources to ensure consistent interactions with customers in the front end of all projects; creates a significant barrier for implementing DT in such an organization.

### **iv. Internal customers are the end customer**

An interesting phenomenon observed in the case study company was that many of the internal stakeholders who identify needs, design solution, manufacture the products and sell the products to the right customers are not themselves users of the company's products. This creates an emotional disconnect between the designers and the products developed. Additionally since the case study company works with high technology products, the knowledge necessary for developing products are skewed in different spheres of science. Thus, a single product from the company might involve the work of people from different spheres of science such as optics, mechatronic, pneumatics, etc. This complexity in the product has led to the development of a culture where a designer or developer considers their chunk of development as the product itself. For instance, a optics engineer in the company only makes sure that the lenses she developed fits to the confines of the operational parameters provided to her from the person before her in the requirements flow and she only has to make sure that the person next to her in the requirement flow is satisfied with the developed optics and she need not think about needs of the end customer. Hence it has become a common practice for employees to view the internal case handling software (called JIRA) as their customers. Although admittedly viewing their works into deconstructed tasks to be completed helps the company to make on time deliveries, this also removes a certain emotional connect an employee might have with the said tasks. It was alarming to realize that even some of respondents who would have to see the bigger picture and work with end customers in mind, did not have anything negative to say regarding employees seeing only the relevant internal

stakeholder as their customer. In such a task based environment, it would be difficult to implement DT as it puts a heavy demand on employees of the company to not just listen to end customer by additionally empathize with their problems and needs before commencing product development and hence is a barrier to implementing DT.

### **5.1.2 Barriers related to Organizational Structure and practices:**

These barriers are linked with the process structure and practices used in a B2B organization with well-developed PDP.

#### **i. There is a limit to how much the process could be changed**

Effective product development by working with customers in a B2B set up requires a degree of controlled-flexibility and hence the process is quasi-formalized (Grafmüller, 2019) depending on the types of products developed. In other words, in a B2B setup a company's development process in turn is highly dependent on their customers. This puts a limit on how much of the process could be changed in a B2B setup. A good example of such a restriction observed in the case study company was related to how maintaining support of legacy products (products launched by the company over twenty years ago) put a restriction on the types modern programming languages they could use in current machines to create agile and optimized software builds. Such a predicament means that a B2B company must consider several different factors into account before introducing a new process in their company. Factors like how the new process with impact a company's long-standing development agreements with their customers is crucial for consideration before a company could introduce a new process in the company.

Another example of a restriction was that several respondents mentioned that the company could not ship half finished products hoping to improve the product after launch (like some smaller software companies could afford to do) as this might ruin the reputation of the company with its customers. Since a key portion of customers for B2B companies are returning customers, losing reputation would mean losing current and future business partnerships with those customers. Since DT seeks to optimize the PDP process in its entirety, the repercussion from adapting any of its principles would have a ripple effect throughout the product development from process conception to delivery and even to post-delivery customer interactions.

For a B2B company, this sentiment creates restriction in one of the five key steps of design thinking i.e. prototyping. For instance, a B2B customer might judge the quality of the product by only looking at a semi-finished prototype resulting in tensions between company and the customers. This would mean that a B2B company would have to cautious while showing prototypes to customers for validation making adhering to design thinking principles difficult. Thus, there is a limit to which B2B companies can alter their processes or adapt new processes into the company. This point can be applied to any new process adaption but is significant for the adaption of an open-ended process for innovation management like design thinking (Rauth et al., 2014). In addition, the ambiguity in the accountability of DT as innovation management process puts DT at an unfavorable place at first glance. To a process owner at a B2B company with well-developed PDP, DT would seem to bring in more trouble in short-term without the assurance of long-term benefits upon adaption. This presents itself as a barrier to adoption of DT in an organization.

#### **ii. Division of Labour and Knowledge Silos is the normal way of working**

An observation made from analyzing the qualitative interviews was that division of labor was a natural by-product of the well-developed PDP in the company. Although not inherently a bad thing, division of labor meant that over the years the company has developed silos of knowledge within

its different functions as indicated by Javalgi, Hall and Cavusgil (2014). These silos are not limited to extrinsic knowledge about the products developed and are even applied to knowledge about where the requirements for the development is coming from. This has led to issues in communication and cross function collaboration. For instance, a respondent who was relatively close to customers in the requirements flow mentioned that they did not have a clear idea of how customer requirements are captured or who captures them, instead they only get a list of things to develop (refer to quote in point i of section 4.4.1).

This has led to a situation in the company where an internal stakeholder's view of customer requirements and customer value and in some cases who the customer is, varies significantly depending on their role and area of product development. Combining this situation with previous points about DT reducing R&D productivity and limits on how much the process could be changed, DT which demands interdisciplinary collaboration and experimenting seems like a needless addition that would complicate the PDP further instead of optimizing it. If a company wants to adapt DT for strategic innovation, it is not merely enough to adapt the principles and hire design thinkers; rather the company should become a design thinking company by making the necessary changes to its structures to allow for DT to thrive and lead the way for better strategic innovations (Conway et al., 2017; Dorst, 2011; Mootee, 2013). But in a B2B company with well-developed PDP particularly with companies developing high-tech products, division of labor and knowledge silos are by-products they must compromise with. These two factors present themselves as barriers for the adoption of design thinking.

### **iii. Microcultures demand different processes**

Communities of Practice are spontaneously formed social networks of people working in similar fields or sharing similar tasks characterized by trust, openness and intense communication that can span organizational boundaries (J. S. Brown & Duguid, 1991). These communities have the potential to accelerate innovation through increased knowledge exchange however they need not be in line with an organization's mission or vision. These communities are small pockets of people within organization that create and religiously adhere to cultures that are inline or diverging from the overall organizational culture, essentially creating several microcultures within an organization. These communities and cultures are primarily used to solve problems through shared knowledge and practices. The quantitative interviews revealed Mycronic to have several such micro cultures like certain development teams using more white session for communication than others, certain teams using a internally developed pictorial language for quick communication, certain teams setting customer centric deliverables and using tools like user story boards to achieve their goal, people working on certain product families creating more prototypes than the others (refer quotes in point ii of section 4.4.1).

One of the most effective ways to ensure success of implementation is to mesh DT methods and practices with organization culture (Rauth et al., 2014). But since there are several different cultures present in the organization as demonstrated from the examples above, this makes it very tedious for an implementation manager to adapt design thinking in such way that it has compatibility with all these microcultures of the company. If the implementation manager fails to find the common ground, then the adoption could fail or even worse, could affect the effectiveness of microcultures that are not compatible with the introduced DT principles. In such a situation, adaption of DT creates more problem than it solves and hence microcultures pose a barrier for implementing design thinking in an organization with well-developed PDP.

#### **iv. Structured PDP allows less time for customer interactions**

Following a well-structured product development process will mean that R&D has to keep up with milestones, timeline, periodic audits. These traits of well-developed PDP will act as drawbacks to designers as they would have significant constraints on time for developing products by collaborating with stakeholders and cocreating with customers. In Mycronic's case, designers and other internal stakeholders engage with multiple projects of varying complexities simultaneously. Some of the respondents highlighted that even productive interruptions like meetings pulled them out of their work and posed as a serious switching cost to their development project deliverables. The internal stakeholders seemed to be engaged with some activity by about ninety percentage of their available schedules. This situation means that only specific stakeholders like sales managers and product managers get to interact with customers. Even this is possible only because it is part of the responsibilities. The other stakeholders like designers and architects have very less time to interact with customers owing to the nature of the structured PDP.

While it would be ideal to regularly review the PDP process and eliminate any non-value adding activities, implementing DT say in its traditional form i.e. in the form of a workshop for each development project would demand complete rework of the development models used in the companies as companies would have to create time where in all relevant stakeholders get to interact with customers. Rauth et al., (2014) briefly discuss an issue connected to this barrier, which is that when companies adapt design thinking, these new activities are not prioritized by employees, especially on heavy workload days. Even if a company were ready to complete change its PDP this would cause issues, an example of which is companies deciding which PDP to use for the existing/running projects. Thus, the nature of a structured PDP used in companies possess a major initial barrier for DT implementation.

#### **5.1.3 Barriers related to customers:**

There are a few barriers related to customers and how they interact with B2B organization that might hinder the implementation of DT in a B2B organization. These finding were surprising as existing literature does not throw much light on problems stemming from customer that might hinder the adaption of DT in a B2B setup.

##### **i. Customers solve their own problems or ask for specific solutions instead of problems to solve**

A use case for design thinking in B2B setup is the potential to leverage the expertise of customers and cocreate products and services with their help and expertise (Liedtka et al., 2013). Customers in B2B setup have technical know-how and are generally experts in their relevant fields.

This being a very good potential for B2B companies to leverage this knowledge to develop the right kinds of products, also presents a glaring drawback. As customers are experts in using the machines Customers solve their own problems without reporting it to the partner company. This leads to a B2B company like Mycronic receiving less information on the issues with existing machines or feedback from customers on how to solve these issues in the future generation products. Customers ask the partner company like Mycronic for specific solutions or machine requirement instead of giving their needs and issues. This makes it very difficult for B2B companies to approach the front end of innovation effectively. Grafmüller's (2019) research hints to customer related issues being prevalent in B2B set up however does not identify the expertise of customers or their unwillingness to engage with companies to cocreate products as issues for DT adoption. This research has identified that if the customers are reluctant in giving customer needs, then to an implementer, the value of design thinking which seeks constant validation of

customer needs might be redundant. And hence customers' expertise and ability to solve their own problem are barriers to the implementing design thinking in an organization.

## **ii. Closed off customers unwilling to interact with the company**

The case study company has a global customer base and many of the respondents had comments about customers being closed off for different reasons. One of the respondents referred to reasons such as language (loss in translation), geographical location (customers from two different places associating different qualities with the same machines) and even the industry the customer operates in (aerospace industry being more confidential than customers from hearing aid industry) as reasons for customers being hesitant with communicating their needs (refer quotes in point i of section 4.4.1).

Respondents painted a scenario where Mycronic's customers were hesitant to interact closely with the company due to confidentiality and cultural differences. One of the respondents said that a customer collaborated with the company mainly for their manufacturing expertise and not for their innovation capabilities. Given this situation, several respondents mentioned that it was easier to interact with those customers who were willing to be open by signing a contract with them. However what many respondents also highlighted was that this meant that they missed out on the voice of those who weren't willing to engage with the company there by skewing the company's development strategy based only on the customers who were willing to interact with the company. This was very evident in one of the business areas of the company where the development strategy has shifted to market pull from technology push without the case study company meaning to do so. Given this situation, implementing design thinking would be difficult as it demands extensive participation from the customers at the early stages of the project. This also calls into question the effectiveness of DT as a front-end innovation mechanism in B2B setup since the customers are not willing to engage with the company making it an unsafe bet for the company.

## **iii. Market Pull is slow compared to B2C hence it is counterintuitive to invest in understanding the customers**

This barrier turned up as distinctive factor against the implementation of design thinking specifically from the perspective of a B2B company. The research revealed that there was a distinct lack of pull from the customers with regards to new products. When asked about this one of the respondents explained that in Mycronic's case, customers' demand for a new generation product is only once in a decade. This is because customers maintain well optimized production setups made up of different machines from Mycronic and change the machines only if their products or customers demand it. So even if Mycronic would radically innovate, there might not be any customers will it buy into these innovations regularly. This has led to Mycronic adjusting its long term development strategy to be in line with the slower market pull.

Several of the respondents had similar views on generational leaps in the company's products. Although the case study company considered itself as a highly innovative firm, they felt that their customers were looking for innovative products only once a decade and hence restricting the company's need to innovate frequently. One of the respondents used to the phrase "*slow moving*" to describe the customers of the company. This perspective of a slower market pull is never discussed in existing DT discourse. But objectively speaking it is apparent that a B2B company would have to keep in pace with a customer more so than an B2C company. For instance, a cell phone manufacturer creating a revolutionary product would have an easier time finding early adopters when compared to a B2B company like Mycronic. This is because when a B2B company like Mycronic creates a revolutionary product its must still function within the confines of the customer's existing operational parameters. This effect is amplified when the fact that B2B

companies generally tend to sell solutions (that solve all end to end needs) to their customers rather than isolated products. Hence the lethargy in market pull in a B2B industry had a major impact on the development processes used in B2B companies. In this scenario, adapting DT principles would have a lesser probability of adding value since the customers remain stoic when the B2B company seeks their needs using in design thinking principles. Hence the lethargy in the market pull and the general lack in need for frequent general leaps present a barrier for the adoption of DT in a B2B company with well-developed PDP.

## **5.2 Opportunities for DT implementation:**

Upon analyzing the situation at the case study company and comparing the findings with DT literature, four factors were identified that could increase customer centricity in a B2B company with well-developed PDP. They are as discussed below.

### **5.2.1 Co-creation is a competitive advantage:**

Although a previous point about customer solving their own problems indicates towards a B2B customer's lack of interest in engaging with a partner company. As mentioned in the background section, Mycronic had hired external consultancy to run an exploratory project using design thinking in 2019. When interviewed, a person from the consultancy who helped with the exploratory project mentioned that the major issue seen B2B companies is the way the company's representatives interacted with customers. For instance, their instinct was to try and sell a product or idea to a customer rather than trying to listen to what the customer had to say. The respondent added that this issue must be overcome by changing the intention with which the B2B company's representatives interact with customer by modifying the types of questions they ask and the types of mechanisms they use to capture the emerging customer needs.

From the respondent's perspective this issue could be overcome by the way a B2B company chose to interact with their customers. Establishing a trustworthy relationship and providing customers with the right input like showing boundary objects like prototypes helps with connecting with customers who often show an unwillingness to co-create (Grafmüller, 2019). Grafmüller (2019) also highlights that managers should convince the customers how the significance of understanding the final use of the customer's product will help the company deliver better suited products. In line with Ahmed et al. (2019) findings about using hybrid design thinking processes for effectiveness, Grafmüller (2019) concurs that usage of dedicated processes by considering the customers preferences will help companies better co-create. This means that a company's process to engage in co-creation with a design-oriented customers should be design time oriented and playful in order to motivate the customer's participation whereas the process used to engage with an efficiency based customer would be to involve them only for crucial areas where their contributions would have the most impact. The open-endedness and adaptability of design thinking principles suits ideally to deal with such diversified customer types when it comes to co-creation.

Furthermore, several of the projects that Mycronic cocreated with customers in the past have been some of the biggest success stories for the company. When talking about instances of co-creation in the company's past, one of the respondents mentioned a project where Mycronic and the customer mutually benefited from each other strength's while cocreating a product that was different from the products Mycronic had developed in the past.

In several instances in the past as well as present, cocreating with customers or thoroughly understanding the needs of the customers in the fuzzy front end of the project has helped Mycronic perform smart and efficient product developments. And design thinking if implemented properly

could help companies co-create with their customers for any given project thereby increasing the probability to deliver the right values to the customers at the end of a product development cycle. This ability of design thinking to provide structure and optimize co-creation in B2B companies makes it a strong opportunity for its implementation.

### **5.2.2 Effective Requirements Flow in an organization with multiple filters/ layers of stakeholders:**

It was highlighted in section 4.2 how the requirement flow in the case study company had points of handover. These points represent the instances where customer requirements are interpreted (/translated) and conveyed to a different internal stakeholder or the instances where work done by one team is taken over by another. Several of the respondents mentioned these points are areas to improve since these handovers are accompanied by some loss of information, for instance, within R&D, one handover point results in the designers losing some key details about the background for developing a project which impacts the way the designer prioritizes the development. Such instances of loss by translation though minor seemed to be common and recurring within the company. The root cause for this issue is not the people rather the way the PDP is structured. In the past, the company had avoided these filter/handover points because being a startup sized company with flexible PDP allowed internal stakeholders to take on multiple roles and hence have several perspectives (e.g. same person handling marketing and development of machines) ensuring that everyone was closer to customers. But maintaining this would be impractical for a larger company like present day Mycronic.

As the company expanded its business over the years, it adapted proper structures, PDP, and compartmentalized work (mentioned as a barrier in point ii of section 5.1.2) to develop products efficiently. This resulted in hampering the voice of customer flow in the company to some extent. When asked about this situation to senior people in the company, they replied that they did not feel this loss in translation and this could be associated to the fact that these senior respondents had been with the company from its yester years and had had the chance to understand the customer better. The factor that enables design thinking to overcome the filters issue is its ability to initialize a deeper transformation in the company by passing or transforming existing points of issues in the company (Dorst, 2011) by the use of a variety of tools suited for purposes like need finding tools, idea generation tools, idea testing tools, etc. (Elsbach & Stigliani, 2018). And since several of these handover points exist in the execution phase of the project, adopting a hybrid process like Lean Design Thinking Methodology (LDTM) suggested by Ahmed et al. (2019) could help reduce these filters by ensuring all the relevant stakeholders working in a project are exposed to the unfiltered voice of customers. Hence implementing design thinking is ideal for overcoming these issues with loss of information due to translation or filters and direct a company in the right direction ensuring efficiency as well as effectiveness in product development.

### **5.2.3 Easier capture of customer value even when designers are not users:**

Based on a case study done in a B2B company, Liedtka et al. (2013) makes note that product developers in B2B industries are at a disadvantage of having less probability of being users for the product they design. In her example, the engineers at 3M's chemical development division had to overcome this issue of not being the actual users of the chemicals they make when trying to talk to customers about their future chemical needs. This issue is very common in many B2B industries and instances of this was observed in Mycronic as well.

Given this situation, it is very difficult for designers to truly understand the needs of the customers for who they develop the products for. Presently, in the case study company, the designers try to

overcome this situation by supplementing their knowledge with information from other experienced internal stakeholders, but this seems to be ineffective at times.

Mootee (2013), Javalgi et al. (2014), and Liedtka et al. (2013) suggest that this hurdle could be overcome by leveraging one of the key principles of design thinking: empathy. By adapting a project-based approach to design thinking where relevant stakeholders are given opportunities to place themselves in the shoes of their customers and truly understand their needs, would help designers gain a better understanding of the values of customers. This would ensure that stakeholders working in a project align themselves with common goals and realistic prioritization based on actual customer needs and requirements in addition to relying on secondary information from stakeholders who regularly interact with customers. Hence in a B2B setup where there is a lesser probability for designers to be the users of their products, design thinking provides the opportunity to understand the voice of customers by all relevant stakeholders working on a project despite of their positions in the requirements flow of the company.

#### **5.2.4 Better customer engagement to account for the longer development times:**

DT implementation in a B2B company would have very minor impact regarding reducing development time in the company however could help with maintaining better customer engagement through the PDP. It was observed that the development time taken in the case study company in certain large-scale projects could be more than five years and presently there is minor to no customer interactions with customers during this extended period. As with any company using a PDP based on stage gate method in combination with the V model, Mycronic consolidates most of the customer interactions to the initial pre study phase and the testing phase at the end of the PDP. And when asked about why this was the case, several respondents relied that Mycronic does not want to over promise and under deliver with their products by frequently interacting with their customers. Some of the respondents also mentioned that Mycronic was not comfortable with shipping of unfinished products to their customer as it would impact the company's standing with returning customers in case if something went wrong. Additionally, the longer development times also seemed to have an impact on the people working on the project as well. The lack of communication (or intermittent customer interactions) gradually led to a dwindling in engagement and morale of the employees working on the product. DT principles if implemented correctly could help alleviate some of these issues related to longer development times. By leveraging the 'tangible prototyping' ideology, companies could reveal their progress on projects to their customers using tailored prototypes (and MVPs) and get valuable feedback while maintaining control of the information at its source. Thus, implementing DT principles in the right way would help with better customer engagement not only at the front end but also throughout the development cycle of a product, particularly during longer development cycles common in B2B companies.

**Research Question 2:** *How should design thinking be implemented at Mycronic to solve their current complications in the product definition phase?*

### **5.3 Ideology behind answering RQ2:**

This section discusses the bird's eye of the solution to RQ2. Upon analyzing the current situation at Mycronic, the areas that could be improved using DT and understanding the barriers and opportunities associated with its implementation, it was decided that the best way to implement design thinking would be to overcome the obstacles and create a tailor made hybrid design thinking process that Mycronic could try on and improve up through validated learning. It was decided that the authors take liberties to ensure the hybrid DT process was practical for Mycronic at the cost that the suggested process might not be a generalized at all companies with well-developed PDP in a B2B setup. Hence despite taking inspirations from literature discussed in the earlier section of this report, the solution to RQ2 were predominantly based on the observations made by the authors at Mycronic.

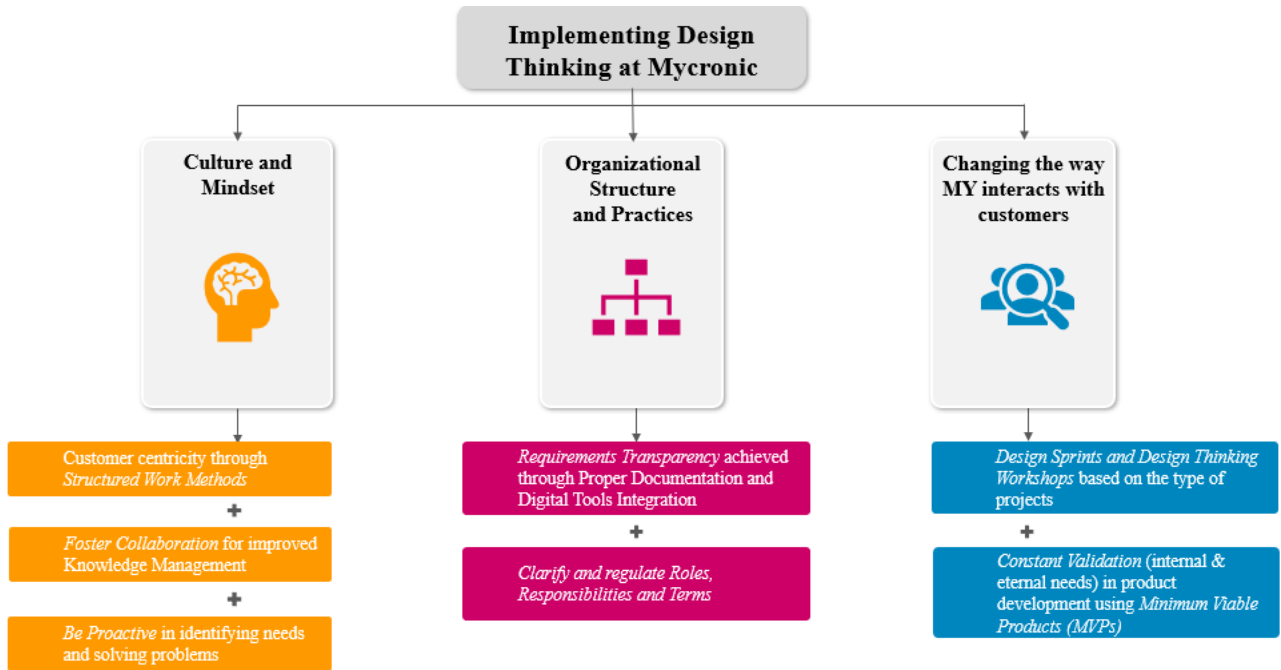
To surmount the open tenderness and vagueness in the design thinking discourse, it was decided that there must be a few polestars or philosophies (Bason & Austin, 2019) that help ground the DT principles and make implementing them straightforward. These philosophies were to help the authors consider the complexities such as organizational structures, product development processes, stakeholder availability, etc. and adapt the insights from the case study and literature to create a wholesome and practical solution. These philosophies were,

*The goal was not to get designers closer to the customers rather closer to the customers problems and needs.* A common misconception about design thinking is that it involves internal stakeholders physically being present near a customer and understanding their needs and values through detailed interviews. While this is true to some extent and has proven be effective for one off cases, it might not be the most practical for regular use in a company where the internal stakeholders have several different responsibilities and deliverables every day. Hence it was decided before framing the solution that it would be impractical to ask the internal stakeholders to visit customers every time a project was initiated. A more effective way would be to optimize other elements, say the requirements flow in the company for instance, to ensure the unadulterated needs and values of the customers reached all the relevant stakeholders even if these stakeholders hadn't visited the customers personally.

*All Internal stakeholders must empathize with stakeholders on either side of them in the PDP (and requirements flow) and not necessarily with the end customers.* This philosophy is in line with using design thinking to elicit an internal transformation of an organization's practices (Dorst, 2011). As mentioned in points ii and iv in section 5.1.1, for several internal stakeholders in Mycronic, the end customer is not the focus of development. Their goals are to deliver something that the stakeholder next to them could work with. Asking these stakeholders to try and understand the needs and values of end customers would be redundant. And it was decided to make sure the solution fostered better internal collaboration by understanding internal customer needs.

Based in these two ideologies, the barriers identified in RQ1 would be negated during implementation as shown in figure 17.

Figure 17. Birdseye view of the framework of changes recommended to tackle the barriers to implementing DT

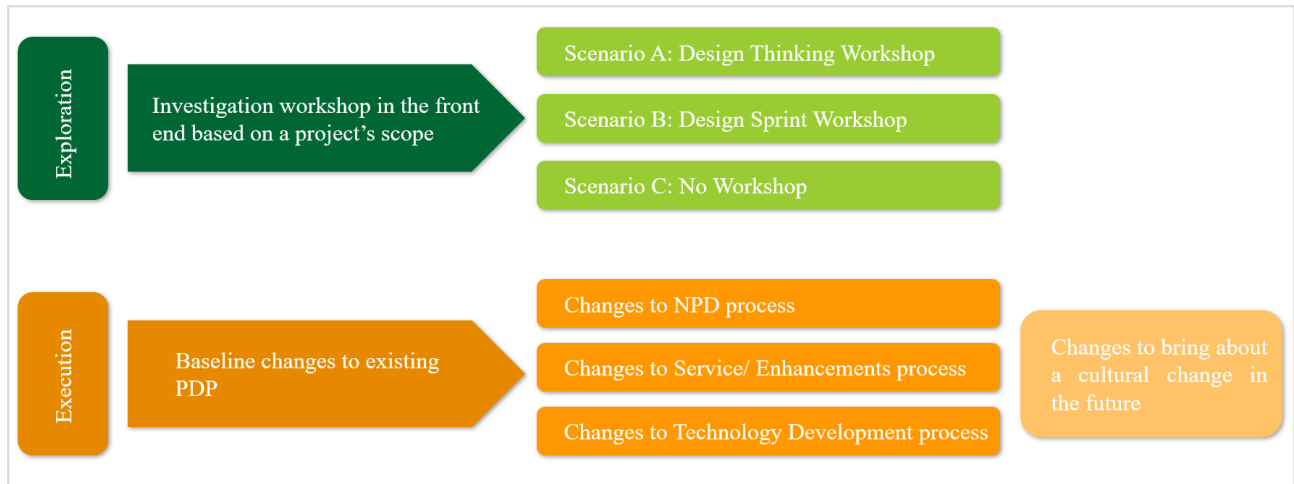


The barriers related to culture and mindset will be overcome by inducing customer centricity by structured work methods (Liedtka, 2018), fostering collaboration and improving knowledge management by bringing changes to practices internally (Elsbach & Stiglioni, 2018; Micheli et al., 2019) and enabling proactive identification of customer needs through a combination of entrepreneurial and systems thinking (Conway et al., 2017). The barriers related to organizational structure will be overcome by increasing end-to-end transparency in the customer requirement flow throughout the product development (Elsbach & Stiglioni, 2018; Liedtka et al., 2013) thereby ensuring internal stakeholders get closer to end customers' needs and bringing clarity to roles and responsibility to ensure better collaboration and effective decision making. And lastly, the barriers related to customers will be overcome by changing the way Mycronic interacts with end customers by adopting a hybrid design thinking process that optimizes exploration by the use of design thinking workshops and optimizes execution through continual customer validation with the help of MVPs (Seidel & Fixson, 2013).

### 5.3.1 Implementation changes with reference to Mycronic's PDP

This section dives deeper and presents a ground level view of the solution to RQ2 indicating the changes recommended to the PDP at Mycronic. Certain aspects of the solution have been omitted from this report to ensure the confidentiality of Mycronic's PDP. In broad strokes the solution to RQ2 has two sections, each of which is meant to help with the exploration and execution phases of the product development process. The section visualized in figure 18 is elaborated upon in the upcoming sections.

Figure 18. Changes in PDP recommended to Mycronic



### 5.3.2 Investigation Workshops

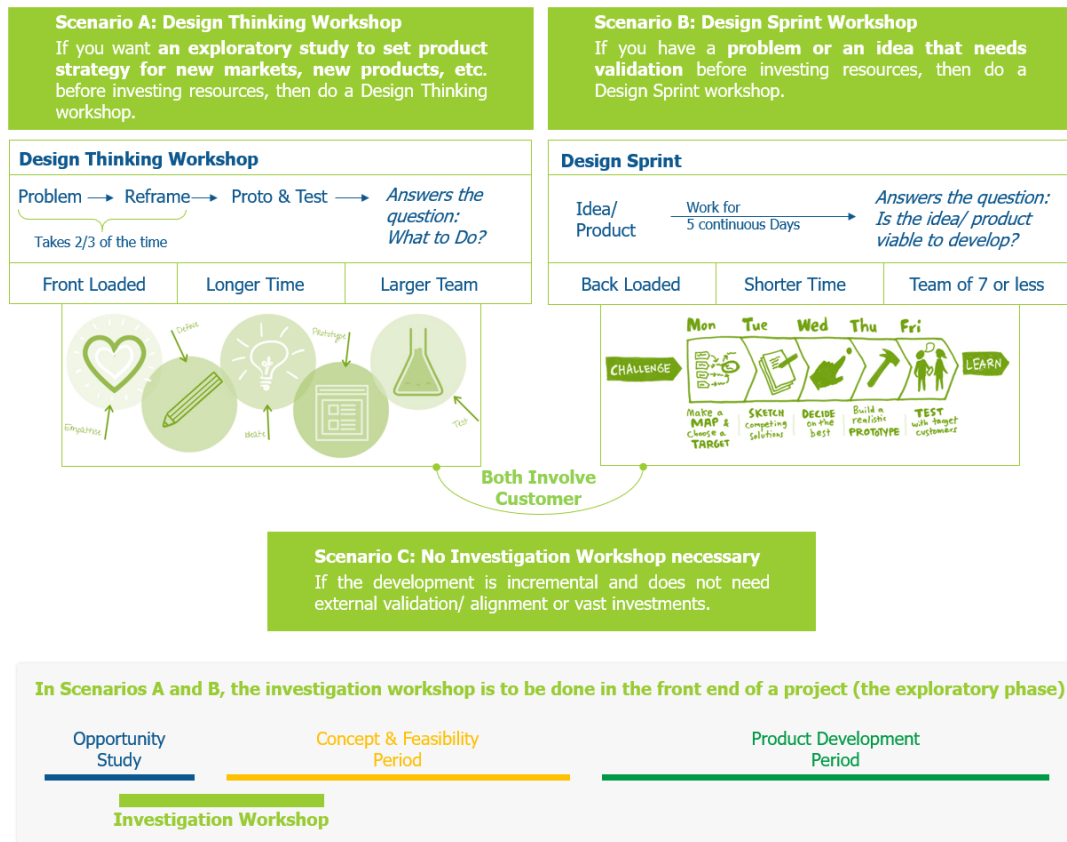
To help Mycronic secure the right initiatives in the front end of a development project, Design thinking workshops should be used to establish a common understanding of customer needs and values. The commonly used structure of such workshops is based on the five steps model developed by the d.school at Stanford, namely empathize, define, ideate, prototype and test. These workshops are front loaded, meaning a lot of efforts goes into the initial stages of trying to empathize and define the customer's problems. In a three-month project, it would be uncommon for these two phases to take up to a month and a half to two months. These two first steps are done by conducting several interviews and using ethnographic studies and mind maps. This workshop is also characterized by involving customers at the beginning and at the end of the workshop and is an exemplary exploratory method that companies could use to balance strategy with customer values in new product development initiatives. While this is right for scenarios involving strategy formulation or radical innovation, the extensive investments a company must make in terms of time and effort make its unfit for incremental innovations. And any organization's product portfolio strategy would be a combination of incremental and radical innovations. To ensure customer centricity even in such smaller project, a more suitable workshop structure would be one based on 'Design Sprints' developed by David Knapp. Design Sprints workshop that can help validate an idea of product by a small team working with the idea for five consecutive days (Knapp et al., 2016). It is a structured problem-solving approach that combines elements from design thinking, value engineering and lean. This type of workshop also involves customer validation but only on the last day of the workshop. Design sprints require less resources and are more suitable for incremental innovation projects. However, a shortcoming of design sprints is that online design thinking workshops, design sprint workshop are backloaded, meaning it merely helps with validating of a product or idea is viable and does with technical development such as systemic breakdown of the development project. The respondents also revealed that a part of the development projects are extremely incremental in nature, like change in the type of on component in the machine, or projects initiated to ensure the development machines adhere to recent safety standards, etc. In such cases it would be illogical to invest any resource for exploratory workshops at the beginning of the workshop.

To sum up, a development projects can fall under one of three scenarios,

- Radical development or strategic development
- Incremental development
- Iterative development (Incremental development with no need for customer validation).

And the type of the investigation workshop for exploratory study should be chosen based on the scenarios as shown in figure 19. Refer Appendix F for further details on the workshops.

Figure 19. The scenarios to select the type of workshop in the front end



By conducting one of the customer centric workshops based on scenario A or B, Mycronic’s development projects would be better aligned at the frontend of the projects. If done right these workshops would also bring in better internal alignment and shared development goals for the stakeholders working in a project. But this focus and alignment on delivering the right values must be carried throughout the lead time of a development project. This is where the use of structured work methods (Liedtka, 2018) and hybrid design thinking methodology (Ahmed et al., 2019) comes into picture. These changes to maintain focus on customer needs during execution phase of a development project are in the form of baseline changes to the existing PDP of Mycronic and these changes are discussed in the upcoming sections.

## 5.4 Baseline changes to existing PDP of Mycronic

These recommended changes are centered around the three different customer requirements flow discussed in section 4.3 namely,

- New Product Development
- Service/Product Enhancement
- Technology Development

An additional set of recommendation have also been made which are intended steadily embed design thinking principles with organizational culture (Conway et al., 2017; Dorst, 2011; Elsbach & Stigliani, 2018; Mootee, 2011; Rauth et al., 2014) to help Mycronic to tap into the full potential of design thinking and bring about a customer/ value centric organizational culture in the future.

### 5.4.1 New Product Development Process

The primary objectives of the changes suggested to Mycronic's NPD are to ensure an optimized customer requirements flow, bring internal alignment and bring in the practice of active customer validation of needs during development (as currently this is just done at the beginning and end of a development project). These changes are,

- *Introduction of a Structured Requirement Sheet to ensure VOC remains intact throughout NPD.* One of the main areas of improvement identified was that owing to reasons such as multiple layers in the organization and subsequent loss in translation of customer needs and requirements, several of the designers or developers are merely told what to do and not why. This hinders lateral thinking, creativity, and innovative mindset. To counter this, a new structured requirement sheet is suggested with addition information such as background information on requirements, the priority of requirements, the stakeholder who initiated the requirements, requirements that needs validation, etc. (refer appendix E for the comparison between old and new requirements sheets). It is also recommended that this sheet be used as the sole means of communicating customer needs within the organization and all relevant stakeholders get to refer to this sheet as their primary source of customer information. The structured requirements sheet presented in appendix E is merely to illustrate the idea of this sheet and it is recommended that Mycronic tailor this sheet to better suit to their needs if necessary. Once fixed this sheet could be integrated with the PLM system of the company and used directly to add requirements into Mycronic's digital tools. Maintaining this sheet throughout the NPD would ensure that there is better transparency in the customer requirements flow in a project thereby better aligning the stakeholders working on the project.
- *Transparent Business case discussion.* In addition to maintaining the structured requirements sheet, it is also recommended that for projects that fall under Scenario A and Scenario B (mentioned in section 5.3.2), there be a transparent business case discussion with stakeholders from different levels and different departments. This discussion session would act as a forum for stakeholders to raise any concerns or clarifications before they begin working on the project as well as come up with and set the key deliverables for a given project. The CFT-1 would be a good forum for this discussion however it might also be well enough to have a remote video conferencing meeting using digital tools for this purpose as this would reduce any difficulties in scheduling the stakeholders for the meeting.
- *Continual validation of customer needs during NPD using MVP for proactive problem solving.* This recommendation would ensure that there is constant validation of customer requirements during the execution phase of a project. Since the requirements that need validation are mentioned in the structured requirements sheet, the developers or designers working on a project can prioritize and create MVPs for requirements that need validation and send it to relevant stakeholders who asked for these MVPs. Any feedback or confirmation for these MVPs

would be discussed in the CFT-1 forum once every month. The project office could monitor the validation process by linking the MVPs with the ‘definition of done’ documentation which is reviewed at the gates before a project is moved to the next stage in the stage gate process. Introduction of this validation process would serve two purposes,

- *Ensures the needs of the customers are understood correctly.*
- *Creates an opportunity to check if a new idea that a developer or designers has is in line with the needs of internal/external stakeholders*

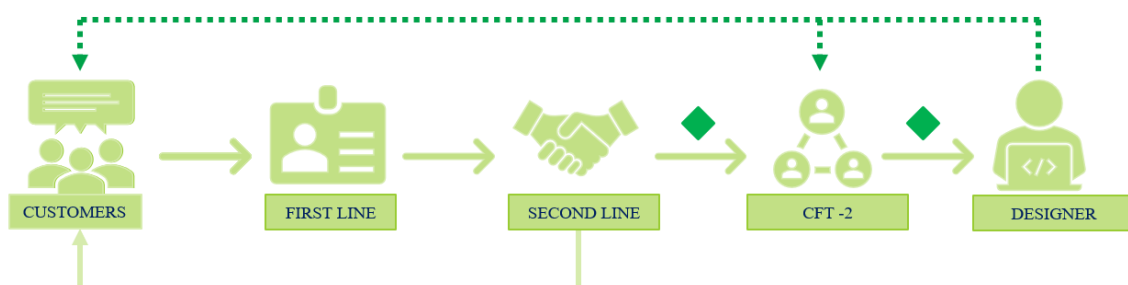
These MVPs will also serve to track customer centric initiatives in the execution phase of a development project ensuring the prototype-test steps of design thinking are practiced both the exploration and execution phase of NPD.

- *Leverage the learning sessions at the end of a project to improve the NPD process.* At the end of every project, the internal stakeholders who worked on the project gather and reflect on the shortcomings and accomplishment stories of the project. But it was observed that presently, the learnings from these sessions are not utilized to its fullest potential. It is recommended that Mycronic document data from these learning sessions in a single place and periodically review twice every year to check if some parts of the NPD could be made better. This would be synonymous with the build-measure-learn principles seen in design thinking and lean startup principles. Although a tedious task, taking this step iteratively would ensure that the NPD process at Mycronic is kept fluid (/ dynamic) to a certain degree and continually improved upon based on the insights from the people who actually work with the NPD process in question.

#### 5.4.2 Service/ Product Enhancements

Aftermarket sales and service is a major source of revenue for Mycronic. Here, customers who own Mycronic machines feedback requirements back into the company to improve their machines, in other words, this can be referred to as the backflow of requirements from customers (who own Mycronic machines) back into the company. The changes recommended for this area of development mirrors the changes suggested for the NPD and are recommended to streamline the existing process. Figure 20. represents the flow of requirements from existing customers into Mycronic and the dark green diamonds and arrows is used to highlight the areas where the recommended changes will have the most impact at.

Figure 20. Image representing the backflow of customer requirements in product enhancements



The changes recommended are as mentioned below,

- *A Product Manager to streamline requirement flow.* As mentioned in the requirements flow section, the role of CFT-2 is like that of CFT-1 from the NPD process i.e. development planning and signoff. However presently the improvements request from the customers are channeled from the second line and sent directly into the CFT-2 for planning and signoffs.

There is no internal stakeholder (for many product families) between the second line and CFT-2 who can contextualize the customer needs underneath these the requirements and assign priorities to them before they are taken up for discussion in CFT-2. It is recommended that an internal stakeholder be assigned for this role to ensure the voice of the customer is delivered to the CFT-2.

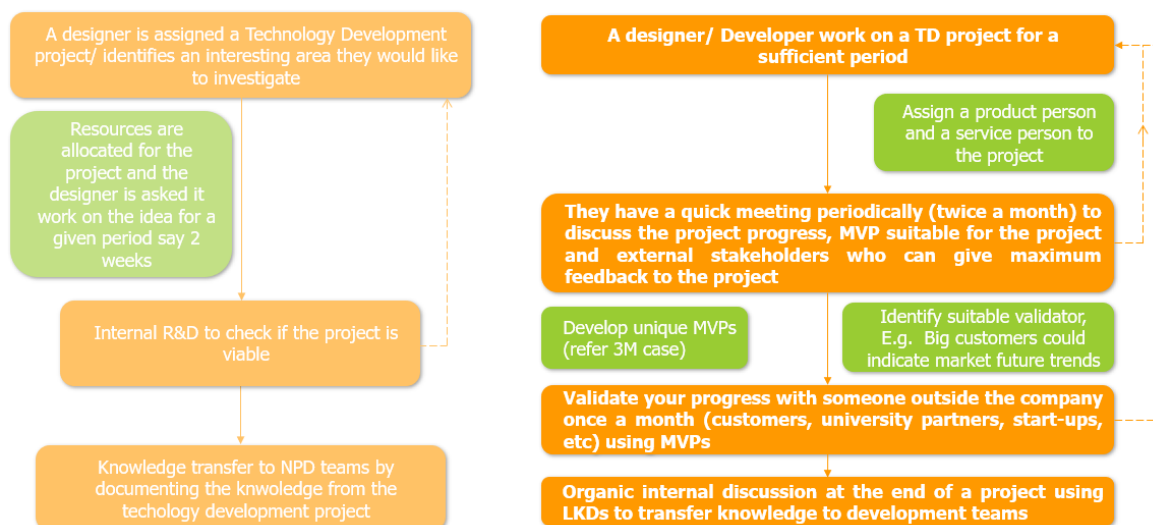
- *Introduction of a Structured Requirement Sheet to ensure VOC remains intact throughout an enhancement project.* The structure and role of this sheet is same as the one recommended in the NPD section. This sheet if maintained properly through an enhancement project would ensure better transparency of customer requirement to all relevant stakeholders working on the projects and helps align them with shared goals and deliverables. This will have the most impact in the areas highlighted by the two green diamonds in figure 20.
- *Continual validation of customer needs during enhancement projects using MVP for proactive problem solving.* This change will also have a similar outcome as discussed in the NPD section and its impact is represented by the dotted green line in figure 20.
- *Run self-contained Design Sprints to validate service business needs.* As mentioned earlier, this area of business is a major source of revenue for Mycronic and it has been observed that the company has constantly tried to identify unique business (models) that could develop this area of the business further. This service and aftermarket side of the company continually develops new tools and business to deliver more value to Mycronic's customers. The smaller scope, resource requirements, and structured approach of Design Sprints are ideally suited for aftermarket business to run self-contained workshops to test their business/ product ideas with end customers before investing resources in into development projects. In this scenarios Design Sprints (involving just five to six people from service and other relevant departments) could essentially use as a risk assessment tool to identify the right market opportunities before investments.

### **5.4.3 Technology Development**

Technology development is unique from NPD and Product Enhancements in that it is less structured and is mostly a solitary effort by one engineer engaged in strategic development of advanced technologies that could be implemented in Mycronic products in the future. The deliverables for this type of development is inherently fuzzier and the end goal is to sufficiently understand a technology and create pockets of knowledge that would be readily available for NPD teams to make use of in the future.

This is an area where design thinking could be used to make this process more open and collaborative in nature (Liedtka et al., 2013). The artifacts used to receive and understand customer feedback in these types of development are to be different from those used for regular development projects as the intent for these projects is not immediate monetary commitment from the customers. Presently the process used for technology development projects in Mycronic, although iterative in nature with an internal review every two weeks, is still a solitary endeavor for an engineer with validation from only his peers from within the R&D. It was understood from the respondents that they would like to have an environment where they could communicate their work and receive feedback from someone from outside R&D, to check if their research could add value to customers in the future. The changes recommended for technology development are to address this point by including diversified viewpoints to the process.

Figure 21. Current Technology Development process on the left and suggested changes on the right



The current process and recommended changes are illustrated in figure 21. In line with the current process a designer is assigned with a Technology Development project and they work on the concept for a sufficient period say a few weeks to a few months. This time will be used by the designer in a similar way as done in the current process, i.e. a basic understanding of the concept and check the viability of the project. Once this is done, it is recommended that the project be assigned with a product person like a product manager and a service person like a service technician or service manager. The designer meets with these two stakeholders intermittently say once a month in a semi-formal meeting (for instance, at lunch) to discuss the project and bounce off ideas among them. The product and service people work closely with customers and have a better understanding of the customer needs and market trends and could provide these unique perspectives to the designer during these meetings. It is recommended that the designer uses some sort of a visual medium such as presentations or videos from the internet to initiate the dialogue with the product and service people during these meetings. The designers continue working on the project as they do in the current process. But as the two assigned product and service experts now have a better grasp of the TD project, they would start identifying external stakeholders such as end customers, partner companies who might be able to provide insights for the designer. Once the right external stakeholders are identified, the designer with the help of the product and service experts could present an MVP of the project to the identified external stakeholder and receive feedback on the project. A typical TD project could go on for a few months to a few years and these external validations could be done every six months. But implementing these changes, TD would no longer be a solitary effort for a designer and they would receive insights from within and outside the company that would help them create something which would be better geared towards delivering the right value to the relevant stakeholders. At the end of a project, the designer documents their knowledge as done in the current process but additionally there would be an organic discussion between the designer and the NPD team just before the NPD team starts working on a project that used the knowledge from the TD project. This organic interaction which could be in the form of a meeting or a presentation given by the TD designer to the NPD team will help overcome one of the handovers highlighted in the requirements flow section.

#### 5.4.4 Changes Recommended to bring about a Cultural Change

A strategic advantage that Mycronic presently has is that the company has managed to retain several of the people from its yester years when the company was smaller and hence closer to its customers. Several of these people hold key positions today in the company and are immense source of knowledge about customer values, industry trends, etc. This was primarily because these people had had the chance to work and collaborate with customers in the past. But over the next

decade, the company would see an intake of people who might not have the chance to understand Mycronic customers as much as the older employees on account of the current size and structure of the company today. Hence this would be the ideal time for Mycronic to implement initiatives to foster a customer centric culture in the company that give the new employees to understand the benefits of understand the needs of the customer. By embedding design thinking principles into the organizational culture, customer centricity could become second nature in the minds of the company's employees in the future. A few recommendations to place Mycronic in the pathway to building such a customer centric organization culture are,

- *Innovation manager/ Champion.* Recruiting or assign a person for innovation management in the company. This person would be responsible for activities including but not limited to overseeing patents, innovation days, external collaborations for open innovation, heading the design thinking workshops (or similar activities), and overall ensuring that customer centricity remain in the focus of all the internal stakeholders in the company by continually introducing innovative practices that employees can examine and adapt in their day to day work.
- *Idea Jams in Innovation Days.* Mycronic hosts an innovation day every year were the company attempts to motivate the employees to collaborate with one another and come up with innovation for products or patents that would help the company deliver better value to the end customers. But it was observed that these innovation days are less guided and hence overall is less effective for the employees of the company. For innovation day to be more effective it should strike the right balance between guidance and freedom to engage in innovation activities. One ideal way would be to structure these innovation days using Double D idea jams that used the five steps of design thinking from Stanford d.school to take the participant from inspiration to prototype stage in a single day. The GapMap tool which is an innovative idea management tool being developed by Mycronic could be used as the database from which the initial inspiration from these idea jams come from. This would ensure that employees are working in the areas that the company wants to investigate while presenting them with enough freedom through the Double D method to come up with innovative solutions to close these gaps.
- *Innovation/ Design Thinking Ambassadors.* Nominating people from different departments as innovation/ design thinking ambassadors and providing them with training in the area through firsthand experience, necessary physical space and digital spaces (pages in the internal webpage, dedicated pages in Microsoft Teams) and encouraging them to actively discuss design thinking would ensure that the effectiveness of DT principle would spread throughout the company and hence a part of the company's culture.
- *Streamline existing Digital Tools.* Mycronic has several different digital tools that empower its employees in different ways. But the issue is that many of these tools remain isolated and are not connected with one another optimally. Several of the employees were unaware of the existence or uses of many of these tools. Streamlining these digital tools and communicate the purpose of each tool to the employees could help bring about a more effective dialogue among the employees of the company.
- *Clear up Roles and Responsibilities.* Some of the people who were interviewed expressed that they were unsure about the limits to their roles and this happened their ability to take decisions in the PDP. Furthermore, a consensus was that there was a moderate difficulty in findings people with expertise in specific areas in the company who could be approached to for feedback on projects. It is recommended that Mycronic take steps to negate this issue since it would optimize both delays in decision making as well as pave way to better communication and collaboration within the company.

- *Optimize the PDP process.* The investigation revealed that there were already several design thinking activities in the company such as using ethnographic studies, user stories and using landing page to gauge customer interest, etc. The issue is however that these best practices are spread across different departments and are isolated. Mycronic should ensure that it identifies these practices, consolidate them, and adopt them into the PDP whenever applicable. Additionally, the rigid nature of the stage gate model used in PDP results in employees finding shortcuts to get things done quicker. These can be seen as variation between practice and process. Mycronic should take steps to identify these points and if the practice does not entail any qualifiable loss in work then they could replace the process prescribed in the PDP.
- *Strategically driven Design Thinking & Clear and Visible Strategy.* As mentioned, in the previous point, there are several individually driven best practices based on design thinking already present in Mycronic. The management should recognize the advantages of these practices and advocate its active use in the company's PDP. Mycronic should also take steps to ensure that the employees are presented with clear and visible strategies for products and processes. Presently, the strategies are clear but not visible to all internal stakeholders in the company. Making the strategies intention behind the products and process clear to all internal stakeholders could bring about better alignment towards the mission and vision of the company.

These changes together will bring about three different changes as shown in figure 22, namely

- Change in mindset that the design responsibility is not only for R&D
- Make the PDP in the company more dynamic and effective by considering the feedback of the internal stakeholders
- To clearly communicate the leadership's support for customer centricity

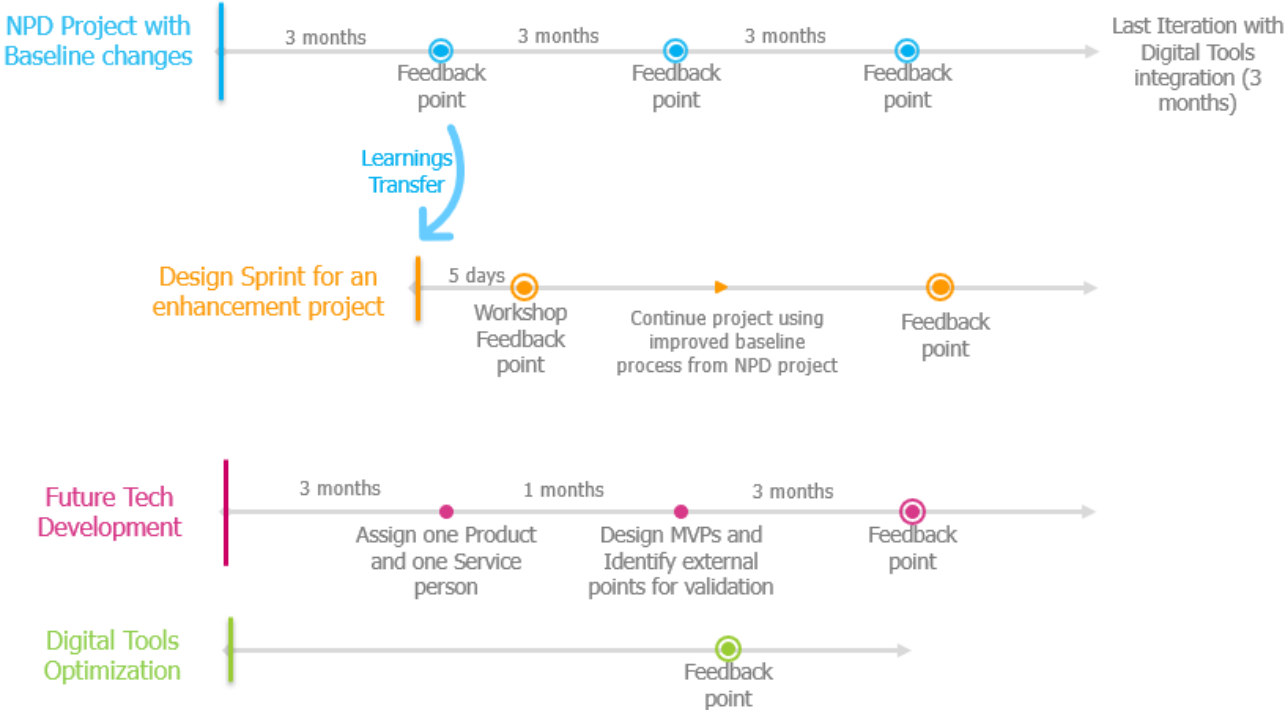
Figure 22. Recommendation to bring about a customer centric organizational culture



# 5.5 Implementation Roadmap:

The key parts of the recommendations for RQ2 have been split into four independent pilot programs that Mycronic could run to test out the recommendations and improve them further before inducting them into the PDP. The four pilot programs are illustrated in figure 23.

Figure 23. Pilot programs for key recommendations of RQ2



The recommendations for the NPD could be tested by implementing the Structured Requirement Sheet and MVPs in low to medium priority project with a small team. The objectives are to establish clear end to end requirements transparency and validated learnings using MVPs. The project could have several feedback points at constant intervals where the team working on the project could discuss and improve the Structured Requirements Sheet and MVPs. Once completed the team could share their feedback and the recommendation could be added to the PDP. The second pilot program is for testing the effectiveness of a workshop in the exploratory stage of a project. But instead of testing the workshop in the NPD it is recommended that the workshop be tested in a product enhancement project due to the self-contained smaller scopes of these projects. It is also recommended that the pilot program to test the workshop be initiated after the first feedback point of the NPD pilot program. This is to ensure that the people working on the workshop pilot program could take the learning from the people from the NPD pilot program when they continue with the enhancement project after the workshop is completed. It is advised that Mycronic bring in an external consultant to help with the design sprint workshop when trying it for the first time. A third pilot program is suggested to test out the changes recommended to the technology development. The key point here is to ensure that the product and service people assigned to the project bring in the market and customer perspective and not discuss the monetary perspective of the technology at this stage in the project. The last and final pilot program is meant to optimize the digital tools at Mycronic. Even though optimizing digital tools is not needed immediate and will have more impact on the culture rather than the PDP, it was observed that this change was the smallest change with the potential to bring out a larger impact in the culture of the company and hence a pilot program to optimize the digital tools is recommended. This pilot program to optimize the digital tools can be split into two activities. The first and smaller of which is updating the roles and responsibilities of all the employees of the company in the Microsoft

Team's 'Structure' menu and checking if this had any impact in collaboration or communication among internal stakeholders through a companywide survey. These second part of this pilot program to optimize the digital tool would be taking into account the learning from the other three pilot programs and creating a connected ecosystem of existing digital tool that would replace the isolated one seen in the company presently.

The feedback points in these pilot programs are important as they dedicate how consecutive iterations of the pilot programs could be changed. Hence at these feedback points it is important to,

- Check the effectiveness of new practices for positive and negative points
- Compare this project with a past project without the design thinking initiatives and highlight differences
- Validate the learnings and feed it into the next iteration

If done properly these pilot programs should help Mycronic test the recommendations to implement DT and generate a unique and tailored way to induct DT principles into the company.

**Note :** Once the recommendations for RQ2 were formulated and discussed with the industrial and academic supervisors, it was decided that a good way to understand the practicality of the workshops (a primary component of the recommendations to RQ2) would be to run one in the company and see if it's a good fit. So, a two-hour workshop was conducted with twelve participants from different departments of the company to help design an idea management tool. The workshop indicated several factors such as its time dependence, the need for the participants to have an elementary idea on what they were working on, the importance of the workshop material, and the need of a plan (to act as a pole star). Thus, this workshop had a twofold effect, it helped make the solution to RQ2 better by the authors taking into account the feedback from the participants and helped validate that a design thinking workshop for an exploratory study could indeed be implemented in a B2B company with well-developed PDP like Mycronic.

## 5.6 Implications for theory

The study adds value to the distinctive gap of DT discourse pertaining to B2B setup and adoption of DT principles into a company's established PDP instead of using them for one off cases in a B2C setting. This thesis can provide new insights on the barriers and opportunities related to implementing DT in a B2B company and identifies several challenges that have not been discussed in earlier research. Particularly interesting is the fact that adoption of DT in a B2B setup is different because of the lack of an emotional connection that B2B customers have to their products, as in most cases these products are merely means to an end in the customer's perspectives. This single factor alone plants an idea for both B2B companies and customers that there was no room for empathy when it comes to product development in B2B space. This at first glance makes DT fundamentally unnecessary for B2B companies. For instance, people presumed DT would have a negative effective by being counterproductive to the very nature of company-customer interactions in B2B companies seen today. This idea of counterproductivity on account of on design thinking being too informal/ playful and resulting in decreased productivity is in line with the systemic policy resistance (Conway et al., 2017) seen in organization while introducing DT for the first time. According to Conway et al., the open-ended nature of design thinking leads way to a cognitive resistance to accepting it as a process for innovation. Mootee (2013) concurs with Conway et al. (2017) and expands upon the reason for this being that DT's association with innovation is often oversimplified by its promoters and this leads to companies viewing design

thinking as just a playful way to brainstorm product ideas or a five step process to create successful products.

In addition, the study shows that the value of customer interaction was considered insignificant for product development since in most cases the problem to be solved is fixed very early in the development process. This is fundamentally at cross with one of the core principles of DT which is 'challenge the problem' suggested by Rauth et al. (2014). Not interacting with customers contradicts advantages of DT principles such as the importance of discovery prior to solution creation, expanding the boundaries of problem definition, and enthusiasm for engaging customers in co-creation identified by researchers like Liedtka et al. (2013) and Micheli et al. (2019) and rises a situation with people trying to get human-centric outcomes without human-centric inputs (Kelley & Radziszewski, 2019). This type of a mindset negates the needs for design thinking principles at the front end of innovation. In addition, even the development process used in such a company was observed to provide a challenge to the principles of DT. The restriction to the degree to which development processes could be altered brings out the sentiment of restriction in one of the five steps of design thinking i.e. prototyping. Grafmüller (2019) briefly touches upon the point that there is a degree to which B2B companies can experiment with new processes and how this restriction presents as a barrier for co-creation in B2B companies when measured against B2C companies. This point can be applied to any new process adaptation but is significant for the adaptation of an open-ended process for innovation management like design thinking (Rauth et al., 2014).

So, at first glance the customers, internal stakeholders and processes used in B2B companies seem to hinder an effective DT implementation. However, the authors of the thesis argue that these appear as hindrances due to an absence of mechanisms in place to alleviate them in B2B companies. The arguable advantages such as better co-creation, improved alignment through different internal layers of the organization, better capture and understanding of customer voice for products where designers are not the users and better customer engagement could have a very positive impact on customer centricity for B2B companies. The added advantage of creating the right products by empathizing and understanding the needs of the customer could help companies gain distinct competitive advantage over their competitors.

## **5.7 Practical implications**

From a managerial perspective, design thinking should be seen for what it is, it is not a five-point step for effective innovation management rather a broad and complex umbrella construct from which managers must select the parts they think are relevant for their work and find ways to adapt these into their processes. To implement design thinking into the existing product development process of a B2B company, a hybrid design thinking framework has been developed in this thesis (refer section 4.8) that can be used as a frame of reference by other companies when planning design thinking adoption. The framework has two primary functions, the first of which is to ensure there is a clear understanding of customer needs at the initial stages and the second being the facilitation of continual interaction of the internal stakeholders of the company with their customer to ensure that the end product is aligned with the right needs of the customer. It should be noted that the processes mentioned in the framework are geared towards a B2B context since the framework was developed by the case study performed in a B2B setup.

Managers must also consider that design thinking is not the solution to customer centricity but merely a streamlined approach towards it. This means that managers must consider the mindsets and work methods of employees when trying to implement design thinking in the organization. So, managers responsible for planning DT adoption must be aware that the implementation

requires significant commitment from all the relevant stakeholders involved in PDP and should not be taken up as a solitary affair. On the other hand, the very idea of design thinking is that there is no one right way and it must be tailored to the specific needs of the company. To this end, the framework also includes pilot programs for different elements of the framework that would enable the manager to test the elements individually and then tailored to suit the needs of the internal stakeholders.

## **5.8 Future work**

The scope of the thesis project was to identify the barriers and opportunities of design thinking and come-up with the framework that would help B2B companies to balance customer centricity with company strategy. The underlying idea of the framework was to ensure that DT principles are interwoven into the existing PDP of the company by focusing on the high rewards areas that would cause the least distribution to the day to day activities of the stakeholders during implementation. This means that certain areas of improvement that came up during the interviews were not made a part of the framework.

Some of these areas include prototyping process in the company, time pressure stemming from the deliverables associated with the PDP, silos working, and knowledge management issues observed in the company, etc. Although areas such as prototyping and silos working are directly associated with design thinking discourse, they were not addressed as a part of the framework to contain the complexity. Future research can investigate how the end phases of product development such as product prototyping could be optimized using design thinking.

Another area that has only been briefly covered are the pilot programs for testing the framework. Although the programs are distinctive from one another, there is a lack of a mechanism to measure the effectiveness of each feedback loop. This ambiguity in effective measurement has been mentioned in the design thinking research literature but has not been investigated extensively in this research. Looking into this is a scope for future research to address a major gap in literature.

The initial scope of the research was to adapt design thinking into the Taby office of the case study company and hence the steps necessary to adapt design thinking for global collaboration or for multiple global offices has not been addressed in this thesis project. The practicality of design thinking for global collaboration is another grey area in established discourse that future research could dive into. Another scope for future research would be to analyse the same concept of barriers and opportunities of Design Thinking in B2B companies by conducting a multi case study research in multiple companies from different industries. Doing such an extensive study would generate enough empirical data to provide a more comprehensive picture of the barriers and opportunities to implement design thinking in a B2B company with a well-developed product development process.

## 6 CONCLUSION

---

Opportunities and barriers of implementing Design thinking in a B2B company has been identified using an exploratory case study conducted in Mycronic. Barriers of implementing DT are categorized under three areas and opportunities of implementing DT under four. Critical areas in the product development process were identified by studying the requirement flow and stakeholder practices. After understanding the barriers and opportunities associated with DT implementation in a B2B company with well-developed PDP, it was evident that a successful implementation was only possible through structured work methods derived from the DT umbra construct and ensuring continual improvement through feedback loop. Thus, a framework was developed using the case study that companies can use as high-level template to improve customer centricity in their product development process. The framework is also geared to overcome the identified barriers and leverage the highlighted opportunities thereby facilitating the adoption of design thinking principles in a B2B company. Care was taken in the framework to ensure that the way to incorporate design thinking was addressed distinctively for exploration phase and the exploitation phase of product development. The exploration side of the framework is designed to incorporate DT principles in the form of workshops which when orchestrated successfully will bring in clear development goals and alignment for the teams. The exploitation side of the framework covers the three major horizons of product development namely New Product Development, Post launch development and Long-term Technology development. The exploration side of the framework is also designed to address how companies could make small changes that could result in the company developing a favorable environment that celebrates customer centricity. Lastly, a key point that B2B companies must take into account while using this framework is that the chances of success depends highly on the shared commitment of designers, managers, leaders and all relevant stakeholders in a company as the intent of the framework (and design thinking in general) is not to create a design thinking company rather to create independent design thinkers within a company.

Finally, the developed framework has been reviewed by industrial supervisors and was considered as a tangible road map for adapting design thinking into Mycronic

## 7 REFERENCES

---

- Adams, W. C. (2015). Conducting Semi-Structured Interviews. In *Handbook of Practical Program Evaluation: Fourth Edition*. <https://doi.org/10.1002/9781119171386.ch19>
- Ahmed, B., Dannhauser, T., & Philip, N. (2019). A Lean Design Thinking Methodology (LDTM) for Machine Learning and Modern Data Projects. *2018 10th Computer Science and Electronic Engineering Conference, CEEC 2018 - Proceedings*. <https://doi.org/10.1109/CEEC.2018.8674234>
- Astley, W. G. (1985). Administrative Science as Socially Constructed Truth. *Administrative Science Quarterly*, 30(4), 501. <https://doi.org/10.2307/2392694>
- Bason, C., & Austin, R. D. (2019). The right way to lead design thinking. *Harvard Business Review*.
- Blank, S. G. (2007). The Four Steps to the Epiphany. *Cafepress. Com*. <https://doi.org/22>
- Both, T., & Baggereor, D. (n.d.). *Design Thinking Bootcamp Bootleg*.
- Brown, J. S., & Duguid, P. (1991). Organizational Learning and Communities. *Organization Science*.
- Brown, T. (n.d.). *DESIGN THINKING DEFINED*. IDEO.
- Brown, T., & Katz, B. (2011). Change by design. *Journal of Product Innovation Management*. <https://doi.org/10.1111/j.1540-5885.2011.00806.x>
- Bryman, A. (2012). Social research methods Bryman. *OXFORD University Press*. <https://doi.org/10.1017/CBO9781107415324.004>
- Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues*. <https://doi.org/10.2307/1511637>
- Carlgren, L., Rauth, I., & Elmquist, M. (2016). Framing Design Thinking: The Concept in Idea and Enactment. *Creativity and Innovation Management*. <https://doi.org/10.1111/caim.12153>
- Conway, R., Masters, J., & Thorold, J. (2017). From Design Thinking to Systems Change. *RSA Action and Research Centre*.
- Dorst, K. (2011). The core of “design thinking” and its application. *Design Studies*. <https://doi.org/10.1016/j.destud.2011.07.006>
- Dunne, D. (2018). Design thinking at work: How innovative organizations are embracing design. In *Design Thinking at Work: How Innovative Organizations are Embracing Design*.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*. <https://doi.org/10.5465/amr.1989.4308385>
- Elsbach, K. D., & Stigliani, I. (2018). Design Thinking and Organizational Culture: A Review and Framework for Future Research. *Journal of Management*. <https://doi.org/10.1177/0149206317744252>

- Fejes, A., & Thornberg, R. (2009). *Handbok i kvalitativ analys*. Liber.
- Fraser, H. M. A. (2007). The practice of breakthrough strategies by design. *Journal of Business Strategy*. <https://doi.org/10.1108/02756660710760962>
- Fraser, H. M. A. (2012). Design works: How to tackle your toughest innovation challenges through business design. In *Design Works: How to Tackle Your Toughest Innovation Challenges Through Business Design*.
- Galbraith, J. R. (2005). Designing the customer-centric organization: A guide to strategy, structure and process. In *Spring*. <https://doi.org/Book Summary>
- Grafmüller, L. K. (2019). *Co-creation of high-tech products in the B2B domain* (1st ed.). Gabler Verlag. <https://doi.org/10.1007/978-3-658-28412-1>
- Hemel, C. van den, & Rademakers, M. F. (2016). Building Customer-centric Organizations: Shaping Factors and Barriers. *Journal of Creating Value*. <https://doi.org/10.1177/2394964316647822>
- Hester, M. B., & McKim, R. H. (1973). Experiences in Visual Thinking. *The Journal of Aesthetics and Art Criticism*. <https://doi.org/10.2307/429057>
- Hirsch, P. M., & Levin, D. Z. (1999). Umbrella Advocates Versus Validity Police: A Life-Cycle Model. *Organization Science*, 10(2), 199–212. <https://doi.org/10.1287/orsc.10.2.199>
- Ingle, B. R., & Ingle, B. R. (2013). Designing for Growth. In *Design Thinking for Entrepreneurs and Small Businesses*. [https://doi.org/10.1007/978-1-4302-6182-7\\_9](https://doi.org/10.1007/978-1-4302-6182-7_9)
- Javalgi, R. G., Hall, K. D., & Cavusgil, S. T. (2014). Corporate entrepreneurship, customer-oriented selling, absorptive capacity, and international sales performance in the international B2B setting: Conceptual framework and research propositions. *International Business Review*. <https://doi.org/10.1016/j.ibusrev.2014.04.003>
- Kelley, B., & Radziszewski, A. (2019). *8 Design Thinking Flaws and How to Fix them*. <http://customerthink.com/8-design-thinking-flaws-and-how-to-fix-them/>
- Knapp, J., Kowitz, B., & Zeratsky, J. (2016). *Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days* (1st ed.). Simon & Schuster.
- Kolb, D. A. (1984). Experiential Learning: Experience as The Source of Learning and Development. *Prentice Hall, Inc*. <https://doi.org/10.1016/B978-0-7506-7223-8.50017-4>
- Kolko, J. (2015). Design thinking comes of age. In *Harvard Business Review*.
- Lee, J. Y., Sridhar, S., & Palmatier, R. W. (2015). Customer-centric org charts aren't right for every company. In *Harvard Business Review*.
- Liedtka, J. (2018). Why Design Thinking Works. In *Harvard Business Review*.
- Liedtka, J., King, A. (Andrew C., & Bennett, K. B. (Kevin B. (2013). Solving Problems With Design Thinking 10 Stories of What Works, (Preview Version of Chapters 1 and 9). *Solving*

*Problems With Design Thinking.*

- Liedtka, J., & Ogilvie, T. (2014). Designing for Growth: A Design Thinking Toolkit for Managers. In *Psychological Science*. <https://doi.org/10.1007/s13398-014-0173-7.2>
- Michalos, A. C., & Simon, H. A. (1970). The Sciences of the Artificial. *Technology and Culture*. <https://doi.org/10.2307/3102825>
- Micheli, P., Wilner, S. J. S., Bhatti, S. H., Mura, M., & Beverland, M. B. (2019). Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda. *Journal of Product Innovation Management*. <https://doi.org/10.1111/jpim.12466>
- Mootee, I. (2011). Design Thinking for Creativity and Business Innovation Series. *Harvard Graduate School of Design Executive Education*.
- Mootee, I. (2013). *Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School* (1st ed.). Wiley.
- Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. In *Journal of Counseling Psychology*. <https://doi.org/10.1037/0022-0167.52.2.137>
- Rauth, I., Carlgren, L., & Elmquist, M. (2014). Making It Happen: Legitimizing Design Thinking in Large Organizations. *Design Management Journal*. <https://doi.org/10.1111/dmj.12015>
- Ries, E. (2016). The Lean Startup by Eric Ries. *The Starta*. <https://doi.org/23>
- Rowe, P. (1987). *Design Thinking* (1st ed.). MIT Press.
- Seidel, V. P., & Fixson, S. K. (2013). Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. *Journal of Product Innovation Management*. <https://doi.org/10.1111/jpim.12061>
- Shah, D., Rust, R., Parasuraman, A. P., Staelin, R., & Day, G. (2006). The Path to Customer Centricity. *Journal of Service Research - J SERV RES*, 9, 113–124. <https://doi.org/10.1177/1094670506294666>
- Wheeldon, J., & Faubert, J. (2009). Framing Experience: Concept Maps, Mind Maps, and Data Collection in Qualitative Research. *International Journal of Qualitative Methods*. <https://doi.org/10.1177/160940690900800307>
- Yin, R. K. (2009). Case Study Research Design and Methods Fourth Edition. In *Applied Social Research Methods Series*.
- Yoo, Y., & Kim, K. (2015). How Samsung became a design powerhouse. In *Harvard Business Review*.



## APPENDIX A

### *Preliminary Study Phase Interviewees*

<b>No</b>	<b>ROLE</b>	<b>BUSINESS AREA</b>
1	<i>Product Manager</i>	<i>Assembly Solution</i>
2	<i>System Architect</i>	<i>Pattern Generator</i>
3	<i>Product Director</i>	<i>Pattern Generator</i>
4	<i>Software System Architect</i>	<i>Pattern Generator</i>
5	<i>System Architect</i>	<i>Assembly Solution</i>
6	<i>Global Aftermarket process manager</i>	<i>Assembly Solution</i>
7	<i>Project manager</i>	<i>Assembly Solution</i>

### *Investigation Phase Interviewees*

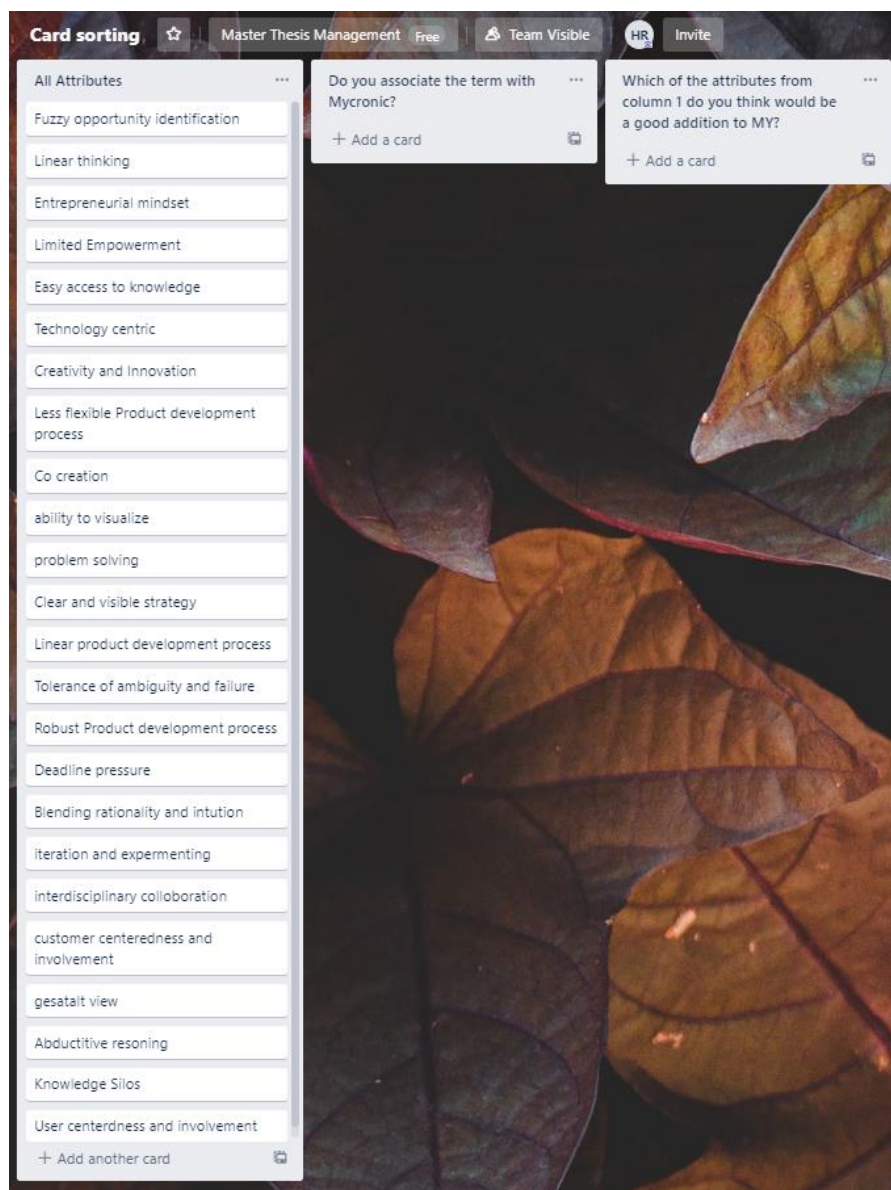
1	<i>Product Area Manager</i>	<i>Assembly Solution</i>
2	<i>System Architect</i>	<i>Assembly Solution</i>
3	<i>Product Director</i>	<i>Pattern Generator</i>
4	<i>Global Aftermarket process manager</i>	<i>Assembly Solution</i>
5	<i>Mechanical Designer</i>	<i>Assembly Solution</i>
6	<i>Director of Industry 4.0</i>	<i>Assembly Solution</i>
7	<i>Software Architect</i>	<i>Assembly Solution</i>
8	<i>Marketing head</i>	<i>Assembly Solution</i>
9	<i>Data Path Architect</i>	<i>Pattern Generator</i>
10	<i>Lead Architect</i>	<i>Pattern Generator</i>
11	<i>Electronics Designer</i>	<i>Pattern Generator</i>
12	<i>Project Manager</i>	<i>Assembly Solution</i>
13	<i>Chemist</i>	<i>Technology Development</i>
14	<i>Systems Sales</i>	<i>Pattern Generator</i>
15	<i>Head of Technology Development</i>	<i>Technology Development</i>
16	<i>Project Manager</i>	<i>Assembly Solution</i>
17	<i>Aftermarket Sales</i>	<i>Pattern Generator</i>
18	<i>Systems Architect (P&amp;P)</i>	<i>Assembly Solution</i>
19	<i>Architect (Software)</i>	<i>Pattern Generator</i>
20	<i>Program Manager (Product Enhancements)</i>	<i>Assembly Solution</i>
21	<i>Head of R&amp;D</i>	<i>Assembly Solution</i>



## Card Sorting Method

Twenty interviewees out of Twenty-one were asked to participate in card sorting exercise which was conducted during each interview. This exercise was established to obtain unfiltered data from the interviewees regarding their thoughts about the company and what they want in the future Mycronic. There were twenty-four words related to Design Thinking, Product development process, Culture etc.

The exercise was conducted in Trello Kanban, The first column consist of twenty four words, First, participants were asked to pick and place the words associated to Mycronic in the second column , second the participants were asked to pick and place the words they would like to improve or see in future Mycronic.



### **Word Cards used in card sorting exercise**

1. Tolerance of ambiguity
2. Abductive reasoning
3. Problem Solving
4. Entrepreneurial Mindset
5. User centeredness and involvement
6. Deadline Pressure
7. Iteration and experimenting
8. Co-creation
9. Technology centric
10. Blending rationality and intuition
11. Knowledge Silos
12. Ability to visualize
13. Linear product development process
14. Easy access to knowledge
15. Linear thinking
16. Less flexible product development process
17. Limited Empowerment
18. Customer centeredness and involvement
19. Gestalt view
20. Interdisciplinary collaboration
21. Clear and visible strategy
22. Robust Product development process
23. Creativity and innovation
24. Fuzzy opportunity identification

## Interview Guide

### I. Opening Questions:

1. What is your role in Mycronic (MY), give us a brief overview of your work?
2. What is your team size?
3. How much experience do you have in Mycronic?
4. What are the different departments you work with(to know about Documents flow)?
5. What do you think are the three strengths and weaknesses of the company?

### II. DT Attributes Card Sorting Game (10 Minutes):

The interviewees will be asked to select from a list of about twenty four cards the things they associate with Mycronic. The cards are a combination of attributes of Design Thinking and some attributes that are unrelated/ opposite to DT. Some of the cards are also closely related such as 'Customer centricity & involvement' , 'Iterative loops'. If the interviewee selects one and not another, it'll give us a way to dig deeper to understand their assumptions vs actuality in the company's Product development Process (PDP). Similarly, we also hope to get a feel of people in which roles/ departments/ business divisions (Assembly solutions & Pattern Generators) think they have more DT attributes.

Once the first sorting is done, we will ask them which things in the unselected pile they would like to see in Mycronic to make the PDP better(and why do they think so?). This would help us to understand what employees need/mindset, so we can improve the PDP of Mycronic which works.

Note: While doing the exercises, we shall explain the terms on the cards asked for clarification but will not tell them which ones are associated with DT. Similarly care has been taken to ensure that the words in the cards are not negative sounding so as to not influence the interviewees while sorting.

### III. Current Setup

1. How do you get the requirements to develop a product? (In which form -Needs/ requirement)
2. Can you give an example of how you involve in the development of the product? (requirement from Input\Output to whom)
3. Do you know how the products are developed by Mycronic? (road map or PDP process)
4. At what points are the customers involved from opportunity identification to New product delivery? (Mention every specific place with an example)?
5. What are your interactions with Strategic Planning & Management (SPM) Dept in New Product Development (NPD)?
6. How do you validate and understand the information from SPM?
7. Is SPM the only source of customer info? If yes\no, what are the other sources?
8. How much do you know about the business proposal of the products you develop? Example: Maximum spec of the product even if there exist high tech components, use low tech in the product.
9. Where and how does Product Development (PD) and Technology Development (TD) combine in PDP?

10. How do you access or edit PDP documentation?

#### **IV. Issues**

1. What are the bottlenecks in current MY PDP?
2. Do you know what Mycronic customer needs or you do with intuition or requirements gathered from SPM?
3. Have you faced any issues in a change of customer requirements during PD or misinterpretation of requirements? (communication issues), if so please provide an example and what happened?
4. Have you formed Cross Functional teams or Collaborations to solve any issues? If so, plz elaborate.
5. How Open are customers? (Customer secrecy in B2B Business)
6. How can we make PDP better in MY?
7. Do you think this process is not required in MY ( with example)

#### **V. Traces of DT**

1. Who is your customer?
2. If you were to order Company Strategy, customer needs, tech development? What is your priority?
3. Do you use any method to think differently to work with or do you work with previous experience?
4. How do you decide a particular solution is correct for a new product? Can you provide an example of how it was handled?
5. Where in PDP is best suited for checking customer input\validation? why?
6. Do you have a portolan wherein you create a prototype before production? When is it used? Could you give me an example?
7. How does Mycronic handle failure? (Product or Project or Service Sales) Plz give an example.
8. Have you seen any failure when TD and PD were combined? How was it handled?

#### **VI. Questions for people who part of the design thinking project were conducted by Mandela.**

1. What is your opinion on DT?
2. Was it useful? (Did you bring with you and implement something in day to day work?)
3. Was it practical? If so please describe what you consider practical.
4. What was the best part? Please motivate me.

## Coding Themes

1. Opportunities
2. Barriers
3. Literature
  - a. Yes
  - b. No
4. Role
5. Interactions
  - a. Internal
  - b. External
  - c. Customer
  - d. Partner
6. Issues
  - a. Exist
  - b. Solved
7. Improvement
  - a. Interviewee suggestion
  - b. Authors
8. Repeated problem
  - a. Contradiction
  - b. Multiple times
9. Others
  - a. Points
  - b. Insights



# APPENDIX E

## Present requirement Sheet

#ID	Requirement	Must-have	Good-to-have
PG771	AAaaaaa		
PG772	AAaaaaa		
PG773	Aaaaaaa		
PG751	AAaaaaa		
PG736	AAaaaaa		
PG774	AAaaaaa		
PG775	AAaaaaa		

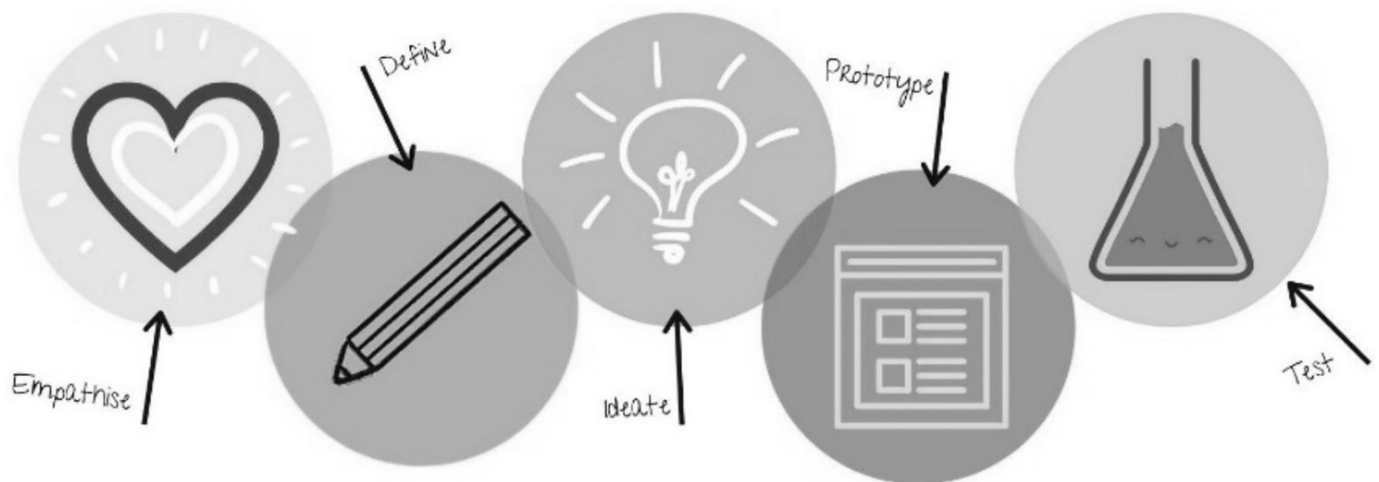
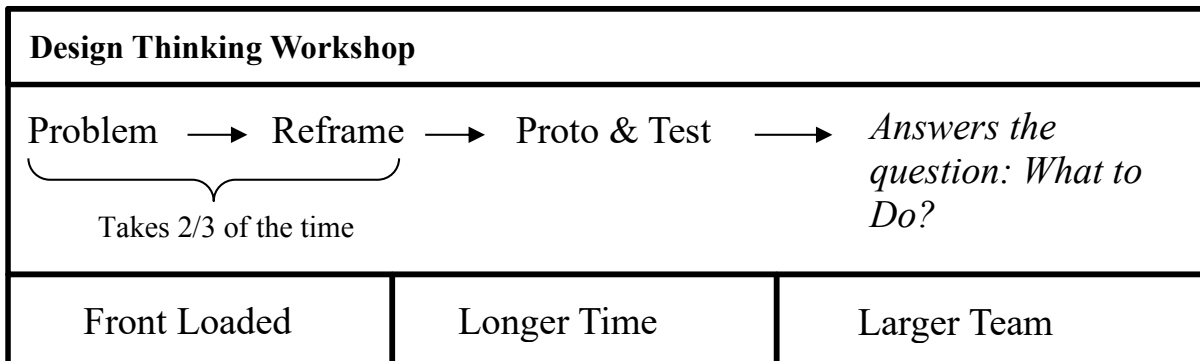
## Suggested changes in requirement sheet

#ID	Requirement	Background information on requirement	Must-have	Good-to-have	Req. Source	Priority	MVP (Validation)
PG771	AAaaaaa				Buyer	High	Yes
PG772	AAaaaaa				Safety	Medium	Yes
PG773	Aaaaaaa				Service	Low	No
PG751	AAaaaaa				Carry-over	Low	No
PG736	AAaaaaa				Operations	Medium	No
PG774	AAaaaaa				Strategic	High	Yes
PG775	AAaaaaa				Purchase	Medium	No



## Design Thinking Workshop

If the company wants an exploratory study to set product strategy for new markets, new products, etc. before investing resources, then the company can do a Design Thinking workshop.



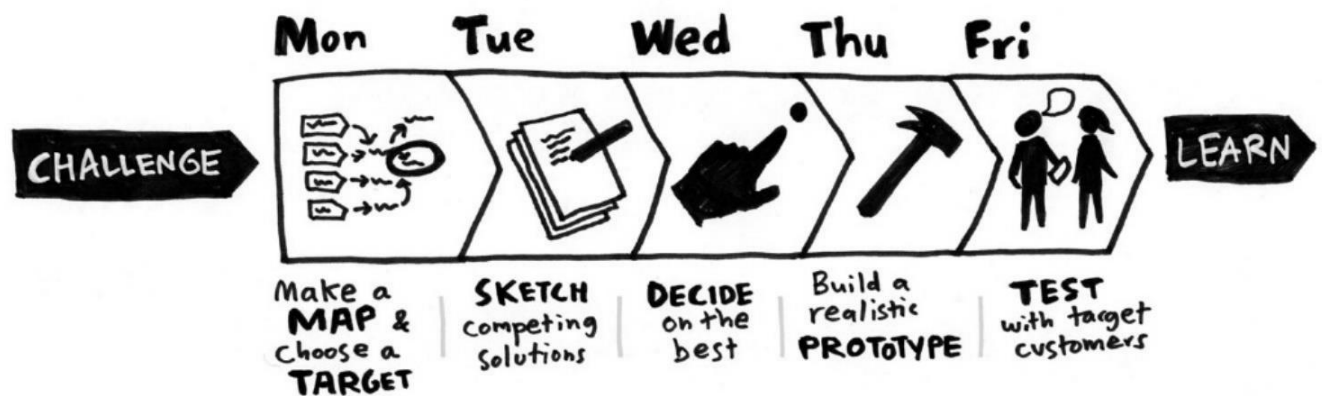
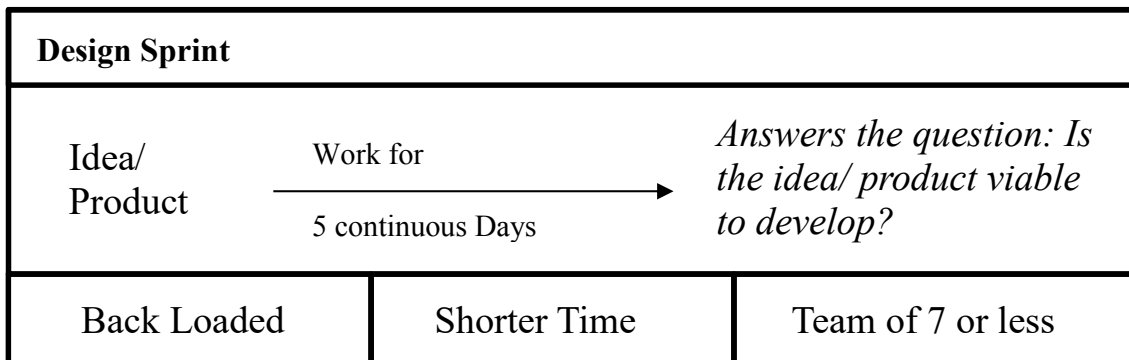
Please use these links to get more information on design thinking workshop

[https://www.youtube.com/watch?v=roVX-aU\\_T8](https://www.youtube.com/watch?v=roVX-aU_T8)

<https://www.youtube.com/watch?v=pXtN4y3O35M>

## Design Sprint Workshop

If the company has a problem or an idea that needs validation before investing resources, then the company can go with a Design Sprint workshop.



Please use these links to get more information on design sprint workshop

<https://www.youtube.com/watch?v=AuktI4lBj6M>

<https://www.youtube.com/watch?v=-ivb5R-44ww>

<https://www.youtube.com/watch?v=8WGDpLDsyOk>





TRITA TRITA-ITM-EX 2020:511