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Increase the efficiency and speed at the fuzzy front end of innovation:

Investigating Design Thinking and Stage-Gate as methods

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Acknowledgments

Dear reader,

This Master thesis will discuss the most suitable method to improve the efficiency and speed of the innovation process. The Master thesis was written as the final part for the completion of the Master Business Administration at the University of Twente. This research has been conducted in collaboration with Tagueri AG, which is a consulting firm with the headquarter in Hamburg, Germany. Particularly what I cherished the most during this research was the combination between theoretical research and practical research.

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Abstract

Innovating happens at most small and medium sized enterprises. It can be important for these firms to find a way how the innovation process in terms of efficiency and speed can be increased. Moreover, for companies it would be important that it is known what the most accepted method according to the literature is, to adapt this. Qualitative research was carried out to investigate if either Design Thinking or Stage-Gate is more appropriate for SMEs. The research was carried out based on a comparative case study in cooperation with a consulting firm. Three teams, all with their own method (1) Design Thinking, (2) Stage-Gate and (3) Freestyle worked on the same case. To research this, the following research questions was formulated: *''How can firms increase the efficiency and speed at the fuzzy front end of innovation - investigating Design Thinking and Stage-Gate as methods?''* Data was collected via various methods including surveys, observations, daily reporting, and personal conversations.

Design Thinking and Stage-Gate are user-centred approach towards the innovation process, both supported by relevant literate and this research. Design Thinking is making use of external information earlier in the process when comparing with Stage-Gate. In terms of performance and team-mood rating both Design Thinking and Stage-Gate do not differ much from each other. If Freestyle will be added, it can be seen that scores are significant lower as the other two methods. This research has shown that both Design Thinking and Stage-Gate were outperforming the team which was using no method at all. Working according to a method improves the creativity, as well as the ideation at the beginning of a project. No significant difference between the two methods can be found, therefore it can be concluded that both methods have a positive influence on the fuzzy front end of the innovation process in terms of efficiency and speed.

Keywords: Design Thinking, Stage-Gate, Freestyle, user-centred, innovation, team-mood rating, performance rating, results, OKR, comparative case study,

Table of Contents

Master Thesis – J.J.W. Weide – University of Twente

List of figures:

List of tables:

Master Thesis – J.J.W. Weide – University of Twente

1. Introduction

1.1. Situation and complication

It is increasingly encouraged to be innovative as a company and to maintain in business in a generally speaking fast moving environment (Meissner et al., 2017). According to van de Ven (1986), innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order. This definition is based on four factors: new ideas, transaction, people, and institutional context (Ven, 1986). Innovation is a new idea which can also be a combination of existing ideas. As long as an idea is perceived as 'new' by a group of people it is an 'innovation'.

Prior research implied the management of innovation and its problems. Van de Ven (1986) defined four categories of problems: human problem of managing attention; problem of managing ideas into good currency; structural part of managing part-whole relationships and problem of institutional leadership. Meaning the innovation process is characterised by multiple resources, functions and disciplines are needed for the transformation of an idea to concrete reality. This means a company needs to be aware of the complete set of innovation management problems, or how to tackle these to be able to innovate.

The above implied problems are relevant in the present time and to the innovation processes firms use. According to Niewöhner et al. (2019), there is high pressure and dedication in lots of small and medium-sized firms to innovate, many do not succeed to establish strategic innovation management in their daily business. Typical characteristics that lead to this are limited human resources and financial capabilities (Niewöhner, et al., 2019). It was indicated that innovation usually comes beside or parallel with the daily business of persons. However, innovating consumes time and especially when it comes next to the daily operations. This, in combination with the process of innovations from an initial idea or vision to an actual perception, similar problems as described above can be faced as well. Therefore, this research is relevant to small and medium sized firms, because it can answer their questions how to increase the efficiency and speed at the fuzzy front end of innovations.

To ensure the innovation process becomes more a daily task or that it becomes clearer how to work with it, there is a need to find the most suitable approach regarding the innovation process. The current struggle is that the efficiency and speed of innovations, especially in the fuzzy front end, lags. This context raises the following situation: can the efficiency and speed at the fuzzy front end of innovation be increased. Therefore, this research focuses on the different methods and theories how the innovation process can be accelerated in terms of efficiency and speed. A comparative case study is used to investigate this thoroughly. A new approach has been taken during this research towards the innovation process. During a specific period of time there will be worked with Design Thinking and Stage-Gate on an innovative case. This in comparison to using no method at all on the same case.

1.2. Research Objective

Since innovating happens at most small and medium sized enterprises it can be important for these firms to find a way how the innovation process in terms of efficiency and speed can be increased. Moreover, for companies it would be important that it is known what the most accepted method is according to the literature, in order this can be adapted. Additionally, it is relevant for companies who are innovating to be aware of what they need to change in their daily businesses to ensure the methods in this research catch up on their business. This can be

a method to differentiate the innovation process of one firm from another. The objective of this research is to have early identification of valuable ideas to continue or stop the innovation process. Investigate and explore two different methods that can increase the efficiency and speed for early identification at the front end of innovations. What could be the potential outcome of these different methods and what is the effect on the efficiency and speed of innovations.

1.3. Research Question

Based on the context and research objective the following research question was formed:

''How can firms increase the efficiency and speed at the fuzzy front end of innovation - investigating Design Thinking and Stage-Gate as methods?''

To be able to answer this research question the following sub questions were created:

- RQ1: What different methods are there for the improvement of the innovation process – how do they address the problems of innovation?
- RQ2: What can be the effect of the different methods on the innovation process – based on a comparative case study?
- RQ 3: What is the most suitable- or combination of methods according to the research?

1.4. Research relevance

The relevance of this research can be found in the field of innovation strategies. The context of this research involves two different methods that are put side by side – Design Thinking and Stage-Gate. Both methods are widely researched phenomena, which are used in many industries and businesses. This research will provide evidence what the communalities and where they substantially differ.

Contributions are being made to the problems in the management of innovations, what these are and how they are applicable in today's world (Ven, 1986). Additionally, contributions to the development of innovation models, how they capture creativity, knowledge and change are made (Berkhout et al., 2006). During this particular research, the methods Design Thinking and Stage-Gate will be compared. In prior research and literature both these methods are not brought side to side to make a clear comparison, although it is both user-centred approaches towards the innovation process (Mueller & Thoring 2012; Edgett, 2015). This research will contribute to an academical comparison between the methods, and where they substantially differ. Through an empirical approach to the innovation process, this research will provide the most effective and efficient method by which the innovation process will be strengthened.

This research will provide companies who are involved in innovating in the broadest sense with relevant information on how their innovation process can be improved. The main goal of the research is that the innovation process at the fuzzy front end of innovation will become more efficient and value-oriented from a customer/market point of view. This research could lead to significant improvements to the innovation process at small and medium-sized companies. Based on this research companies can implement the most sufficient method in their innovation process to ensure innovation can become a day-to-day activity and not something that is always pushed aside. Concluding this research is also of practical relevance to all companies who are involved in innovating in the broadest sense.

2. Literature review

This chapter discusses the two methods which – Design Thinking and Stage-Gate – that can increase the efficiency and speed at the fuzzy front end of innovation. Especially regarding the early identification of valuable ideas, whether to continue or to stop the innovation process. To understand why these two methods are investigated, the first subchapter will explain the umbrella term / commonalities between the two methods. Second, there will be a thorough description of what Design Thinking is and how it is related to the innovation process. Thirdly, the Stage-Gate system will be explained in relation to the innovation process. Finally, the substantive aspects are discussed in the result

2.1. User-centred innovation methods

Design Thinking and the Stage-Gate method are two different approaches towards the innovation process. In many aspects they differ, however there are also some communalities. These communalities can be placed under an umbrella term. This is a terminology used to cover a wider-ranging subject rather than one specific item. Therefore, the following umbrella term was established for this research; user-centred approach towards the innovation process.

Both Design Thinking and Stage-Gate have in common their user-centred approach (Mueller & Thoring 2012; Edgett, 2015). Both approaches involve potential users, customers and/or other stakeholders through each subsequent stage of the innovation process. Another communality, and especially during this research, is that the methods aim to detect early in the innovation process whether the innovation towards a product/service will work out. Given the approach and the communality of early detection, both methods might have a positive influence on the innovation process.

Design Thinking and Stage-Gate both focus on solving certain problems in the innovation process. It can be said that both methods are an approach towards solution development. Prior methods and research were primarily focussing on the development of products. Design Thinking and Stage-Gate have their roots in the development of products as well, however they are both matured to the standards firms have today, so they are applicable now on products, services and/or processes. Also, both methods are according to figures 1 and 2 shown as linear processes. However, it is important to mention that they both have in common that they are non-linear processes. In both methods, there is a certain process that can be followed, but it is overlapping with all different stages and going parallel with sub-processes in the larger process. However, Stage-Gate has a more linear approach than the Design Thinking approach.

2.2. Decision of methods

In the above paragraph, the umbrella term and commonalities of Design Thinking and the Stage-Gate process can be found. However, these communalities are mostly towards the greater good of the innovation process and not particularly focussed on how the methods work. The most important aspect is that the differential effects of the methods can be tested, so what is the impact of the methods when working with them.

The difference in the methods is primarily in the approach toward the innovation process. The Stage-Gate process is a more step-by-step approach where decisions are made after each stage to continue with the idea or kill it. The Design Thinking approach is more broadened and has no focus on killing ideas in the early stages, yet there is a focus on early identification of whether it works. Design Thinking uses failures not as threats but as learning objectives. To

compare, Stage-Gate will kill ideas earlier, whereas Design Thinking is a more continuous process of improvement. Another difference can be seen that using Design Thinking there is just the project team working on the innovation, with limited influence from outside the project team. With Stage-Gate, there is a larger influence from outside the project team since the decision on kill or go are being made mostly by senior managers (or appointed personnel).

2.3. Design Thinking

Design Thinking can be generally defined as a creative and analytical process that engages people to experiment, create, prototype, collect feedback and redesign again. Design Thinking was primarily used in the actual fields such as engineering and the more technical professions. (Razzouk & Shute, 2012). Today Design Thinking is widely used in more business fields than originally only in the design fields. It is understood as a way of thinking which leads to innovation, transformation, and evolution. It contributes also to new forms of living and new/improved ways of managing businesses (Tschimmel, 2012). As can be read Design Thinking is not just another way of approaching business topics, but it can change an entire company approach if one is open to it.

Before Design Thinking became a popular conceptual thought for the innovation process, it was designed and described by researchers solely as the cognitive process of designers (Tschimmel, 2012). This research mainly focussed on the subject of design creativity, which narrowed down the subject only to the designing fields instead of a more universal approach applicable to several businesses and industries. The object then was improving the Design Thinking abilities in individual and mutual design processes (Tschimmel, 2012). Since the first decade of the 21st century, the actual concept of Design Thinking was broadened and was not limited anymore to actual designing fields. The definition of Design Thinking was mainly broadened because of a publication by Tim Brown, the CEO of IDEO, one of the world's most powerful designing consultancies. Besides the definition of IDEO towards Design Thinking, there is also the approach from Roger Martin, Dean of Rotman School (Tschimmel, 2012). Roger Martin described Design Thinking as ''a way of approaching business problems in the same way designers approaches a design problem''. In Design Thinking failure is not a threat but an avenue for further improvement and learning. Most difficulties and constraints are embraced since they pave the way to innovative ideas and solutions (Razzouk & Shute, 2012).

Nowadays there are many different manners to implement the Design Thinking philosophy into a firm. Many models can be used to follow as a guideline. All these models have in common that it is not a linear process but rather a system of overlapping spaces. In the past, there are several models on Design Thinking published and all were defended as the most appropriate (Tschimmel, 2012). The best-known models in Design Thinking are the Human Centred Design Thinking (3I Model) and the 5-step Design Thinking model. Both models have a little different interpretation, but follow mainly the following process: empathize, define, ideate, prototype and test (Tschimmel, 2012). When using Design Thinking, it is important to consider that complete planning of when the team shall be in which phase is not possible. It is always depending on the findings in which phase the team is, and as described above, it is a system overlapping spaces.

In figure 1, a combination of the 3I Design Thinking model and the more traditional 5-step Design Thinking model can be found. During this research, this combination of models will be

used more as a guideline rather than a strict protocol. The DT-process differs regarding the phases and wording but, essentially, it is always the same.
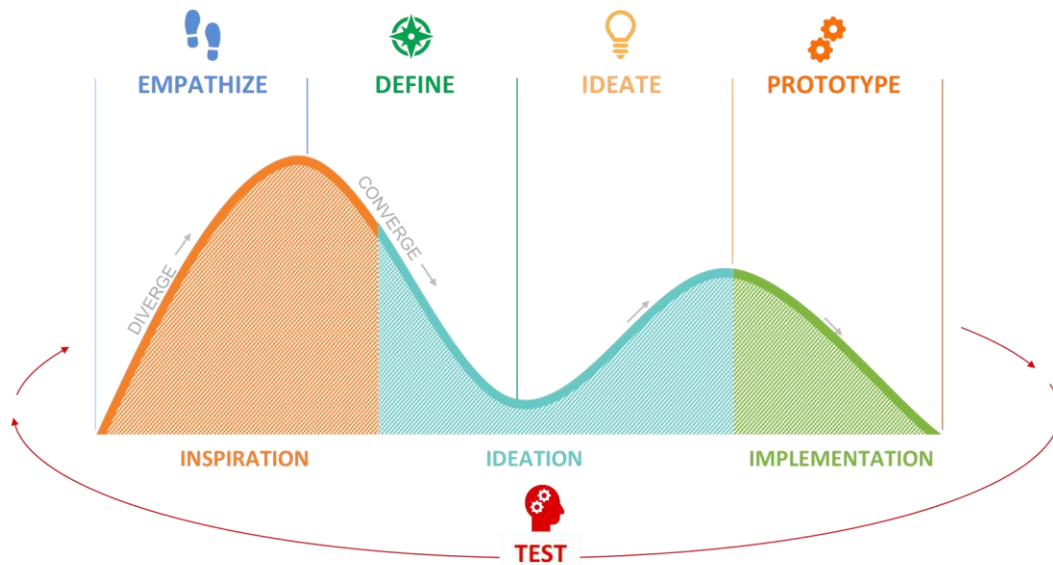

Figure 1: Combination of methods HCD DT and DT (Hoover, 2018)

First a thorough explanation of the Human Centred Design Thinking part will be given. This is also known as the 3I model. The phases are Inspiration, Ideation, and Implementation (OpenStax College, 2019). The design challenge or the so-called problem is the **inspiration**. This is then followed by **ideation**, which is a creative process focussed on solving the design challenge based on observations (OpenStax College, 2019). Lastly, ideas are turned into actions in the **implementation** phase. Possible solutions are throughout the process tested via experiments to ensure the best version will be created. In figure XX, the words diverge and converge can be found. This are the two main types of thinking throughout the phases. Divergent thinking makes use of the imagination to open to new solutions and possibilities and become more innovative. Convergent thinking moves from broader thoughts to more concrete understanding. Inhere, the thoughts of divergent thinking can be narrowed down to more promising ideas and/or solutions (OpenStax College, 2019).

The 5-step Design Thinking model has in broad lines the same approach, yet it is with different wording and phases. The first phase is **empathized**. Main goal is to gain an empathic understanding of the problem that is tried to be solved (Dam, 2021). Usually, a substantial amount of information is gathered during this phase, to be used in all other phases for the development of the best possible solution. In the **define** phase, information gathered and created in the previous phase is put together. This to define the core problems identified upon this point. There should be tried to define the problem as problem statement in a human centred manner (so again a combination between the two methods of DT) (Dam, 2021). At the **ideate** phase, the designers are starting with the idea generation. Usually, it is an outside the box approach to identify new solutions to the problem statement defined (Dam, 2021). Fourthly, the **prototype** phase. In this phase a number of prototypes are created. These are shared within the type but sometimes also with smaller groups outside the team (Dam, 2021). Lastly, is the **test** phase. In this phase the designers or evaluators test the solution thoroughly. Since DT is an iterative process, results of the testing phase are used for redefinition for better understanding (Dam, 2021).

2.4.   Stage-Gate

The Stage-Gate system is both a conceptual and operational model for moving a new product or service from initial idea to launch. This system can be used as a blueprint for managing the new product process to become more effective and efficient (Cooper, Stage-Gate Systems: A New Tool for Managing New Products, 1990). Since the development of the Stage-Gate process, the aim was to become better at the innovation process, to drive the product development process faster and to make fewer mistakes in the entire development process. According to prior research, 60% of the respondents in a survey for new product development were using some form of the Stage-Gate process (Griffin, 1997).

A Stage-Gate process is consisting of a series of stages where essential tasks or activities are carried out. The stages are supplemented with gates where performance is assessed. The stages comprise the actual development work. The activities performed depend on which stage the project currently is in. In the traditional Stage-Gate process, the early stages focus on discovering opportunities and idea generation. Where the stages further in the process focus on concept development, testing and commercialization (Grönlund et al., 2010). The stages are taken cross-functional and activities are taken parallel with other activities to ensure the speed of the process. Typically, the next stage will be more time consuming than the preceding one, which results in increased commitments. However, it also ensures the number of unknowns is reduced as well as the uncertainties so risk will be managed effectively (Cooper, 2008).

In the Stage-Gate process, there is a set of information gathering stages which are followed by go or kill decisions. Each stage consists of information gathering activities, integrated analysis of the results of the activities and the results of the integrated analysis which will be the input for the gate, for the go or kill decision (Cooper, 2008). The gates are usually manned by senior managers or project executives, which are called gatekeepers. They evaluate the based-on business rationale, quality of execution, and quality of the action plan. Since the gatekeepers are early involved in the process, the level of quality will be ensured, or the ideas need redefining whenever it fails to meet objectives (Grönlund et al., 2010).

Over the years, there were various versions of the original five step Stage-Gate process defined by Cooper (2008). Some examples of the different versions on the original Stage-Gate process are the Xpress (slightly smaller than original one), which was created for with moderate risks, such as extensions, modifications, or improvements (Cooper, 2008). Another modified Stage-Gate process is the Lite version, which is there for very small projects such as simple requests from customers (Cooper, 2008). However, for this research these modified approaches have less chance to succeed. Therefore, the original 5 step Stage-Gate process will be used during this research.

According to Cooper (2008), the Stage-Gate process sounds very easy, but surprisingly many people get it incorrectly. Hereunder in table 1, the debunks of the Stage-Gate process can be found. The misconceptions are based on how people frequently misapply, misread, and abuse the Stage-Gate process.

Table 1: Debunks of the Stage-Gate process

Debunks of the Stage-Gate process
It is not a functional phased review process (like in the 1960s)
It is a non-linear process
It is a non-rigid lock-step process

Master Thesis – J.J.W. Weide – University of Twente

| It is not a project control mechanism |
| It is not a stagnated, dated system |
| It is a non-bureaucratic process |
| It is not a data entry scheme |
| It is not the same as Project Management |
| All information in this table is gathered from research by Robert G. Cooper (2008), in the Journal of Product Innovation Management |

In figure 2, the five step Stage-Gate process can be found. There are a few key takeaways coming with the Stage-Gate process. Each stage is designed for data gathering to reduce key project risks and uncertainties. Each stage costs more than the preceding one, so the process can be seen as an incremental commitment process. As can be read above, each stage is cross-functional. There is no special R&D stage or marketing stage. No single department owns one stage; therefore, the Stage-Gate process is undertaken by a team of different functions and departments within a company (Cooper, 2008).
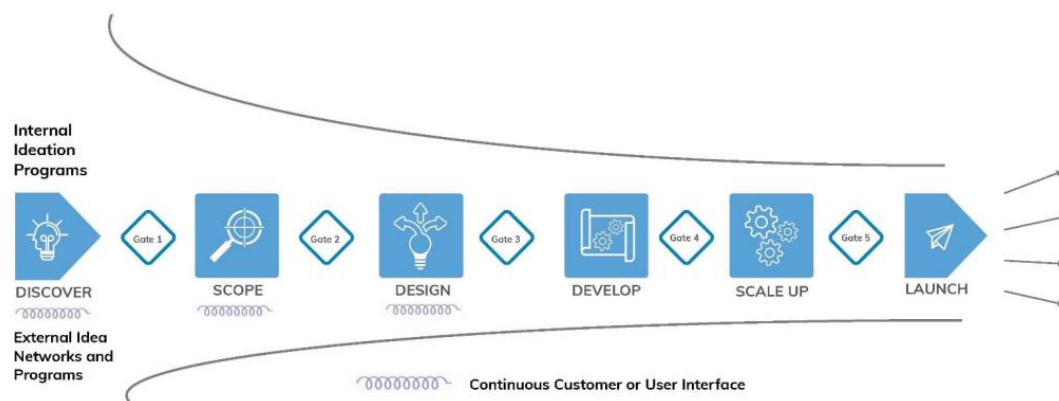

Figure 2: Typical five step Stage-Gate process (Edgett, 2015)

Before the five-step Stage-Gate process starts, there is an ideation or discovery phase. During this so-called 'prework', the discovery or uncover business opportunities and/or generates new ideas (Edgett, 2015; Cooper, 2008). The first stage is the **scope** stage. This is a fast, inexpensive investigation (preliminary) of the new project. This is gone mainly via desk research. This is followed by the **design** stage (also called build business case). This is more detailed research involving data from customers, technical and markets (primary data), leading to a business case. Usually, this includes project and/or product definition, justification, and proposed plan for development. Thirdly, the **development** stage. Including the actual development and design of the new product (or innovation) as well as the required operations or production process for eventually full-scale production (Edgett, 2015). Fourthly is the **scale up** stage (also called testing and validating). During this stage, there is an extensive testing or trials to validate and verify the proposed new marketing, production, operations, and new product plans. Lastly in the Stage-Gate process is the **launch**. Which is the beginning of full-scale operations and/or production, sales, and marketing (Edgett, 2015).

Proposition: Based on both the descriptions of Design Thinking and the five-step Stage-Gate process, it can be assumed that both methods will have a positive influence on the innovation process as opposed to the controlling group - using no method at all (Freestyle).

3. Methodology

In this chapter the methodology used to investigate which of the two methods, in terms of efficiency and speed has the most impact on the innovation process of SMEs. This chapter is separated into three sub-sections. Firstly, the actual research is described by appointing the method and substantives of the case. Secondly, the participant selection is explained. Finally, the measurement (data collection methods) used are elaborated.

3.1. Research Design

3.1.1. Comparative case study

For this research, a comparative case is conducted. According to Denscombe (2014), case studies focus on specific phenomenon or change. It provides an in-depth account of events, experiences, process, or relationships. The case study approach has been used widely in several research. In practice, a regular case study has more alignment with qualitative research rather than quantitative research (Denscombe, 2014). In a case study, there is always 'the case', which forms the basis of investigation. This is usually something of existence, a naturally occurring phenomenon. When covering two or more cases in a way that produces more general knowledge, how or why particular events, experiences, processes, or relationships work or fail to work, then there can be talked about a comparative case study.

Comparative case studies are undertaken over time with the emphasize on comparison within and across contexts. It involves the analysis and synthesis of the differences, similarities, and patterns across two or more cases that share a common focus or goal (Goodrick, 2014). In this research, the common goal is to increase the efficiency and speed at the fuzzy front end of the innovation process. To be able to carry out a comparative case study well, the specific features should be described in depth at the beginning of the case study. Comparative case studies incorporate both qualitative and quantitative data, which is explained more in detail in paragraph 3.2. There are many similarities in in data collection methods for both a single case study and comparative case studies (Goodrick, 2014). Yet, comparative case studies require more extensive analytical, conceptual, and synthesizing work. Synthesizing across cases extends beyond comparisons of similarities and differences. To using these similarities and differences to support or refute propositions as to why an intervention may succeed or fail (Goodrick, 2014)

For the comparative case study in this research, there are three different teams, each using another method towards the innovation process. The main goal is to test whether Design Thinking or the Stage-Gate process is more appropriate and successful. A third team is using no method (Freestyle) which will be the controlling team of this comparative case study. In terms of reliability and validity for this comparative case study, formation of groups was done as described in paragraph 3.1.4. When introducing the different methods to the teams, introductions were only given to the particular team, ensuring teams are not influenced by any other methods or information.

3.1.2. Description of the case

This research was done in collaboration with a consulting firm, originating from Germany. The company follows solution-oriented consulting approach. Mainly the reason for consulting is a project or concrete problem at other firms. The company positions themselves as problem solvers with great demands for situating the problem. Since the establishment, the goal has been to improve client's competitiveness and create an exceptional professional environment for exceptional people. The company grew to 400 employees and 7 locations across Germany. In all the years they consulted for 400 customers from medium-sized business to global corporations. Their expertise field is in organization, innovation & technology, process consulting and project consulting & implementation. Within this expertise's there is broad knowledge from change management and new work to business model management and cybersecurity.

However, with new ideas and innovations, several problems also arise. The company is facing problems especially at the starting phase of innovations, similar as described in the situation and complication. The main pitfall of the current innovation process is that it usually takes too long besides the daily business to define and validate products/services. The available time needs to be used very efficiently. According to the company's principal, it is about the process and not about the results. When the innovation process is improved, there is more space for innovations in general, where the good ideas go through and the less good ideas prematurely can be detected.

During this research and the comparative case study, all three teams will be working on the same case. Yet, each team has the focus on their own method; Design Thinking, Stage-Gate, or Freestyle. The case the groups will be working on was defined by the management of the consulting firm. Hereunder, the value hypothesis as defined by the consulting firm can be found.

*"Our customers are part of a complex environment (economics, society, politics) which is characterized by a low planning reliability due to **high dynamics** and **uncertainty**. The **execution of strategic goals** is a great challenge in this environment as the daily business takes the center stage.*

*Therefore, we **postulate** that we, as the consulting firm, are able to offer a service package based on the collaborative goal setting framework **Objectives & Key Results (OKR)** which will deliver a **measurable added value** to our customers by **realizing their strategic goals**.*

*We believe that **10 percent** of our **current customers** are potential buyers."*

To summarize, all three teams will be working on the same case, with the only information that is given is the value hypothesis, next to some sources regarding what the OKR method is. To give more context on the OKR method, it is a collaborative goal-setting approach / methodology used by both individuals and teams. It is used to set ambitious and challenging goals by measurable results. OKRs are how progress is tracked, to create alignment and for the encouragement around measurable goals (Panchadsaram & Doerr, 2020). All teams are going to create a service package, that can be offered to the current customers of the consulting firm. The service package includes the OKR methodology as described above. In appendix 2, more information on OKR can be found.

3.1.3. Outline of the case

The outline of the comparative case study, prior to the execution is described hereunder. During the execution, there were hardly any ambiguities or misconceptions. Therefore, the execution of the comparative case study, in collaboration with the German consulting firm can be seen as successful. In the paragraph above, the case description can be found, where the groups will be working on during the comparative case study. The comparative case study consists of three different 'teams'. Each team is using a different method towards innovation process of the particular case. Hereunder, the three different teams can be found.

- **Team 1:** Design Thinking
- **Team 2:** Stage-Gate
- **Team 3:** Freestyle

Team 1 follows the Design Thinking approach. In the theoretical part of this research the different steps of the method can be found. However, for the sake of the case study it is not described when which phases are carried out. This is because Design Thinking is a non-linear approach with system overlapping spaces. Therefore, there has been chosen to indicate the phases of this process as iterations. Iterations focus on the practices of building, re(de)fining, and improvement of the innovation process.

Team 2 follows the Stage-Gate process. Other than Design Thinking, this method is following a more structured approach with different phases defined in figure 3. However, it is good to mention that the steps given by the different days worked as an indication. This is because one phase can take a little longer/shorter than the other.

Team 3 follows a Freestyle approach. It is indicated as Freestyle because there is no clear process or method defined here. The team working with this approach self-driven with no other guidance. Therefore, this approach is used as a controlling method, to measure if the two other method show significantly other methods than the controlling approach.

In figure 3, the outline of the comparative case study can be found. In the top row, the days can be found. In the left column, the approaches can be found. It is important to mention that this outline worked more as an indication throughout the comparative case study rather than a strict guideline.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Team Design Thinking	Iteration 0	Iteration 1		Iteration 2		Iteration 3		Buffer		Results
Team Stage Gate	Idea Gen.	Scoping	Business Case	Development (Prototype)			Test & Validate	Buffer		Results
Team Freestyle	(self-organized approach)							Buffer		Results

Figure 3: Outline of the comparative case study

3.1.4. Selection of participants

Several factors played a role in the participant selection for the comparative case study. The comparative case study method is also used as one of the main data collection methods. Therefore, it is important that the participant selection was handled with the highest level of appropriateness. Participant selection and participation is of importance because collected information is eventually compared to the literature and latter parts of this research are based on the collected information. Meaning participants must have a certain level of knowledge and thinking knowledge. When selecting participants, the non-probability convenience sample was kept in mind. Because the main goal is to say something about the innovation process at SMEs using the different methods.

For this research, all empirical data is collected in collaboration with a German consulting firm. Therefore, the three different teams in the comparative case study do exist out of employees from that company. The composition of each team was made in consultation with the company's management. With the participant selection and distribution over the three teams, the degree of homogeneity/heterogeneity of the group was kept in mind. The selection of the participants was also done considering the level of randomization. The management of the consulting firm selected various participants for the comparative case study. All teams are divided equally in terms of number of people. Further the teams were defined randomly. In table 2 the participants who were selected and participated are described by, team, experience, position, personality profile and nationality. All participants within the teams had no prior working experience with each other. Meaning that this will not influence the results of the research.

Table 2: Participants

Participants				
Participant	*Experience(yrs.)*	*Position*	*Cooperation**	*Nationality*
Design Thinking 1	2.5 yrs.	Jr. Consultant	No	German
Design Thinking 2	4 yrs.	Consultant	No	German
Design Thinking 3	1 yr.	Work student	No	German
Stage-Gate 1	1.5 yrs.	Jr. consultant	No	German
Stage-Gate 2	0.5 yrs.	Intern	No	German
Stage-Gate 3	10+ yrs.	Jr. consultant	No	German
Stage-Gate 4	4 yrs.	Consultant	No	German
Freestyle 1	0.5 yrs.	Jr. Consultant	No	French
Freestyle 2	1 yr.	Work student	No	German
Freestyle 3	5 yrs.	Consultant	No	German

In this table all participants are listed that that participated in the comparative case study. The table shows their relationship in the study. This is indicated by 'Design Thinking', 'Stage-Gate' and 'Freestyle'. Additionally, the experience, position personality and nationality of the participants are indicated.

* With cooperation is meant if there is already prior experience within the team regarding cooperation with each other (project experience, team, etc)

3.2. Data collection methods

Data collection for this research consists both of qualitative and quantitative research methods. This is mainly due to the scope of the research, where two different methods towards the innovation process will be investigated. The main research method used is a comparative case study. This method incorporates both qualitative and quantitative data (Goodrick, 2014). All data collected from the comparative case study is empirical/primary evidence. Whereas the data collected in the theoretical part of this research is secondary evidence. During the research and especially execution of the comparative case study, various data collection methods were used. In table 3 the methods used can be found, followed by a description and its relation to the case.

Table 3: Data collection methods

Data collection methods: comparative case study	
Method	*Description*
Interviews	Interviews are used throughout the research process. Conducting interviews requires knowledge of the interview topic from both parties. Interviews are valuable because it allows the researcher to explore subjective viewpoints and to gather in-depth experiences of people (Evans, 2017). Before each interview took place, the interviewee received an interview schedule with relevant information regarding the interview. Permission was asked prior to each interview to ensure confidentiality. All interviews conducted were in a semi-structured way. This methodology allows the researcher to ask follow-up questions, resulting in a more in-depth data collection.
Observation	Observations are used throughout the comparative case study. Observation is watching something and taking notes about things that happen, their behaviour or what they say (Goodrick, 2014). During this research, observations were done equally among the three different teams, to have similar observations on the subject. Also, during group discussions, the researcher observed the teams behaviour and the things that were said.
Survey	A survey is a way of conducting research in which is made use of a questionnaire, presented to several people. These people may form the entire target group or are a representative sample. In a survey, both facts and opinions may be involved. The surveys used during this research can be found in appendix 1. In total, surveys were conducted two times during the comparative case study, on days 1 and 6. The main goal of the survey was to get a clear image of the perception of the people working with the different methods.
Personal conversation	This method has a similar methodology as interviews. However, with personal conversations there is no clear structure. This method was mainly used during interventions to ask people about their feelings and findings using the different methods towards the innovation process.
Project documentation	This is the process of recording the key project details, in this case the case the participants are working on. At the end of each day, each team member writes a short report about how it went, what their struggles were, and how the method contributed to their process. (Individually on a MIRO board)
All information obtained from the different data collection methods is transcribed/summarized into text by anonymized participant numbers. In the next paragraph, the method of analysis of the data collected can be found.	

Master Thesis – J.J.W. Weide – University of Twente

3.3. Method of analysis

All data gathered using the different data collection method needs to be analysed, before results and conclusion can be drawn from it. Since for this research two different data collection methods, quantitative and qualitative data has been collected, there are also different methods of analysis.

The main input for the **quantitative** analysis came from the survey, which was conducted three times, as described in the above paragraph. Before the analysis, all gathered data was prepared. The entire data set was checked on outliers and missing data. If this was the case, the missing data or outlier was removed from the data set. The data set was analysed using the statistical software SPSS. During the analysis the data was mainly transferred into easy understandable graphs and figures. These were mainly used in terms of support of the qualitative output.

The **qualitative** input is based on interviews, observations, personal conversations, and project documentation. Additionally, the teams were making use of a Miro board. This Miro board was used as a tool to collect various data streams, including the daily reporting and progress regarding the method of the teams. All teams were using their own Miro board. Thematic analysis is conducted for the analysis of all the data. Common themes, topics, ideas, and patterns of meaning came up repeatedly in the data. All collected data is thoroughly analysed. After analysing the output of the qualitative data is processed in the result section of this research. Qualitative output is supported by quantitative output such as tables and graphs accordingly.

4. Results

In this chapter, the results concerning the information gathered during the case studies are explained. This is done with the use of text and tables. The interpretation is based on both gathered data, combined with the literature. Also, the personal opinion of the participants regarding working with Design Thinking and Stage-Gate is considered accordingly. Next to this, daily reports are kept by the teams. Based on these reports, results are displayed where conclusions are drawn from.

Ensuring all teams have a comparable start, teams were defined on the first day. Meaning no biases were formed in terms of understanding of the methods. All teams went off to create a common understanding on either Design Thinking or Stage Gate. The third team which has the Freestyle method decided to immediately start working on the value hypothesis of the case study, as described in paragraph 3.1.2. Both team Design Thinking and team Stage-Gate were working half of the day to get the understanding on the method, before starting working with the method. In comparison on team Freestyle, that started right away with working on the case.

4.1. General observations and results

4.1.1. Time invested

Before the start of the comparative case study, it was expected that all teams were putting the same amount of time and effort into the project during the given time of 10 working days. Expected was that the teams would invest roughly six to seven working days on the project. This expectation came about because some participants still had obligations in their position at the consulting company. In table 4, the time invested per team can be seen. Both Design Thinking and Stage-Gate had days off. Meaning that the number of days stated in the table are also the actual days the teams worked on the case. Team Freestyle worked in general the greatest number of days on the project. However, when looking at the amount of time invested in terms of hours, they invested the least time in the case.

Table 4: Time invested

Time invested in the project	
Team	*Days*
Design Thinking	+/- 5/6 days
Stage-Gate	+/- 5 days
Freestyle	+/- 4 days
In this table the teams and number of days invested in the case study are listed. The average of all teams members in taken in the consideration of the days. Please note, an eight-hour working day is taken when displaying the days.	

Both team Design Thinking and Stage-Gate were putting the most time and effort in the comparative case study on the first three days. After this, the amount of time worked per day on the case declined. For team Freestyle, most time was invested after the fourth day.

4.1.2. Survey results

Before the start of the comparative case study, all participants filled in the survey as described in the methodology. All were asked what their opinion is on the method with the highest chance of succeeding. The outcome can be found in figure 4. Of all participants, no-one thinks that the Freestyle method has the highest chance of succeeding. One of the respondents

mentioned that Freestyle seems to be very unstructured. The Stage-Gate method has a 33% chance of succeeding according to the participants. Reasonings are most methodical and financial checkable. The majority of 67% thinks that Design Thinking will succeed. Arguments were that it is agile, contemporary and user/customer focused perspective. Additionally, it was mentioned several times that an iterative method should be the best.
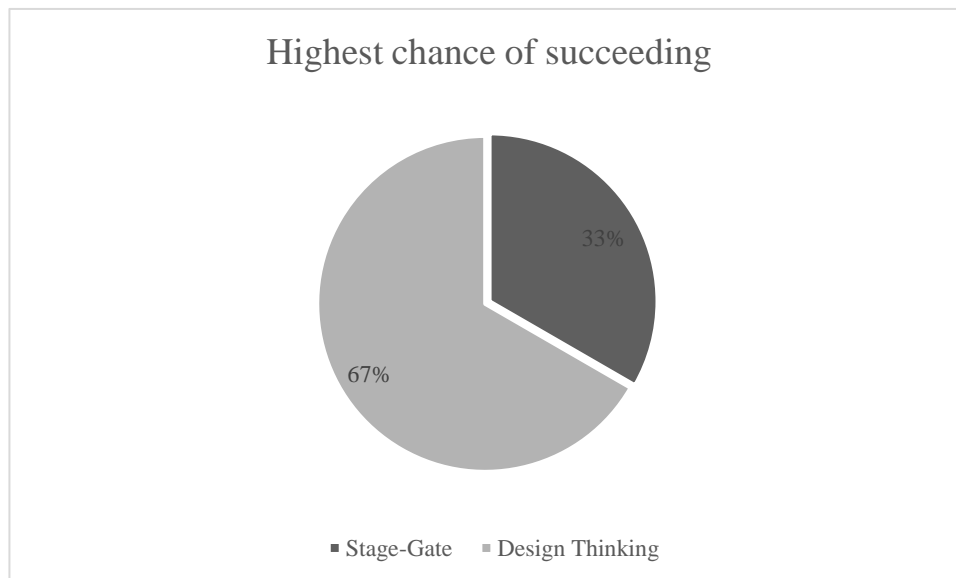

Figure 4: Pie chart on chance of succeeding

Using a 1–5-star scale, the familiarity among the participants regarding the method was measured. No significant distinction in the familiarity was found with a mean score of respectively 2 for Design Thinking and 2.25 for Stage-Gate. Accordingly, both team Stage-Gate and Design Thinking did understand the method based on the provided materials and discussions within their team. Meaning this will not lead to ambiguities in the process. Both the Design Thinking and Stage-Gate team both have a common feeling towards whether the method will work out or not. Using a 1–5-star scale again, the mean score given by both teams was 4 out of 5. Regarding the influence of the method on the innovation process, a small difference in the perception can be recognized. The Design Thinking team is rating the influence the method might have on the innovation process slightly higher than the Stage-Gate team. Yet, both teams have a positive perception on the outcome.

Half-way of the comparative case study all participants were asked to fill in the survey again. This was to see whether there were significant differences from the first time they filled in the survey. It can be concluded that there was no large change in results, in comparison to the first time the survey was completed. However, two participants of team Freestyle were mentioning that they did not understand the method they are working with, while the first time they completed the survey the did. According to observations, this can be traced to communication difficulties within the group. Additionally, lack of structure in the approach towards the case study can be mentioned as one of the reasons. A more thorough explanation will be given in paragraph 4.4.

Master Thesis – J.J.W. Weide – University of Twente

4.2. Design Thinking

At the end of each day, all members filled in the team-mood and performance rating of that day, including motivations. In figure 5 the average team-mood and performance rating can be found. These ratings will be further explained later in the text, in the accompanying piece according to the timeline. First observations of the performance and team-mood rating of team Design Thinking are that especially on the first three days the correlation is equal. On day one and two, the ratings were at its highest. On day three both performance and team-mood rating declined to a score of 3/5. After which the team-mood rating rose whereas the performance rating stayed at a lower level.
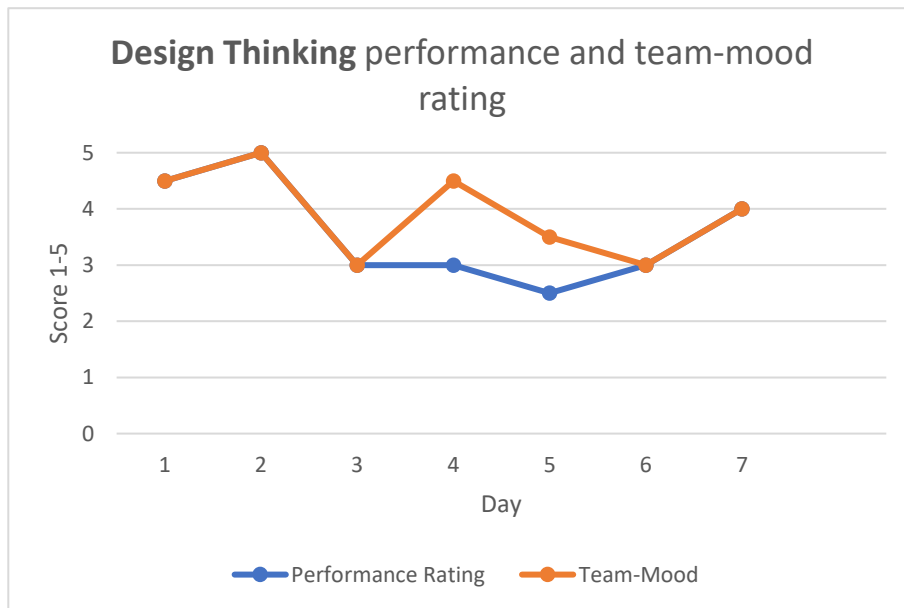

Figure 5: Design Thinking performance and team-mood rating

4.2.1. Iteration 0

As can be read above, roughly half a day was used to have a common understanding on Design Thinking. After this was achieved, the team started looking at the case and accompanying hypothesis. Although Design Thinking is a user-centred approach to the innovation process, with the external output throughout the process, it is still a question whether this will be done (Tschimmel, 2012). Within the first day of the comparative case study, the team was creating interview questions. These interview questions helped them to compare the interviews conducted on the first day. In total, they did five interviews. All these interviews were external in terms of out of their team, but internal regarding that the interviews took place with employees from the consulting firm. Something that is significantly different in comparison to either Stage-Gate or Freestyle, is that Design Thinking was the only team conducting interviews so early in the process, helping them with their discovery phase.

The researchers observations were in line with the team its performance and team-mood rating. According to the team, there was a quick understanding of the task/case. Regarding the performance, after the first day the team is ahead of schedule. The team-mood rating is as positive as the performance rating. The team mentioned that there was nice interaction within the team, good energy, and progress. The team followed the first half of the double diamond of the Design Thinking process. This double diamond can be found in appendix 3. The discovery and define phase up to the empathy map helped them towards their first iteration.

Master Thesis – J.J.W. Weide – University of Twente

At the end of the first day, the team had their iteration 0. After this iteration the team will continue working with ideation and prototyping in the next days of the case study. Concluding observations of the first day were that the process towards the first iteration went smoothly, where the Design Thinking process was followed according to the guidelines. The team made good use of external information, to understand the hypothesis and to collect data on the OKR case. Iteration 0 was done so early in the process, as this is recommended in relevant literature. This iteration had helped the team to have a common understanding to continue working with the Design Thinking process towards Iteration 1.

4.2.2. Iteration 1

On the second day, there was continued working with Design Thinking and the OKR case. On this day they continued working with the second half of the double diamond. Following the Design Thinking process, they continued with the ideation phase. Trying to find the needs and pains of the customer. Also, the first realization of the concept was created. Accordingly, the prototype was tested on some employees of the consulting firm. Meaning the Design Thinking team made use of external input again, as well as they continued using it throughout the process. With their tests, feedback was clustered and implications for the next day were created. On the second day, the Design Thinking team made great efforts again regarding the OKR case. Additionally, the Design Thinking process helped them to move so quickly from having no understanding of both Design Thinking and the case, to prototyping already. Participant Design Thinking 1 mentioned that new things are designed pretty fast and external feedback is good and helpful. Team-mood rating, as well as performance rating, are scoring 5 out of 5 on the second day of the case. There are some signs of correlation between performance rating and team-mood rating visible already. This will be elaborated on later in detail.

At the end of the second day, ideation and prototyping were gone through by the team for the first time. For the ideation, the team made use of a visualization, which was used during interviews as well. Regarding the prototype, the team had developed a PowerPoint presentation with their answer to the OKR case, namely the OKR as a Service. Finally, the last thing that was done by the team on the second day was testing their prototype. The prototype was presented to people in the office, after which feedback was collected. The team closed the day by a group discussion what the most important input was form their testers. There was made use of the feedback grid, to structure the feedback and see where the improvements are, see figure 6. First feedback on the prototype the team received was that there is too much information on the slides, what the point of attachment is (when and how to use) and to make the concept more understandable and simpler.
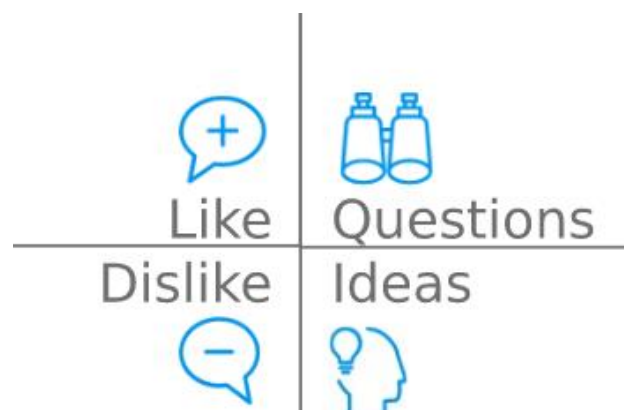

Figure 6: Feedback grid (Personal Communication, 2022)

Master Thesis – J.J.W. Weide – University of Twente

The team continued working on the OKR case on the third day. On this day they started going over the Design Thinking process again. First, refinements were made on the discovery and define stage of the Design Thinking process. All this was done based on the input and feedback received from the interviews on the day before. Furthermore, the team held a couple of internal interviews again to gather a clear perception on OKR. Accordingly, they worked on their prototype to point out the OKR method more clearly. Also, the pain points regarding the OKR method were investigated. This helped the Design Thinking team to bring more refinements to the ideation and prototyping phase. One of the participants mentioned that the Design Thinking method is completely new for them, but they are quite surprised in what they managed to achieve within just 2 days. Additionally, it was mentioned that how the Design Thinking method is structured, there is much space for creativity and to overthink everything.

However, the feedback that was received from one of the participants, observations of the third day were different. It was observed that the Design Thinking team made less progress on the third day, when comparing to the previous two days. This was also in line with the daily reporting of the team members. The performance rating was scoring an average score of 3/5. It was mentioned that they had troubles with sticking to the timetable and that they had changed it during the day. Also, this day was less structured than the first two days. Since the performance rating declined, the team-mood rating also fell. Although the mood was still quite okay, it was mentioned that they were a little lost on the task which influenced the team-mood. Another participant mentioned that they were less motivated as in the beginning.

At the end of the third day, Iteration 1 took place. During this Iteration, a similar approach was taken as during Iteration 0. The feedback grid was used again. However, this feedback grid was used more often by the Design Thinking team, as their process was generally speaking well-structured. This Iteration helped the Design Thinking team to process all feedback that was received from the internal interviews, and to come with an action plan of how to continue working towards Iteration 2, which is also the final Iteration during this case study. Although the Design Thinking team is making good use of external information sources, there has not been any contact with people outside the company. So, there is still no contact with potential customers, which could give other insights or points-of-view which can influence the outcome of the OKR case.

4.2.3. Iteration 2

On the fourth day of the case, only two team members worked the entire day on the OKR case. Other members worked less than one hour. Another ideation round was started to make the services clearer. Results were clustered and services were worked out in individual work. The services the Design Thinking team wants to provide to the OKR case were redefined and put in the pitch again. Ultimately the new parts were tested and provided with feedback. What the Design Thinking team did was before they actually tested their prototype, was squeezing all questions from the day before to three main questions and develop solutions to these questions. Generally speaking, the team-mood made improvements in comparison to the day before. Same for the performance rating of the team. Due to the good team-mood, criticism is problem focused and handled like that by everyone, mentioned participant Design Thinking 1.

After an off-day and the weekend in between, two participants continued working on the OKR case again. It was immediately observed that the team changed a massively. From large improvements at the beginning of the case study, to little refinements of the case. However,

because of these little refinements, almost all members had the feeling their productivity declined. This was influencing both performance and team-mood rating. Participant Design Thinking 2 mentioned: *''the progress is much more in the detail and therefore feels like not achieving as much as in the beginning''*. Although the team-mood is still good, motivation declines, which pulls down the team spirit as well. Yet, cooperation between all members is still good and problem focused.

On the final day the Design Thinking team worked on the OKR case, the final Iteration took place. During this Iteration the team went straight to the ideate phase. This was also in line with the expectations because refinements were continuously made during all previous days and the feedback that was received, became also less. It was observed that the Design Thinking team only made use of communication within the consulting firm. Only on the last day, one day before the deadline one of the participants asked if there was a possibility to test their prototype with one of the potential customers, as described in the value hypothesis of the OKR case. Due to the short notice of this question and the upcoming deadline of the comparative case study, this was not possible anymore. Therefore, all information of the Design Thinking team is based on internal feedback. However, it was expected that the Design Thinking team would at least conduct a few customer interviews, to get a better understanding of the market environment.

4.3. Stage-Gate

Similar to the Design Thinking team, team Stage-Gate invested roughly half a day to have a common understanding of the method. The Stage-Gate team had a little struggle with their first half of the day. There were many uncertainties towards the Stage-Gate method due to the fact that this method was completely new to them. Next to that, the value hypothesis of the case was not clear to their understanding. After the value hypothesis was explained, also the method of Stage-Gate became clearer to them. Yet, the process of Stage-Gate is somewhat incomparable to the Design Thinking process. Before the Stage-Gate team entered the Stage 1: Scoping, they first jumped into idea generation. According to the literature, idea generation is important for the discovery or to uncover and/or generate new ideas and business opportunities (Edgett, 2015; Cooper, 2008). Although the Stage-Gate method is a non-linear approach (Cooper, 2008), this section is structured according to a chronological order of the stages and gates.

Gate 1 -> Preselection: Which alternative do we go with and why?
Gate 2 -> Rough profitability (cost factors, willingness to pay, comparison of customer and firm)
Gate 3 -> market analysis (target group, target size), legal aspects, project plan (rough), business case
Gate 4 -> quality check, profitability and financial review, tests/proof of concept
Gate 5 -> plan-actual comparison, critical screening

Figure 7: pre-defined gates

During the first half of the first day, something that was noticed was that the gates were pre-defined by the Stage-Gate team. Although the literature provided to the team provided some guidance on the gates and how to proceed at each gate, it was positive that the team was thinking of it and trying to understand the gates as best as possible. In figure **7** the pre-defined gates can be found. When there is referred to a certain gate in this section, references are made to the pre-defined gates by the team, unless stated otherwise
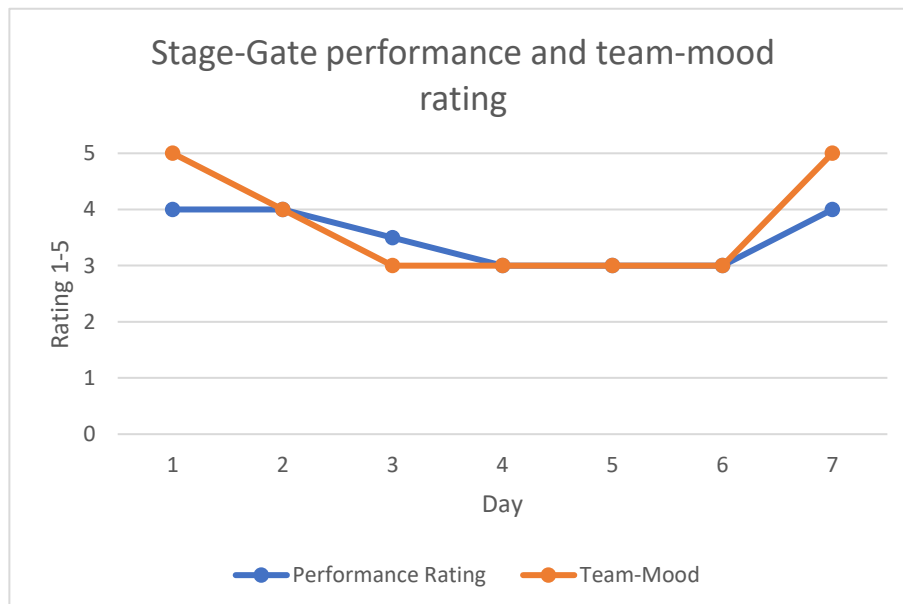

Figure 8: Stage-Gate performance and team-mood rating

Similar to both team Design Thinking and Freestyle all members of team Stage-Gate filled in the performance and team-mood rating at the end of each day. The pattern of team Stage-Gate is slightly different than the pattern of team Design Thinking. These differences will be

Master Thesis – J.J.W. Weide – University of Twente

explained later. Team Stage-Gate started with a very good team-mood rating scoring the maximum number of points. Whereas this declined to a score of 3/5 on day three. As from day three, this score remained at the same level until the lowest point was reached on the last day (effective working days) the team was working on the case. Performance ratings given by the team started with a score of 4/5 on the first two days, after which it decreased to 3/5 the rest of the OKR case study.

4.3.1. Idea generation

On the first day of the case study, team Stage-Gate started with the idea generation for the OKR case. During the idea generation there was not made use external input from the team. Meaning that no external information was collected in the uncovering and generation of ideas and opportunities. Although, the idea generation process went very well with the team. Regarding the case, distinctions were made regarding Objectives and Key Results and what the vision and business goals of the case are. The team came up with four different product parts, forming the idea, to develop further later in the process.

At the end of the first day, the Stage-Gate team arrived at the first gate. According to the literature of Cooper (2008), this was according to the planning. Namely that the first phases are less time consuming than later stages. It was observed because the pre-defining of the gate was done, that this gate can be quickly passed. There were no struggles so far with the Stage-Gate method. All teams members were dedicated to stick to the method without influence from any other methods. Member Stage-Gate 1 mentioned that it is interesting to work with another approach as they are used to. The team rated their performance 4/5. Main remarks were that the team had some misunderstandings regarding the OKR case and accompanying hypothesis. It was also mentioned that they did not have a coach for the method. The team-mood rating of the team was very positive, as can be seen in figure 8. Maximum scores regarding the team-mood were given by all team members.

4.3.2. Scoping

At the end of the first day after the first gate was passed, the Stage-Gate team already started with the scoping stage. They continued working with scoping on the second day as well. In the scoping stage, a preliminary SWOT table was created. Also, the market, technical aspects and the costs were defined on a preliminary basis. At the end of the second day, the team arrived at gate 2, rough profitability. Motivations according to the team to pass this gate are: *'' We believe there is a large market for the product. Studies have already been conducted and the interest of 10% of the customers is considered realistic. It should also be mentioned that the product can lead to long-term cooperation and open more customers.''* However, the OKR value hypothesis, namely that 10% of the current customers are potential buyers is not validated by the Stage-Gate team. Something both the Design Thinking and Freestyle team also not did do.

Performance ratings of 4/5 were given by the team. They did need to circle a little back to define the gate a bit more clearly. According to Cooper (2008), this is rather normal in a Stage-Gate process since it is a non-linear process where sometimes you have to go back to continue. Additionally, the team mentioned that they were ahead of schedule at the end of the second day and that good progress is made, especially during the first two days. The team-mood rating is scoring an average of 4/5 as well (similar to performance rating). Participant Stage-Gate 3 mentioned that there is a good team spirit and good progress right from the start. However later there was a lack of motivation. This lack of motivation might have a relation with the fact that

the team was ahead of their schedule. The ratings given by the team are in line with the observations. Main observations were that the team-mood is quite good as well as the interaction within the team. Working with the Stage-Gate method is still going according to the schedule. Yet, it is important to mention that the Stage-Gate team is not making use of external communication outside of the team.

4.3.3. Build Business Case

At the end of the second day and day three the Stage-Gate team started with the second stage, building the business case or also called the definition (Cooper, 2008). During this stage, the Stage-Gate team started with the creation of a Business Model Canvas (BMC), by Osterwalder et al. (2010). This BMC is filled in based on desk research by the team, as well as several internal interviews. Meaning that although the Stage-Gate approach also is a user-centred approach towards the innovation process, it took three days before external communication was used. Similar to Design Thinking, these interviews were held internally at the consulting firm. Additionally, the Stage-Gate team worked on a project plan, as well as more detailed requirements for the OKR case. Next to that, the Stage-Gate team conducted research on the technical aspects, regulations, and justifications.

It was observed that the Stage-Gate team made less progress than in the days before. However, this was also expected, because the first stages in the process are less time consuming than when you get further in the process. Although it was expected, for the team it was a little disappointing. Their performance rating was slightly lower than the days before as well as their team-mood rating. Participant Stage-Gate 4 mentioned: *''motivation is a little low, but that is because we have to wait for interview partners. So, it drags on a bit''*. Participant Stage-Gate 3 mentioned: *'' Mood is okay but we haven't spent a lot of time with each other due to other work activities/interviews. Not as fun as the other days/no lunch breaks together etc.''*. However, the contrast with the days before is large. Because the team was first ahead of schedule where it seems to be that they have the feeling they get behind of schedule, because of the lack of motivation and the time that is consumed by doing the interviews. On the next day the team was working on the OKR case, almost all team members did work for only one hour on the case. During that day, summaries of the conducted interviews were made. This to get a better understanding of the market, and to prepare themselves to pass the third gate, on the next day the team will be working on the case.

The third gate was passed on the fourth day the team was putting time and effort into the case. Regarding the gate, the Stage-Gate team followed their pre-defined gate description. Before the team made the decision to continue to the next stage, the feedback of the interviews was processed, and changes were made to the stage of building the business case. Ultimately, halfway in the morning the third gate was passed, and the team moved to the third gate, which is the development stage.

4.3.4. Development

Most of the team members invested the rest of the day working on the development stage of the Stage-Gate process. In this stage, a detailed project plan to the OKR case was developed, including a phase-by-phase approach the consulting firm can take. It is recognised that this detail plan is well-structured and thought out. However, the outcome of the OKR case is not applicable to this research since the focus is only on the innovation process. It was observed that the team was raising questions regarding the OKR method, as well as the difficulties they

had regarding proceeding with the OKR case. The rating of their performance was rather positive during that day. Mainly because good progress was made by the team, but the observations were confirmed by their daily reporting. One of the participants was mentioning that it is increasingly difficult to define the OKR product, since they are not OKR masters. During this day the Stage-Gate team worked also remotely. This also had influence on the team-mood rating because the spirit is different in comparison to working in real life.

In the next two days the Stage-Gate team had similar pain points, as the day before. Progress that was made became less. This also had a negative influence on the team-mood rating. Even some frustrations came out, because one of the participants mentioned that it is frustrating to not be able to do anything, without asking someone else. This resulted in various blocking points for the Stage-Gate team. According to the team, they were not able to progress in the Sage-Gate method, because the stages and gates require them to be specific, which the team was not able to do. One the final day before the closure of the OKR case study the team met again, and both the performance rating and the team-mood rating went up again. During this day the team worked on the final presentation of the OKR case.

However, the team was not able to continue to stage 4, testing and validation. This was because they were not able to pass Gate 4, because they were not specific enough in terms of information and knowledge on the OKR case. Cost estimations for example were not as specific, because this was not in their field of expertise. Therefore, the Stage-Gate team worked successfully up to and including stage 3 but were not able to continue working further. It was expected that stage 5 was not able, because this is just not feasible within ten working days, however stage 4 would have been possible to reach by the Stage-Gate team, according to relevant literature.

4.4. Freestyle

Team Freestyle had a completely different start than the other two teams. This mainly had to do with the fact that there was no predefined method or structure the team could start working with. Next to that, team Freestyle started off remotely, whereas the other two teams started the project working face-to-face. It was recognized that starting off a new project remotely comes with extra challenges in terms of communication and coordination of tasks. This in combination with not working according to a method resulted in a tough start of the case for the Freestyle team. Team Freestyle also filled in at the end of each day they were working on the case the daily reporting in terms of performance rating and team-mood rating. In figure 9, the team-mood and performance rating of team Freestyle can be found. In the figure, the ratings for seven days can be seen.
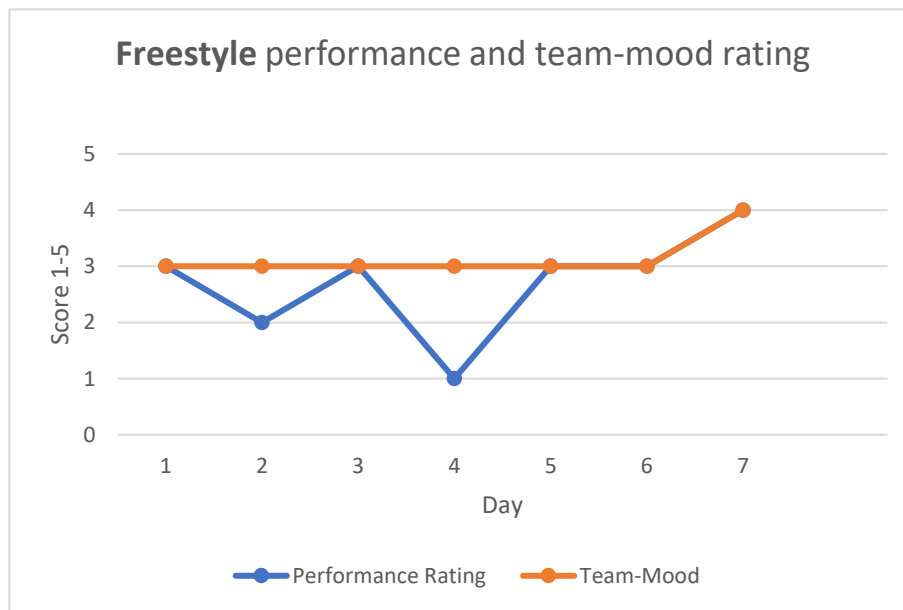

Figure 9: Freestyle performance and team-mood rating

It can be immediately seen that the performance and team-mood rating of team Freestyle are significantly lower when comparing them to Stage-Gate and Design Thinking. The team-mood rating was not scoring higher than 3/5 until the last day when a score of 4/5 was given. The performance rating started at a score of 3/5 after which it was going back and forth to a lower score.

4.4.1. Brainstorming

After the Freestyle team met remotely, first steps that were taken by the team was investigating the OKR method, to create a common understanding on the case. It was observed that the problem definition room was neglected. The team immediately jumped in the solution mode. According to the literature, this is an intuitive move when working on new ideas or innovation (Schmarzo, 2020). After there was already spoken about the solution to the OKR case, the team decided to use brainstorming to preliminary work out their solution and to get an understanding of the value hypothesis of the case. Key figures in product development were used by them to structure their brainstorming to some extent. After the first day the team rated their performance rating a 3/5. Participant Freestyle 3 mentioned that the start was a little chaotic and that they did not work as efficient as they could have been if there was worked according to a structure. Additionally, it was mentioned that challenging factors within the team were the different personalities in terms of common understanding, adaptation and thought

process. Also, starting of remotely as a team also did not have a positive influence on the performance of the team, according to all members.

On the second and third day of the OKR case, the team continued working remotely. On the second day all participants worked individually on different parts for the case. Parts that they have been working on were market / competitor analysis, product definition and example and the OKR example. As described above, that the problem room was neglected and participant Freestyle 1 presented a potential idea for the solution. During the second day, all team members put merely half a day of work into the OKR case. In comparison, the other two teams invested already two full days on the case. During the second day, performance rating was scoring only 2/5. Participant Freestyle 3 commented that the work that was put in was not equal. So, one team member invested more time into the OKR case as the others. Additionally, the Freestyle team did not come up with shared ideas during their meeting. The only focus they had, was to understand the solution that was presented by one team member. The team did spend many times talking about general management concepts. The team-mood rating came down to an average of 3/5. However, this was only achieved because the team tried their best. The longest time of the day the team-mood rating was around 2/5, because of the gap of understanding of tasks, knowledge, and frustrations.

4.4.2. Half-way observations

The start team Freestyle made is very different than the start the teams made that are working according to a method. On the third day, there was no team meeting by the Freestyle team and all members worked individually on the tasks that were divided the previous day. On the fourth day the team members were going to meet each other for the first time in real life. Because of that, they are preparing their own tasks to present it the next day. Because all members are excited to meet each other in real life, the team-mood is staying at the same level, although there is very little interaction between all members.

Early in the morning all participants of team Freestyle met for the first time in real life. From a researcher point of view, this looked like a new start of the project. During the conversations early in the morning it seemed that the participants agreed with this, because of the little progress that was made so far. However, because the Freestyle team is not working according to a method or a certain structure, there is the feeling that something is missing. During the fourth day, performance rating was 1/5. This was because the group did not deliver new results. During the day discussion between the team members were getting heated and frustrations rose because a common ground was not found. However, after the researcher acted as a mediator to calm things down, a common understanding was created. This common understanding was in terms of both teamwork, the case, and an agreement on the product. Additionally, an agenda for the next day was set by the team, to try to work according to a schedule to make cooperation easier for them. On the next day, the team continued working in the office. According to the team good progress was made and the team-mood rating still was okay. From an observer point of view, the Freestyle team did waste a lot of time in finding common ground regarding both the OKR case and the working style of each other. Also, the Freestyle team lacked in finding a certain method for themselves, although before the start of the comparative case study a Miro board was already established for them, with various hints to use pre-made templates to structure their innovation process.

Master Thesis – J.J.W. Weide – University of Twente

4.4.3. Final observations

During the last week of the comparative case study, all participants invested roughly 3-4 hours a day working on the OKR case. On the effective sixth day of working on the case, the Freestyle team interview questions and partners were defined by the team. The team reached an agreement on doing research, on how competitors sell OKR and what the consulting firm has to offer. The team set the deadline for the interviews on Thursday. During the next day, the team talked through the interviews so far and used this input for their own OKR case. However, very little results were booked again. During these two days, both teamwork and performance rating were scoring an average of 3/5.

The last couple of days of the comparative case study the team was still struggling with their Freestyle method. Next to working on the OKR case, the team was preparing their presentation for the last day. Final observations were that the teamwork within the Freestyle team had difficulties along the way, which were mainly caused by that there was no certain structure that was followed by the group. Additionally, team members had different understandings on both the task, the subject OKR and group work. Therefore, the time invested by all team members was not optimally used and sometimes even wasted, because days were spent where no results were booked by the Freestyle team.

4.5. Method differences

In the three paragraphs above explanations are given on how the different teams were working with their methods on the OKR case. Explanations were given regarding both team-mood and performance rating. To start off, each team had a different approach towards the case and the way of working in a team. In figure 10, the differences in performance rating can be seen. It can be immediately seen that the performance rating of team Freestyle is generally speaking lower than the other two methods. Only on day six and seven, the rating is in line with the performances of the two other teams. Design Thinking and Stage-Gate are share many similarities. Both teams shared a good start of the case. It is explainable that Design Thinking is scoring a little higher on the first two days, because there was made use of many external information and input. Towards day four, performance rating of team Design Thinking and Stage-Gate declined, because both teams peaked in terms of output on the first days and were getting stuck later in the process.
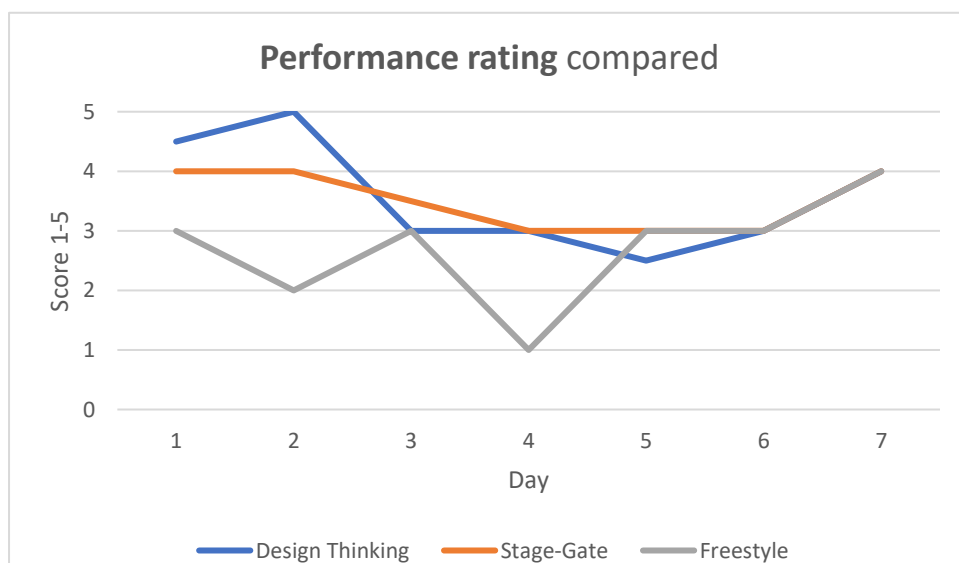

Figure 10: Performance rating compared

Master Thesis – J.J.W. Weide – University of Twente

In figure 11, the team-mood rating compared can be found. Both team Stage Gate and Design Thinking started with a rather good team-mood, which is also in line with their performance rating. On the third day their performance rating declined, as can be seen in figure 10. Similar to their team-mood rating, that also declined. This was also observed at both teams because results and achievements were not as great as the first two days anymore, the mood within the teams went down. However, it needs to be mentioned that both interaction and cooperation continued at a decent level. As from day three till day six the team-mood rating of both Stage-Gate and Freestyle remained at an average of 3/5. This was caused by the Stage-Gate team because of the team was working remotely. At the Freestyle team this was caused because of having troubles with not working according to a method as well as having difficulties in finding common ground towards the OKR case. By all three teams the team-mood went up on the last day. This was caused because all participants were feeling somewhat happy that the OKR case is almost over, and what was achieved in a relative short time frame.
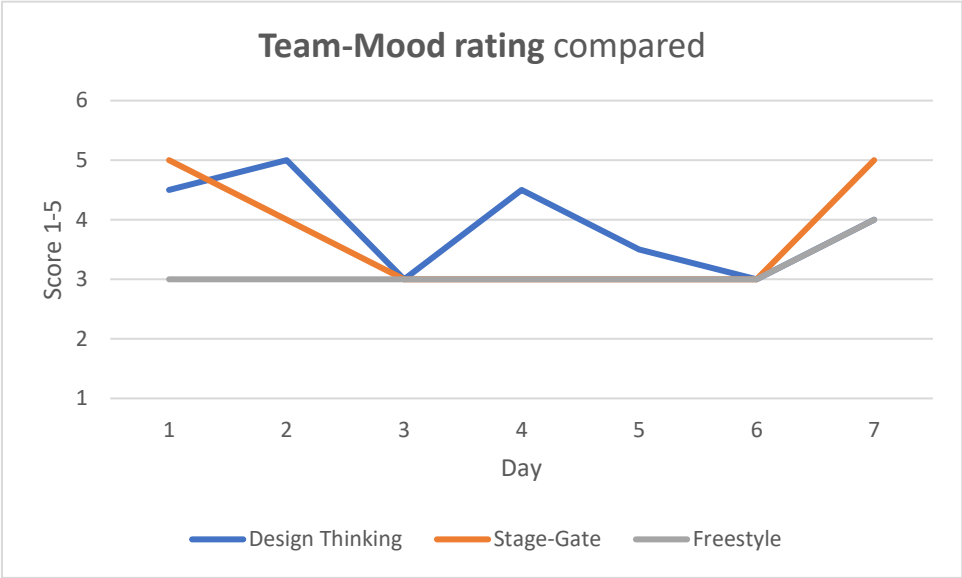

Figure 11: Team-Mood rating compared

5. Conclusion and Discussion

5.1. Conclusion

This research was conducted using a comparative case study, to answer the following research question: *''How can firms increase the efficiency and speed at the fuzzy front end of innovation - investigating Design Thinking and Stage-Gate as methods?''*. To decrease the complexity, three sub-questions have been formulated: (RQ1) *''What different methods are there for the improvement of the innovation process – how do they address the problems of innovation?''*, (RQ2) *''What can be the effect of the different methods on the innovation process – based on a comparative case study?''* and (RQ3) *''What is the most suitable- or combination of methods according to the research?''*. The results are mainly based on the comparative case study at the consulting firm, with enhancements of relevant literature.

To start-off and answer the research question the efficiency and speed at the fuzzy front end of innovation can be increased by working according to a certain method. This research has shown that both Design Thinking and Stage-Gate were outperforming the team which was using no method at all. Working according to a method improves the creativity, as well as the ideation at the beginning of a project. Since both Design Thinking and Stage-Gate are user-centred approaches towards the innovation process, the problem room of the case was not neglected (Mueller & Thoring 2012; Edgett, 2015). By team Freestyle, the problem room was neglected, because they used their intuition and moved almost directly into the solution room. The other two teams did really think about the problem, avoiding the intuitive move to the solution. Therefore, working according to a method, positively influences the innovation process for companies. When looking further at Design Thinking and Stage-Gate, no significant differences on the influence of the innovation process can be found. Main difference is that when working with Design Thinking there is made use of external information earlier in the process. Whereas Stage-Gate made use of external information once they had a clear understanding of the project. Additionally, the Design Thinking team was the team which have spent the most amount of time on the case, as well as the greatest number of days being present in the office. This positively influenced the innovation process in terms of common understanding, creativity, and cooperation.

As mentioned above, it can be concluded that working according to either Design Thinking or Stage-Gate can be used to increase the efficiency and speed at the fuzzy front end of innovation. Therefore, according to the research both Design Thinking and Stage-Gate are both suitable methods to increase the efficiency and speed at the fuzzy front end of the innovation process. Yet, it is dependent on the preferences of a company, which method is the most appropriate for them. This is prompt to future research, to find out which method towards the innovation process suits what company culture the best. Also, there might be an influence of the sector/industry a company is active in; however, this needs to be proven.

This research has shown that working according to a method is especially important at the beginning of a project. Over time, the relevance of the method decreases. Therefore, at the start of a project working according to a method has the most added value. At both Design Thinking and Stage-Gate it was shown that there was a drop of achievements and results around the third day of the comparative case study. This was due to the fact that in the first days great results were booked, but after a few days this stagnated. Also, having ten full days at the fuzzy front end of an innovation project is rather long. Therefore, the conclusion can be drawn that it will

be more efficient and effective, when one working week is used to start-off a new project. This is because the attention of participants as well as focus will remain. After one week, there can be chosen to either continue working according to the method or stop using it. Since it is especially of added value at the beginning of the innovation process.

An additional conclusion that can be drawn from this comparative case study is that it does make sense to start a project in real life and not remotely. Both Design Thinking and Stage-Gate have shown that it improves the team effort, creativity process and especially the understanding of the common goal. Whereas the Freestyle team did start remotely, where it took an additional of three days until the common understanding of the case study. Later in the process the Stage-Gate team worked remotely for a couple of days. This influenced the performance and team-mood rating negatively. Therefore, it is recommended for companies to invest time and resources, where people are able to work on a project simultaneously.

5.2.   Discussion

During this research, a comprehensive approach was taken to analyse the effect of Design Thinking and Stage-Gate, on the fuzzy front end of the innovation process. A comparative case study was carried out. This was done at a consulting company, which has the size of a SME. During this case study, three teams all working according to a different method, worked on an OKR case, and accompanying hypothesis, provided by the company. The comparative case study took in total ten working days, meaning that it is not a full development cycle but the start cycle of the innovation process. During the comparative case study all teams were reporting on the same aspects, namely performance rating and team-mood rating. Additionally, reporting was done on activities, results and time invested.

In the first three days of the comparative case study, it was directly observed that there was a large difference in the use of external information and communication. According to Mueller & Thoring (2012); Edgett, (2015), both approaches involve potential users, customers and/or other stakeholders through each subsequent stage of the innovation process. However, Stage-Gate made use of this as from the third day, where Design Thinking made use of it from the first day. But, both teams only made use of involvement of internal people (from the consulting firm) and not of any customer interaction.

The literate study did not offer a solution which method would be best (Edgett, 2015; Tschimmel, 2012). The comparative case study offered a similar solution, meaning that there is no significant difference between either Design Thinking or Stage-Gate to this research case. According to Cooper (2008), the Stage-Gate process is a non-linear process. This research showed that the Stage-Gate process shows a more linear approach as the Design Thinking approach, which is an approach with system overlapping spaces according to Tschimmel (2012). It was shown that Design Thinking circles more back and forth, whereas Stage-Gate mostly continuous without looking at prior stages.

Literature has shown that both Design Thinking and Stage-Gate are processes to solve problems in the innovation process. This was confirmed by this comparative case study. Both methods thoroughly investigated the problem space. After this was defined work continued finding a suitable solution to the case and accompanying hypothesis. Additionally, this research showed that the team with no method made the least progress during the starting cycle of development. Thus, increasing the efficiency and speed at the fuzzy front end of innovations

shall be done using an innovation method. This can be either Design Thinking or Stage-Gate, since in both literature and this research no significant differences are shown.

5.3. Limitations and Further Research

This research and accompanying findings are based on a comparative case study that was carried out in collaboration with a consulting company. The theory is consisting of general information regarding the methods and is therefore not industry specific. The case study is carried out based on the availability of employees of the consulting firm and a pre-selection has been made. Although after the pre-selection the teams were randomly selected, it is based on a convenience sample. This, in combination with the OKR case study relevant for the company, is at this point not one hundred percent possible to validate whether the range of results found in this research can be directly applied to other firms with different characteristics/cultures. As already described in the conclusion, it is dependent on the preferences of a company, which method is the most appropriate for them. This is prompt to future research, to find out which method towards the innovation process suits what company culture the best. Also, there might be an influence of the sector/industry a company is active in; however, this needs to be proven.

Additionally, no significant difference between either Design Thinking or Stage-Gate were found in relation to the research question. This is also key to further research, whether to investigate on a larger scale which of the methods is most suitable for which industry sector. Given the fact that this research mainly had the focus on the start cycle of the innovation process and not on the full development cycle, outcomes might differ when the full development cycle will be investigated.

The survey was conducted among the participants of the comparative case study. The first time the survey was distributed the participants knew already in which team they were participating. Consequently, the survey was only distributed among the ten participants, which still gives a good representation for this research, however additional research is needed to rule out if these results are indeed representative for various companies and industries.

Finally, this research is mainly based on participant interaction and input. As also can be read that various teams worked some time remotely, where other teams were interaction with each other. Because of this, a bias in team-work perception can arise. Future research can focus on the effects of teamwork and working according to a method, in one case study.

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Appendices

Appendix 1

Hello, thank you for participating in the comparative case study, towards the innovation process. Please fill this survey as precise as possible in. Data will be used for further analyses, to draw conclusions on the participants perception and feeling when using the various methods. You are asked to fill in this survey at the end of day 1 and 6.

Questions:

1. Which of the following methods has the highest chance of succeeding?
   a. Design Thinking
   b. Stage-Gate
   c. Freestyle
2. Why do you think that?
   a. Text box, please elaborate
3. In which team are you participating?
   a. Design Thinking
   b. Stage-Gate
   c. Freestyle
4. Are you already familiar with the method you are working with?
   a. Scaling from 1-5, where 1 is Low and 5 is High
5. Do you understand the method you are working with (based on provided materials, discussions, and further individual research)?
   a. Definitely yes
   b. Probably yes
   c. Might or might not
   d. Probably not
   e. Definitely not
6. How is your feeling towards the method?
   a. Scaling from 1-5, where 1 is Bad and 5 is Good
7. How do you think using the method will influence the innovation process?
   a. Very Good (Very positive influence)
   b. Good (positive influence)
   c. Neutral (no influence)
   d. Bad (negative influence)
   e. Very bad (Very negative influence)
8. Are you happy with the results so far?
   a. Scaling from 1-5, where 1 is Low and 5 is High
9. How would you rate the results so far?
   a. Scaling from 1-5, where 1 is Low and 5 is High
10. How would you rate the process (working with the method) so far?
    a. Scaling from 1-5, where 1 is Low and 5 is High
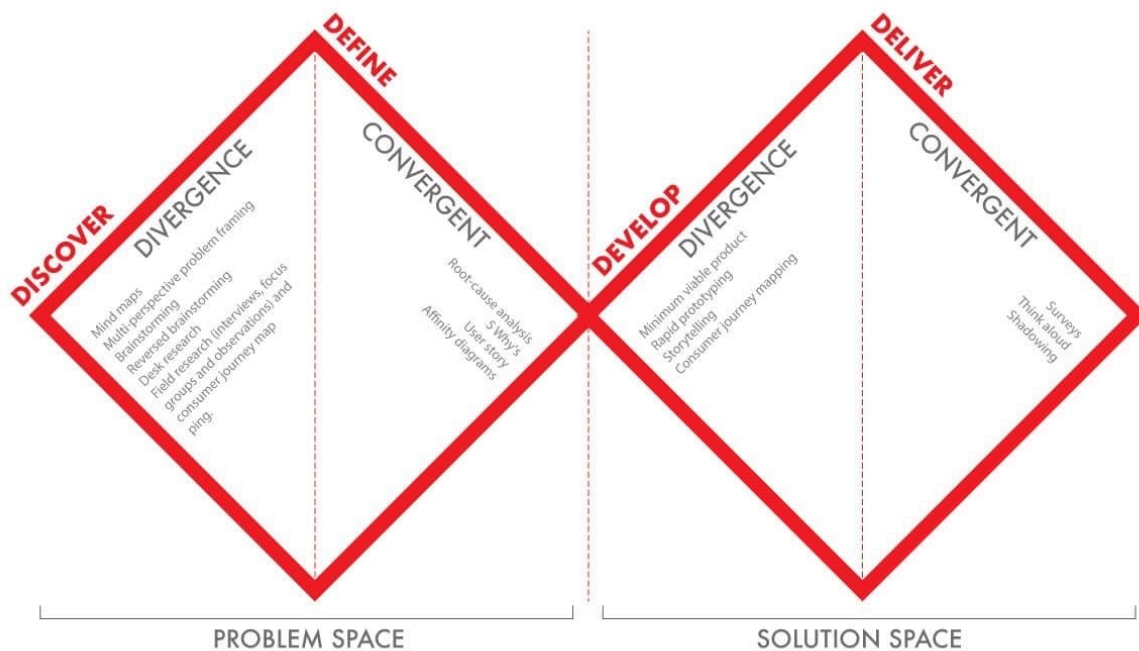
Appendix 2

(Cuofano, 2021)

Appendix 3

(Ball, 2019)

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