STORYBOARDING
FRAMING AND REFRAMING OPPORTUNITIES
IN THE FRONT-FRONT END OF INNOVATION

Anders Wikström
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STORYBOARDING
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Akademisk avhandling

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Abstract

This research proposes that design and visual thinking in combination with narrative theory contribute to enhance knowledge of innovation processes and support managers in their work. In particular, the focus is on the use of Storyboarding to support a better definition of a project’s brief. Innovation studies have shown that the initial phases of innovation processes (typically called the “front end of innovation”) are crucial for success. A proper definition of a brief, that occurs at the front of the front end, is therefore one of the most relevant events in innovation. This study investigates the early phases of innovation by developing and evaluating a new method for developing a brief.

First, an explorative approach has been used in order to develop knowledge of challenges in the front end of innovation and how design thinking, visual thinking and narratives can bring new insights in teamwork. In this explorative search the use of case studies has been employed. Then, the explorative search has focused on the use of Storyboarding as a tool for reflection, and in particular for igniting dynamics of framing and reframing of innovation problems. Finally, in order to create a deeper knowledge in the use of storyboarding three hypotheses has been evaluated, four experiments has been conducted with the involvement of more than 60 people defining innovation briefs. In these experiments, storyboarding (visual and narrative) has been used to support “thinking” that leads to the brief. In other words, storyboarding has been seen as a process to enable innovation teams to think differently or more precisely, rather than just a tool to represent or to communicate the brief. The experiments show that using storyboarding has effects that can support innovation management. First, storyboarding is useful if management wants to “stimulate” a reflection on meaning when developing a brief, i.e. when they want an innovation team to consider both utilitarian and emotional/symbolic factors in an innovation process. Second, Storyboarding brings a narrower focus, compared to traditional written briefs, within the “area of interest” brought up by management, which sometimes may be asked for when the organization is in search for reframing the direction of innovation.
Abstract

This research proposes that design and visual thinking in combination with narrative theory contribute to enhance knowledge of innovation processes and support managers in their work. In particular, the focus is on the use of Storyboarding to support a better definition of a project’s brief. Innovation studies have shown that the initial phases of innovation processes (typically called the “front end of innovation”) are crucial for success. A proper definition of a brief, that occurs at the front of the front end, is therefore one of the most relevant events in innovation. This study investigates the early phases of innovation by developing and evaluating a new method for developing a brief.

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Sammanfattning

Denna avhandling föreslår att design och visuellt tänkande i kombination med narrativ teori kan bidra till en bättre förståelse och ledning av innovationsprocesser. Framför allt med fokus på användningen av storyboarding för att stödja en bättre definition av ett projekts uppdragsbeskrivning, eller som det kallas en ”brief”. Tidigare innovationsforskning har visat att de inledande faserna av innovationsprocesser (vanligen kallad “the front end of innovation”) är av avgörande betydelse för att innovationer skall nå framgång. En ordentligt utformad ”brief”, formulerad tidigt, i de inledande faserna av innovationsprocessen är således en av de mest relevanta händelserna för framgångsrikt innovationsarbete. Denna forskning bidrar till kunskap i de tidiga faserna av innovationsprocessen genom att utveckla och utvärdera en ny metod för att utveckla en ”brief”, storyboarding.

Först så har en explorativ metodik använts för att skapa förståelse för de tidiga faserna av innovation och hur metoder och teorier från design, visuellt tänkande och narrativ kan ge nya insikter i teamarbete. I denna explorativa del så har fallstudier använts som forskningsstrategi. Därefter så har mitt sökande efter förståelse fokuserats på användningen av storyboarding som ett verktyg för reflexion, och i synnerhet att formulera och omformulera inramningen av möjligheter för innovation. Slutligen, för att skapa en djupare förståelse av storyboarding, så har tre hypoteser utvärderats med hjälp av ett antal experiment med mer än 60 personers deltagande där team utvecklar en ”brief”. I dessa experiment så har Storyboarding använts för att stödja teamens ”tänkande” för att utveckla en ”brief”. Med andra ord så har Storyboarding setts som en process för att möjliggöra för team att tänka annorlunda eller mer exakt, snarare än bara ett verktyg för att representera eller för att kommunicera en ”brief”. Experimenten visar att användningen av Storyboarding har ett antal effekter som kan stödja ledning av innovation. För det första kan vi se att Storyboarding kan vara användbart om man vill ”stimulera” reflektion kopplat till innebörd (meaning) när man utvecklar en ”brief”, dvs. när man vill att ett team ska överväga både funktionella så väl som känslomässiga/symboliska faktorer i en innovationsprocess. För det andra så skapar storyboarding en ”smalare” definition, jämfört med traditionella skriftliga ”briefs”, inom det av ledningen valda fokusområde. Detta kan vara önskvärt när ledningen söker efter nya möjligheter för innovation.
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Eskilstuna in August, 2013

Anders
Publications

The dissertation is based on the following, appended papers. The letter in front of each publication (A-G) refers to the study presented in the thesis.


Wikström initiated the paper and made the literature review, data collection, and was the main corresponding author of the paper. Jackson reviewed and quality assured the paper.


Wikström and Jackson initiated the paper and made data collection and analysis. Wikström was the main and corresponding author of the paper. Jackson reviewed and quality assured the paper.


Wikström and Berglund initiated the paper and made data collection, analysis and wrote together.


Wikström initiated the paper and was the main and corresponding author of the paper. Data collection and analysis was made by all authors as a team.


Wikström initiated the paper and was the main and corresponding author of the paper. Verganti reviewed and quality assured the paper.


Wikström initiated the paper and was the main and corresponding author of the paper. Verganti reviewed and quality assured the paper.

Wikström initiated the paper and was the main and corresponding author of the paper. Everskog, Forsberg Wallin, Hyltefors and Larsen assisted the experiments and in analyzing the data. Verganti reviewed and quality assured the paper.
Additional publications
This is a list of additional publications by the author not included in the thesis.


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   6.1. General discussion
   6.2. Conclusion
   6.3. Academic and industrial contribution
   6.4. Limitations
   6.5. Future research
Introduction

During the last decades, several approaches have been used to explain and provide details about the areas of innovation. Rothwell (Rothwell, 1994) describes five generations of innovation models, of which the later ones are increasingly more complex and sophisticated, taking into consideration more elements. The descriptive linear innovation models dominated from the 1950s to the mid-1970s. Integrated and networked models then replaced them. Nowadays the trend is “open innovation”, where links and connections become as important as the actual production and ownership of knowledge (Chesbrough, 2003, Chesbrough and Garman, 2009). The latest trend is approaches synthesizing technological, organizational, and commercial aspects of the innovation process (Tidd and Bessant, 2009). Von Hippel (2005) also describes the non-linearity of the innovation process and further explains the concept of user-driven innovation.

Hence, complexity and dynamics seem to be agreed upon as significant concepts to understand innovation processes. However, when it comes to knowledge about what is done in these processes (which relates to innovating instead of business as usual), there is still much to be said. In short, what the verb innovate points towards in everyday practice in organizations still seems to be a mystery. Lundvall (2006) argues, for instance, that the interpretation of innovation has travelled far away from the early discussions that focused on how people – and their competences, relations, and interaction – contributed to newness. In contrast, innovation is in contemporary discussions often used as a parameter of understanding and explaining differences of growth between different nations, regions, and companies. Miettinen (Miettinen, 2002) have the same opinion but maintains that the economic theories contain a paradox, as the core theme – interaction between people – cannot be studied with traditional economic methods. A vital part of understanding the processes of innovation making is left unanalysed.

Innovations are an important factor in both the development of high technology companies and their success internationally. Companies need to manage continuous innovation and perform the development process in a good way. Their innovation capability needs to be on a high level. According to Jevnaker (1998), innovation capability is crucial for companies to be competitive in the market and to retain competitive advantage. Creativity, ideas, needs, problems, and new opportunities are some of the sources needed for innovation to occur.

Consequently, even though innovation is argued to be important for contemporary society, it is arguably difficult to know how to initiate and support innovating without a processual knowledge of innovation. Buijs (2007) argues that innovation processes are multifaceted and full of contradictions; he explains the process of innovation as quite different from a normal way of “getting things done”. However, knowledge of the process of innovation is something that could be acquired only by experience, by repeatedly performing innovative projects with a goal to create something new to present on the market.
In this research theories from design thinking and visual thinking in combination with narrative theory has been applied in order to contribute in developing the content of innovation processes and supporting innovation managers in their work (Figure 1.1). By merging design thinking, visual thinking and narrative with the construction of meanings in innovating we can develop new knowledge about the innovation process. And when the communities of innovation and design merge to meet the challenges and complexity in products, a different way of thinking is required, irrespective of whether the products are professional tools, machinery for production, medical equipment, daily consumer goods, services, or experiences.

Figure 1.1. The research area and its contribution.

1.1 Design thinking, visual thinking and narrative

Utterback et al. (2006) describe the importance of industrial design as a lever for innovation, and this way of designing is best known as “design thinking”. In the design field, industrial design is the competence enabling an overall integration of customer experience and needs into a product with the intended functionality, form, and other design values. This competence is essential for multidisciplinary projects requiring to capture “the whole”, focusing on the intended values that the product should communicate. Design thinking, is used to explain designerly thinking in an innovation management context, where designerly thinking refers to the theories developed in order to understand the professional designer’s practice. The discourse of designerly thinking is much older and more mature than the design thinking discourse. But by providing a clear link between innovation management and designerly thinking, the discourse of design thinking is valuable. However, as Johansson-Sköldberg et al. (2013) argues, “the design thinking discourse will most probably die if it does not acquire a scholarly base that relates more to designerly thinking” (p.131). This argument is adequate and this research provides an attempt to strengthen the link
between designerly thinking and design thinking, using theories provided in both discourses and clearly add value to innovation management. The theories develop by Schön (1991) regarding reflection in action as well as Lawson (2005) and Cross (2007) regarding the designerly way of knowing is central and combined with the work of Verganti (2009) who builds further on Krippendorff (2006) about creating meaning, is proposed to be essential to understand.

Design thinking is closely related to visual thinking which is important in innovation and design. The use of visual representations to support design practice in making new products is well known in the design community; however, as Arnheim (2004) argues,

“The value of visual presentation is no longer contested by anybody. What we need to acknowledge is that perceptual and pictorial shapes are not only translations of thought products but the very flesh and blood of thinking itself and that an unbroken range of visual interpretation leads from the humble gestures of daily communication to the statements of great art” (p. 134).

This opens up the discussion about thinking and mental imagery. Ferguson (1992) describes the evolution of visualization in engineering design and focusing on visual thinking as the language of engineers in the modern world. The creating of “the mind’s eye” is something that we do all the time by, in our memory, collecting images of remembered reality and imagined contrivance.

In companies, visual representations are valuable in communication between employees, especially if they have different roles in the design process. The enthusiasm for all kinds of images rests on the belief that they promote comprehension and learning and foster insight. Tversky et al. (2007) shows that visual representations relieve the pressure on human memory since they externalize memory and reduce processing load by allowing the understanding to be based on external representations rather than internal. When working memory is released, new information can be processed and creativity stimulated. In an era of more complexity in business, management, and products, this will release resources and create a better foundation for development work and decision making.

However, despite the importance of design and visualization in strategic work, it has only recently become a central issue in management (Chanlat, 2006; Liker, 2004). The notion of Visual Management (Greif, 1991) belongs to the field of visual communication. It mirrors lean production in factories from a visual communication viewpoint. Visual management focuses primarily on visual control in factories but also on the intricate relation between visual communication and management. Still, visual communication should not be isolated from management (Greif, 1991) and needs to be intertwined in the work of innovation management. However, the employment of visual thinking is still something rare in innovation management even though the final products of such thinking, visualizations, are used in order to communicate and manage the process of innovation.
Design thinking and visual thinking is related to making innovations (designers practice) while management practice is more related to stories of an innovation. Therefore the discourse of narrative theory has in this research been used from a point of view of conceptualization of innovation making and innovation telling. It is argued that knowledge can be distinguished when it comes to how innovations are shaped interactively and how language is used to explain innovative features in organizational contexts. And when using the narrative process as a way of learning as sensemaking (Weick, 1995), you bring new learning from the world of experience closer to the people involved in designing. Abbott (2008) also explains narratives as “representations of an event or a series of events”. However, narratives are not only constructions of meanings, but are a means of making and moving ideas in an organizational setting (Whittle and Mueller, 2008, Kelley and Littman, 2005).

The focus in this research is to increase the knowledge of innovation processes and how a combination of design thinking, visual thinking and narrative brought together as a method, storyboarding, can support innovation managers in their work defining a brief, framing and reframing opportunity for innovation in the front-front end of innovation (Figure 1.2). With a theoretical framework combining design, visual thinking, and narrative, new knowledge has been developed in the field of innovation management. In the context of storyboard, narrative is central since it is a way for individuals to organize their life and create order by connecting different parts of life into a coherent whole (Abbott, 2008, Czarniawska, 1997); a storyboard is one way of organizing events in a time frame in order to understand their context and appearance, creating meaning.

![Figure 1.2. Overview of the focus area.](image)
1.2 From storyboard to storyboarding

Within product and service development today the use of storyboards are common in order to explain a future service or the experience of a new service. However, the application of storyboarding as a process tool is new. Also the area of use is new, pre-brief activities.

The tradition of storyboards as a pre-visualization tool for the film industry starts in the early 20-th century with artists like Winsor MacKay and films like “Sinking of the Lusitania, 1915” and thrives from comics in its way of graphic storytelling and visual narrative form. The way of explaining verbal stories with frame-by-frame sketches like storyboards is a way of explaining the stories narrative for the entire production team involved in making a film. It also supports the organization of the team within complicated actions and support interpretation of the whole set before the actual filming takes place (Hart 1999). The use of storyboards in film industry is about creating visual manifestation of the verbal story, going from abstract to concrete in understanding the whole (Figure 1.3). When using storyboard the key is to explore the visual appearance of the scene and identify what kind of issues that have to be solved before realizing the concept. The mapping of action into visual appearance is a way of simplify and bringing clarity to concepts.
The reasons for developing storyboards are for making this low-resolution film of the verbal story and to prepare for the coming development. The storyboard emphasize problems at hand and gives visual information to different competence areas such as camera team, lightening team and so on, supporting planning activities. Different ideas can be evaluated quickly and at low cost and it is used to interpret what the viewers of the film will experience, it puts the viewer in focus. The meaning of this is that the pictures within the storyboard are for creating a mindset that influence the way we actually see what’s in the pictures and the way we create new knowledge in the interpretation of them.

Van der Lelie (2006) shows how storyboards can be used on two levels in design work; first as a way of experience the new design before it exists, and second; to reflect on the interaction visualized. This is just one example of using the finalized storyboard, there are more within the field of interface design (Haesen et al., 2009) and business strategy (Norton, 2009). However, this research interest lies in the use of storyboard as a process tool (storyboarding), the actual making of the storyboard, a tool to support thinking, framing and reframing a situation in order develop a brief. The application of storyboarding as a process tool is new and applying it to the pre-brief activities will be presented as my main contribution.

1.3 Problem statement

When developing innovations, a company’s management faces challenges due to ambiguities in the process and the uncertainty of a successful outcome. With a focus on creating innovative solutions, the use of creativity and design methods is advocated by researchers in the fields of business (Martin, 2009) and innovation (Utterback et al., 2006, Verganti, 2009). There is also significant evidence that the success of innovation depends on directions taken in the early phases of innovation processes, namely in what is called the “front end” (Bacon et al., 1994, Cooper and Kleinschmidt, 1995, Khurana and Rosenthal, 1998, MacCormack et al., 2001, Verganti, 1999). The phase of the front end is of great importance for the success of innovation; it does not matter how well the process is managed or the design realized if they are based on a wrong assumption regarding the problem (Cooper, 1988). In an attempt to bring clarity to “the fuzzy front end”, Koen et al. (2001) state that “the front end of innovation (FEI) appears to represent the greatest area of weakness in the innovation process”. Zhang and Doll (2001) highlight this problem and argue that the “front-end fuzziness is beyond management’s control”. They describe team vision building and knowledge sharing as making the problems connected with the fuzzy front end more manageable.

It is at this front end that opportunities are identified, major constraints are detected, and most of the final outcome is defined. Cross (2008) argues that the design brief (used to frame the opportunity for innovation for the design team) does not always get the attention and priority it needs and deserves in order to stimulate the team to carry out a successful project; if more focus can be put on developing the
brief, the design process may have a better outcome. Yet, as Paton and Dorst (2011) explain, there is little design research in the specific area of framing the opportunity for innovation except for a few groundbreaking works by Cross (2007), Lawson (2005), and Schön (1991). This is also the case in innovation management research according to Darsō (2001), who explains this phase in the following words:

“What happens before something turns up as a pre-project is rather obscure, in real life as in literature. At best it is described as a chaotic and turbulent phase with certain individuals as central actors who make use of internal networks, intra- and inter-organizationally” (p. 31).

The capability within companies regarding innovation is constantly developed. However, there is a need to develop methods to support these activities. And since research have focused on activities after defining a brief, such as idea generation, brainstorming and concept development, methods for defining a problem or even finding a problem is insufficient. This motivates the scope of this research, to create knowledge of the activities and characteristics of opportunity framing and unlock some hidden parts at the “front-front” end of innovation making.

The focus in this research is on the early phases of innovation, particularly where the information gathering around the context of the area merges with the formulation of the scope of the challenge framing the project, this phase is what I define as “the front-front end” of innovation (Figure 1.4). This phase is considered to be one of the most difficult ones in the entire innovation process (Dell’Era et al., 2011); this is also where you frame the entire project and create the foundation of the common mental image in the team and among management.

Phillips (2004) argues that a design brief is a “written description of a project that requires some kind of visual design”. He also states that the narrative format has worked best for him, but with a lack of information about how to construct this narrative format you are left to explore without the help of guidelines or examples. The formal requirements of the design brief could be listed in many different ways, but how to actually perform in the pre-briefing phase is not explained to any greater extent, even though one important question should be posed:

“What exactly is the problem to be solved?”
This question is something that haunts every manager at the front-end of innovation. There is, however, a need to understand how to improve the activities performed when creating a design brief. Today this work is done by management relying on broad interpretations of market research. This does not answer the need for radical innovations or new improved products and services. Companies today have begun working with design methodologies to solve problems, but when finding, framing, and formulating the brief, the traditional way of writing documents is still predominant.

Using design methodologies in this phase can be relevant according to five different characteristics or attributes (Nielsen, 2009):

- Designers tackle wicked problems and approach all problems as if they were ill-defined.

Since design work often starts with a written brief developed in the front end of innovation, the brief need to be formulated in a way that stimulate the designers work and support their approach to problems, and if designers approach all problems as ill-defined this must be supported by the brief.

- Designers are human-centred and have a myriad of tools and methods to approach the user (or the network of stakeholders).

When developing support for the front end of innovation, these support need to stimulate what is needed. In this case supporting a human-centred approach early, briefing a problem adds meaning into the brief and can support innovation driven by meaning.

- Designers co-develop the understanding of the problem along with the creation of the solution.

Using designer’s methods and tools in the early phases of innovation an understanding of the problem is co-developed with the brief. This brings new value to the brief since a deeper knowledge of the situation is already defined in the pre-brief activities performed.

- Designers use abductive reasoning and strive for a solution.

When developing a brief, a wish or a demand is defined. Through this a value to create is identified and this value stimulates the abductive reasoning designers employ.

- Designers engage in a reflective conversation with the situation.

The reflective conversation with the situation starts when new knowledge about the situation of interest is developed, i.e. when defining a brief.

This connects the innovation management with design thinking alongside the fact that designers use visual thinking in their creating of knowledge and in the reflective conversation with the situation. When innovating, management faces challenges due to the ambiguities in the process and the uncertainty of a successful
outcome, which calls for more research in the area of framing and reframing opportunities for innovation. Where framing and reframing is the conscious response to a problem situation that designers perform, frames are “underlying structures of belief, perception and appreciation” (Schön, 1984). It is what makes up the initial knowledge of the situation and as defined by Hey et al. (2007):

- a desired end state goal
- relative importance and relevance of features
- boundaries to the design situation
- criteria for evaluation

And reframing is the reformulation of either of the above as an answer to new information acquired from the situation.

Understanding the process of innovation has received a great amount of research during the last decades. However, evidently there is a lack of research regarding the important activities of framing a problem (Paton and Dorst, 2011). Given that the areas of innovation and design are merging there is a call to enhance knowledge in how design thinking affects innovation managers in the front-front end of innovation, framing a problem. This since it is in this phase that opportunities are identified, major constrains are detected, and most of the final outcome is defined. By bringing a new method (storyboarding) in this area using theories from visual thinking and narrative new knowledge can be developed in the field of innovation management. In relation to this problem the aim of this research is to provide new knowledge in the field of innovation management and the following research objective is therefore posed.

1.4 Research objective

As described in the introduction there is a need to strengthen innovation and product realization capabilities in industry through utilization and integration of new and improved design, visualization, and narrative methods and models. This involves developing resources and methods for industry in areas of organizational conditions, strategy and management, ideation and product development processes. This will facilitate decision making and strengthen the industry regarding innovation and product realization capabilities.

The scope is to create knowledge about the use of one specific method (storyboarding) in framing and reframing the opportunity for innovation in pre-brief activities. The reasoning behind using storyboarding can be found in the relationship between narrative, visual thinking, and design thinking and how they are connected with innovation (Beckman and Barry, 2007, Wikström and Berglund, 2011).
With this problem in focus the following objective can be presented:

The objective is to increase the knowledge of how storyboarding can support innovation management in the front-front end of innovation.

This research argues that it is important to adopt design methodology early at the front-front end of innovation, specifically the visual thinking and narrative involved in design thinking. This constitute the fundament in posing the following research questions.

1.5 Research questions

In order to reach the objective, the following research questions are posed. Going from broad to specific, knowledge is developed regarding the qualities of design thinking, visual thinking and narrative in general and the use of storyboarding in particular.

RQ1: How does design thinking, visual thinking and narrative affect the front-front end of innovation?

RQ1.1: How does design thinking affect the specific activities involved in innovating?

RQ1.2: How does visual thinking affect the front-front end of innovation?

RQ1.3: How does narrative affect the front-front end of innovation?

This broad research question is posed in order to create an explorative search for knowledge regarding the challenges involved in team pre-brief activities. The results required knowledge of the connection between innovation management and design practice. As this knowledge was developed, storyboarding came up as a candidate to transform the theoretical explanation into a method, since storyboarding combine design thinking, visual thinking and narrative. This caused the research to focus on storyboarding in pre-brief activities, and the following research question was posed:

RQ2: How can innovation management benefit from storyboarding at the front-front end of innovation processes?

RQ2.1: What is the role of storyboarding at the front-front end of innovation?

RQ2.2: What is the difference between using storyboarding and written documents to define a brief?
The answers to these research questions contribute to solve the academic problem in increasing knowledge about how storyboarding can support innovation management in pre-brief activities framing and reframing opportunities for innovation. Since this new knowledge is implemented in a method it is accessible to companies or organizations requiring new methods and tools to support the search for innovation opportunities.

This opens up the question about requirements for defining a brief. However, we need to take one step back to consider what type of research is performed in the areas of design thinking, visual thinking, and narrative in order to see how we can connect these into a base explaining how this research contributes to the knowledge of innovation management, and then return to the “problem behind the problem”.

1.6 Delimitations

This research focus is on the early phases of innovation, what I call the front-front end of innovation. In this phase a new method is developed supporting managers in defining a brief. Phases before and after this briefing is understood and partly involved in the research but the scope is within framing and reframing an opportunity for innovation. The action taken after this phase, the design phase, is not considered in this research.

The research has also been performed on a conceptual level, regarding research question 1, as well as on a concrete level, regarding research question 2. The conceptual development regarding design thinking, visual thinking and narrative connects designerly thinking to design thinking, this conceptual elaboration does not give detailed information regarding the bridge between designerly thinking and design thinking, but connects the reflective practice to both best practice as well as common practice. It also builds a theoretical foundation for storyboarding, and is used as a foundation to understand storyboarding as a process. The concrete level determining the characteristics of creating a storyboard, and not the finalized storyboard, as a communicative visualization but as a process. This delimits the research to the concrete level of storyboarding as a process tool.

1.7 Outline of thesis

The introduction will guide you through the main focus of the research and present the core of the research performed. The problem section develops the academic problem and industrial demand when creating new knowledge and useful methods and theories. The focus is on pre-brief activities such as framing and reframing an opportunity and develop knowledge about the context of the situation of interest.
The method section describes my experience throughout my third-cycle education and explains the methodology used. The ontology and epistemology will be explained, the research design outlined and the different studies will shortly be described. An evaluation of the research performed will be presented along with a chronological description of my journey through the process of developing skills in research.

The theoretical framework is developed and constitutes my lens for developing new knowledge in how storyboarding can support innovation management in the front-front end of innovation. Since a combination of theories is used, the framework in itself constitutes a result in this research. The explorative search for develop knowledge in how design thinking, visual thinking, and narrative can support innovation management has brought me to this framework, whose focus is on team thinking for framing and reframing opportunities for innovation using storyboarding. You will be guided through my exploration of design thinking, visual thinking, and the narrative format of storyboarding. The background will also present the theory of the problem and guide the reader in the thinking needed for creating a design brief. The theoretical framework of storyboarding in the front-front end of innovation when framing and reframing opportunities for innovation will summarize the chapter.

The empirical chapter contains a description of all the studies performed in order to understand the use of storyboarding in the front-front end of innovation with special attention to how this can contribute to support innovation management. It will explain storyboarding and the consequences that follow from using storyboarding in this phase. However, since this research is partly a comparison between a written document and a storyboard, it also provides knowledge about the shortcomings of the traditional way of working in this phase, writing documents. The empirical findings will be presented and explained in order to create a foundation for the discussion in the next chapter.

In the discussion chapter I will link the hypothesis to the theoretical framework and elaborate on the findings from the experiments conducted. I have used storyboarding (visual and narrative) as a process tool to support “thinking” that leads to the brief, not just a storyboard to communicate the brief but as a tool to be used during the pre-brief activities to support thinking while developing a brief. This should lead to a brief that can be an input to the innovation process, focusing on the opportunity for innovation.

The findings will be presented in the conclusions chapter, the research questions will be answered, and some suggestions for future research will be presented.
2 Method

When developing skills in conducting research you are forced to understand in what way you can create knowledge from a scientific perspective as well as from your own perspective, and also how these perspectives affect your research and the results generated. PhD studies are to a great extent about learning how scientific research is performed and understanding how you perceive scientific work and how to tailor your approach to knowledge development. This means that an explorative approach is taken in order to understand the context of scientific work (doing research), but in my case the explorative approach has been on the level of creating knowledge as well. This means that both ontological and my epistemological perspective have developed over time, or at least have become more reflectively understood during the later part of the PhD studies.

2.1 Research approach

In this section the research methodology and the scientific methods is described. I will also guide the reader through a journey building up the methodology used to answer the research questions posed earlier.

This research is mainly done in an explorative way searching to enhance knowledge about the use of design thinking, visual thinking and narrative in design and innovation activities. To gain this knowledge a number of activities have been undertaken; some of them have developed over time to generate new knowledge about how to support managers through the use of design thinking, visual thinking and narrative. When knowledge about the specific area has grown, the research has developed into exploring more specific activities and methods in order to gain new knowledge about the early phases of innovation, what I call “the front-front end” of innovation.

The focus of this research is to increase the knowledge of using design thinking, visual thinking and narrative at the front-front end of innovation both at a general level and with the help of storyboarding in specific. The approach to create this has alternated between theory and practice, as shown in Figure 2.1. This interpretation of Fagerström (2004) description of such a research process highlights the theoretical and industrial problems and how they repeatedly interact during the process. The approach supports the research, in which the objective is to contribute both in theory and in reality to meeting the needs related to, in this case, innovation management.
Figure 2.1. Interpretation of Fagerström (2004) process of an applied research project
When approaching a research area as a researcher you need to determine how you experience the world (your world view) in which the phenomena you are interested in are located. The view selected affects the choice of methods used in the research. According to Arbnor and Bjerke (1997), there are three approaches to looking at the world:

- the analytical approach
- the systems approach
- the actors approach

These approaches are linked to the two major paradigms in social science as shown in Figure 2.2.

![Figure 2.2. The space between the positivistic and the hermeneutical paradigms.](image)

In this research, the systems approach is used to explain components in the development of a brief. And the whole spectrum of the systems approach has been exploited, from the actors approach (using inductive reasoning) enhancing knowledge in how innovation is connected to a narrative towards a more analytical approach (using deductive reasoning) in the experiments testing the hypotheses. The systems approach is based on the world seen with objective eyes, and the studied phenomenon is independent of who is watching.
The systems approach in this research is based on the fact that creating a brief can be seen as part of a system, and this system can be divided into several subsystems, such as activities and events. Each of these activities or events can be studied individually. When using the systems approach, the whole is not the sum of all included parts but greater, which is different from the analytical approach. The relationships between the activities or events are important and will affect the result, the finished brief (Figure 2.3).
2.2 Methodology

One of the success factors for any research project is the design of the research in an appropriate way. This designing of research studies can be seen as an action plan for getting from here to there, where "here" may be defined as the initial set of questions to be answered and "there" as some set of conclusions (answers) to these questions (Yin, 2009). Since this research investigates and proposes a new method (storyboarding) supporting innovation managers’ in the front-end of innovation, design research methodologies are used. These methodologies support research regarding development and evaluation of tools and methods aimed at assisting practice. Design research is focused on understanding how designers perform in action in order to create new knowledge about “designerly ways of knowing” but also about the practices and processes that they employ and, finally, about the products that are created through designers’ use of practice and processes (Cross, 2007). The understanding of the activities involved in designing lays a foundation for developing support for improving those design activities (Blessing and Chakrabarti, 2009).

Maxwell (2005) suggests that with all components of the research process, from collection and data analysis, development and modification of theories, and the exploration and re-formulation of research questions to the identification of validation, some components occur simultaneously and affect each other. This means that the design of a qualitative research project is difficult to define exactly from beginning to end. As such, continuous evaluation and analysis of the processes is required in case the need to correct the subsequent steps or redo something already done arises. This research has been inspired by Maxwell (2005) in accordance with a model (Figure 2.4) for the design of research projects.

Maxwell describes the qualitative research in design as

"an ongoing process that involves ‘tacking’ back and forth between the different components of the design, assessing the implications of goals, theories, research questions, methods, and validity threats for one another. It does not begin from a predetermined starting point or proceed through a fixed sequence of steps, but involves interconnection and interaction among the different design components” (Maxwell, 2005).

The researchers are given the opportunity to move interactively between the various components and in their respective fields to create new knowledge. This leads, in turn, to new questions arising on the way to the overall objective. Figure 2.4 shows the outline of the model Maxwell presented. The model consists of five different focus areas for research: objectives, conceptual framework, methods, research, and validation.
The overall goal of this research is to support companies in developing their innovation capability. During the research, sub-goals have been developed, such as enhancing knowledge in how design thinking, visual thinking, and narrative support the front-front end of innovation. This has then led to proposing a tool, storyboarding, derived from my theoretical exploration of design thinking, visual thinking, and narrative and its effect on the front-front end of innovation. This has also been the goal of this research, to create knowledge regarding storyboarding in the front-front end of innovation, providing new knowledge in the discourse of innovation management.

**Conceptual framework - in what context will the research project be implemented?**

This is a broad explanation of the framework that the research derives from and includes the researcher’s own experiential knowledge, existing theory and research, the pilot and exploratory research, and thought experiments. Since the research has been explorative the conceptual framework is developed through knowledge of design thinking, visual thinking, and narrative in the front-front end of innovation and
lead to proposing storyboarding as a method developed through this knowledge. Even though theories from design thinking, visual thinking and narrative are used the core has always been to add value and knowledge within the field of innovation management.

Research questions – what is to be illustrated and carried out in the research project?

Research questions are what keeps the project running and establish measurable criteria for the objective of the research. The goal of the questions is to help focus the study, to give guidance as to how the study will be carried out, to point to what the researcher is trying to understand, and in the end create new knowledge. The first research question is used to explore the front-front end of innovation through design thinking, visual thinking and narrative. This explorative search for knowledge became the foundation for proposing storyboarding as a method in pre-brief activities that developed the second research question.

Methodology – what methods are used to arrive at answers to the research questions?

The literature describes different strategies necessary for collecting the data needed to achieve the objectives of the research. In this research two case studies was initially performed in a explorative manner in order to enhance knowledge of the challenges in the front-front end of innovation. With an initial focus on how design thinking, visual thinking and narratives can bring new insights in the front-front end of innovation. This exploration provided me with insights about the use of narrative in the front-front end of innovation and a study was designed to follow how people relate to stories of an idea. After this, the explorative search has focused on the use of Storyboarding as a method for reflection using workshop as a method. The explorative search in creating knowledge about storyboard continued. And a methodology for idea development was developed, DoTank. 54 teams performed a DoTank and the material was analysed. This further developed my knowledge of storyboarding as a process tool and initialized an explorative experiment. This experiment was set-up to compare storyboarding with the traditional way of working, writing, and through this experiment three hypotheses was developed. Finally, four experiments to test the three hypotheses have been conducted, involving 22 teams (more than 60 people) defining briefs.

In order to conduct this research, the Design Research Methodology (DRM) developed by Blessing and Chakrabarti (2009) was used as a process. DRM builds on an understanding of design research as not being sufficient to do descriptive studies in order to improve the design process, since descriptive studies only provide the characteristics of existing processes. You need to continue the research process with phases of developing support, testing and refining this support in the manner outlined in Figure 2.5.
Figure 2.5. The Design Research Methodology, DRM (Blessing and Chakrabarti, 2009).

The methodology is based on four generic steps performed iteratively:

Research clarification – identify and describe the success factors the research project aims to improve.

Descriptive study 1 — uses interviews, observations, and analysis to identify the key criteria that contribute to the improvement of the success factors.

Prescriptive study – develop support addressing the criteria identified in Descriptive study 1 in order to improve the success factors.

Descriptive study 2 – applies the support and validates it by assessing its impact on the criteria identified and the success factors.

The DRM approach is not a sequential process. It runs with many iterations between the different stages, and some stages run parallel as well (Blessing and Chakrabarti, 2009). This goes well with the applied research presented in this thesis.

Since this research is performed in an explorative way searching to understand the situation of using design thinking, visual thinking and narrative in the early
phases of innovation and ending up applying this knowledge I a method (storyboarding), the road getting from here to there has not been a straightforward one. But iteratively and interactively it focused on a direction interpreted by the development of the conceptual framework, including the knowledge developed along the road. The strategy has been adjusted over time regarding the direction of the focus; for this change Yin (2009) suggests the following five guidelines as support for choosing the right strategy for the research:

Experiments answer “how” and “why” questions best, focusing on contemporary events in controlled environments.

When seeking to understand causal relationships between variables developing a new method like storyboarding the use of students in experiments are to prefer. This because a new method is hard to implement in companies without knowledge regarding the value it can bring. You also need a controlled environment in order to secure the data collection.

Surveys answer “who”, “what”, “where”, “how many”, and “how much” questions focusing on contemporary events.

Since a new method (storyboarding) is developed in this research a survey does not give answers needed since it then must be based on something not existing, leading to speculative answers.

Archival analysis answers “who”, “what”, “where”, “how many”, and “how much” questions for both contemporary and historic events.

Some events in this research have used archival analysis (study B) but since the main contribution in this research is a new method archival material is not available. In study B archival documents were used in order to understand more about the use of visual thinking in practice within these companies.

History answers “how” and “why” questions, focusing on historic events.

As described above the main contribution of this research is a new method, and any historic events regarding storyboarding are not available. This strategy is not suitable for the explorative parts of this research either. However, exploring storyboarding as a method to support reflection (study D) historical events was described in storyboarding by the teams. These historical events did not contribute to new knowledge about storyboarding but the workshops developed knowledge about the process of storyboarding.

Case studies answer “how” and “why” questions, focusing on contemporary events.

In this research the activities studied are of a complex nature, and when enhancing knowledge about specific activities in its natural context a case study is a preferred method. When exploring design thinking, visual thinking and narrative in companies you need to interact with the activities or the people involved in
these activities through observations and interviews. A case study enables a deep knowledge of the activities studied and gives explanation on the background of the answers as well.

However, these guidelines have their advantages and disadvantages depending on (a) the type of research question we want to answer, (b) the researcher’s control over actual behavioural events, and (c) the focus on contemporary as opposed to historical phenomena.

As presented earlier, two different strategies have been used in this research, case studies (to learn) and experiments (to develop and evaluate). A presentation of the different purposes of the research will be shown below, following how (Saunders et al, 2007) classify the research purpose in three parts, explorative, descriptive, and explanatory. However, there are no distinct borders between these purposes; instead they could be both descriptive and explanatory, and this may even change over time and there could be a combination of them like in the studies explained below. The following describes the research strategy employed in the different studies (Table 2.1).

The research questions were presented in Section 1.4, but a reiteration here is in place.

RQ1: How do design thinking, visual thinking and narratives affect the front-front end of innovation?

RQ1.1: How does design thinking affect the specific activities involved in innovating?

RQ1.2: How does visual thinking affect the front-front end of innovation?

RQ1.3: How does a narrative affect the front-front end of innovation?

RQ2: How can innovation management benefit from using storyboarding at the front-front end of innovation processes?

RQ2.1: What is the role of storyboarding at the front-front end of innovation?

RQ2.2: What is the difference between storyboarding and written documents?

In Figure 2.6 we can see the relationship between the framework of the DRM process proposed by Blessing and Chakrabarti (2009), and the performed studies in relation to the research questions. Filled circles represent strong relationship, while unfilled circles represent weak relationship.
2.3 Design of research studies

This section will explain the research design starting by explaining the chronological appearance and then explaining at a generic level the theoretical methodological framework connecting the different studies to the strategy used. After this, the research strategy is connected to the design research methodology and the seven studies performed discussed in relation to the strategy. More information regarding the different studies is presented in chapter 4.

The chronological appearance

The main thread in these studies is design thinking, visual thinking and narrative in the early phases of innovation. It all started from the broad perspective of the use of visual thinking in 26 companies (study B) and then went on to follow how people relate to stories of an idea during the early phases of innovation (study C) towards the best practice in one of the most successful companies in the world (study A), IDEO (www.ideo.com). Those initial studies led me to the use of storyboarding to highlight lessons learned in already implemented projects (study D). From this the focus has been to develop knowledge regarding the use of storyboarding at the front-front end of innovation (study E-G). With this as a topic, the doctoral thesis was planned and three conference papers were published.

In the first year as a PhD student my focus was to create knowledge on how visual tools and methods were used in design practice in an industrial context for developing new products and services. I also wanted to gain knowledge of how best practice in this field of work is performed. During this period I made interviews with
26 companies regarding their use of visualization and visual tools in design projects (Wikström, 2009, Wikström, 2010, Wikström and Jackson, 2012b). The initial study created knowledge of the approach to visualization and the actual use of visual thinking in practice. This knowledge has also influenced the development of the idPeo methodology used in a concept development course at Mälardalen University, the sandwich course.

When reflecting on the projects performed in the sandwich course and all the students participating I realize how much this has supported me during my studies, both in the exploring phase and in the positive response and collaboration with company representatives and students. When looking back on the 50 projects carried out using the idPeo methodology since the first version in 2007, it strikes me that this has been one extensive explorative research study performed during the entire time of my PhD studies. It has been a platform to explore and experiment with the different tools and methods that I have developed but also to test tools and methods developed by others, and of course to understand design practice for innovation. The around 200 students that have participated in the course have given me extensive knowledge regarding both tools and methods but something even more important, insights into the complex setting of working together in multidisciplinary teams with ill-defined problems, framing and reframing the problem in order to understand the design space. This has guided me in exploring the possibilities of developing new ways of working at the front-front end of innovation. The sandwich course might need some more explanation. The course is set up to run for 15 weeks during one semester and the teams are handpicked among the students who apply for this course. It runs during evenings and meetings are set up every week on Mondays between 5 p.m. and 8 p.m., and since the students take other courses during daytime they come directly from these courses to the sandwich course. This speaks for a need of a short break and some food before starting, which gives an added dimension to the denomination sandwich course. We start with a sandwich and some coffee or tea before a seminar or workshop starts. The seminar always includes five teachers in the course. Since innovation is a multidisciplinary field, the teachers in this course come from different areas and have a wide range of knowledge reaching from forecasting and innovation management to design methodology and further to engineering design and computer science. This supports the teams in the course since the teachers can guide them through the whole chain of actions needed in making innovations.

In table 2.1 an overview of the seven studies are presented. Studies A-D together with the projects in the sandwich course provided me a foundation regarding the use of visualization as well as insights into what aspects are important for supporting management in their strive towards success in innovation making. The idea of using storyboards came up in 2009 as a natural candidate to transfer my theoretical exploration into a normative tool. A process develop knowledge in how storyboards can
Table 2.1. Overview of the studies performed

<table>
<thead>
<tr>
<th>Study</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>In thesis</td>
<td>Section 4.1.1</td>
<td>Section 4.1.2</td>
<td>Section 4.2.1</td>
<td>Section 4.2.2</td>
<td>Section 4.3.1</td>
<td>Section 4.3.2</td>
<td>Section 4.4.1</td>
</tr>
<tr>
<td>RQ</td>
<td>RQ 1.1</td>
<td>RQ 1.2</td>
<td>RQ 1.3</td>
<td>RQ 2.1</td>
<td>RQ 2.1</td>
<td>RQ 2.2</td>
<td>RQ 2.2</td>
</tr>
<tr>
<td>Type</td>
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<td>Descripto-explanatory</td>
<td>Explanatory workshop</td>
<td>Explorative workshop</td>
<td>Explorative workshop</td>
<td>Explanatory experiment</td>
<td>Explanatory experiment</td>
</tr>
<tr>
<td>Purpose</td>
<td>Understand</td>
<td>Develop knowledge</td>
<td>Understand</td>
<td>Explore</td>
<td>Explore</td>
<td>Understand</td>
<td>Test</td>
</tr>
<tr>
<td>Unit of analysis</td>
<td>Design thinking in innovation</td>
<td>Visual thinking in innovation</td>
<td>Narrative in innovation</td>
<td>Storyboarding as a tool in reflection</td>
<td>Role of storyboarding</td>
<td>Difference between storyboarding and written briefs</td>
<td>Characteristics of storyboarding for brief work</td>
</tr>
<tr>
<td>Geographic location</td>
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<td>Sweden</td>
<td>Sweden</td>
<td>Sweden</td>
<td>Sweden</td>
<td>Sweden</td>
<td>Sweden and Taiwan</td>
</tr>
<tr>
<td>Participants</td>
<td>Designers</td>
<td>Designers</td>
<td>Variety</td>
<td>Engineers</td>
<td>Variety</td>
<td>Students from design, innovation, and information design</td>
<td>Students from design, innovation, and information design</td>
</tr>
<tr>
<td>Data source</td>
<td>9 interviews, office tours and informal Conversations</td>
<td>26 interviews and Documents</td>
<td>1 workshop and Observations</td>
<td>2 workshops 6 teams in total</td>
<td>24 workshops 54 teams in total</td>
<td>1 experiment with 8 teams</td>
<td>4 experiments in total 25 teams</td>
</tr>
</tbody>
</table>
be used in different parts of innovation processes started; interviews with project leaders from film industry alternated with testing storyboarding with students and companies as well as discussing with colleagues. These explorative tests and discussions ended with using storyboarding to capture experiences from implemented projects. At the same time I had the idea of using storyboarding as a method in framing and reframing an area of interest as a pre-brief activity supporting innovation management at the front-end of innovation. This was a result of literature studies as well as identifying a gap in practice, along with a demand from industry to develop the capability of performing in this fuzzy phase.

The descripto-explanatory studies (Research clarification, Studies A and B)

The focus of a descripto-explanatory study is to perform a descriptive study as a precursor to an explanation of the relationship between variables (Saunders et al., 2007).

Even though the case studies have had different setups, from single- to multiple-case studies, the motivation for using this strategy derives from Yin (2009) suggesting that a case study is a preferred research method when a specific phenomenon is to be closely studied in its natural context. The case study is almost always used to collect qualitative data such as texts, figures, and images. Case studies are often employed when trying to understand when and where a phenomenon actually happens and the knowledge about the context or delimitations is inadequate. The advantage of this is the possibility to use several sources and different types of data combined with the use of several methods of analysing these data.

This allows case study research to answer complex questions and explain the background to the answers as well. However, this characteristic of case studies may be a disadvantage when the researcher interprets the data: a subjective opinion may lead to biased or wrong results. When collecting data in case studies, there are, according to Yin (2009) six sources to use: documents, archival records, interviews, direct observation, participating observation, and physical artifacts. In this research, the empirical data in the case studies were collected through interviews, observations, and documents.

Yin (2009) describes interviewing as one of the most important data collecting methods in case studies. When looking into a system that depends on people’s opinions and decisions, interviews with key individuals in the system are regarded as valuable data. Lantz (1993) notes that there are four main types of interviews; structured, semi-structured, directed open, and open interviews. The first two forms are more suitable for collecting objective data (a more positivistic view). The other two are more related to subjective data and are therefore associated with a more hermeneutical view.
The explanatory studies (Studies C, F, and G) and the explorative studies (Studies D and E)

The difference between an explanatory study and an explorative study is that in an explanatory study you seek to understand the causal relationships between variables, while in an explorative study you seek to clarify your knowledge of a situation, and this can trigger a change in direction of your research. Common to these five studies is that observations and interviews were combined with workshops and experiments in order to obtain a deeper knowledge and explanation of the situation. Yin explains that observations may be conducted casually or formally (Yin, 2009). Kidder (1981) claims that if observations are to be scientific, the following criteria have to be fulfilled:

- fulfilling a scientific aim
- being planned
- being systematically registered
- being controlled with respect to validity and reliability

Observation gives the researcher the opportunity to dismiss or verify data collected from other sources that are considered less reliable (for example, interviews and documents). Participatory observation is described by Merriam (1994) as perhaps the most important method of collecting information for a case study. It gives a first-hand description of the situation being studied. In combination with interviews and source analysis, if possible, a holistic interpretation of the situation is achieved. In a participating observation, you can choose to act along a scale that moves from simply attending to only observing. It is important to find an approach to the observation situation in order to combine the two action principles.

An experiment on the other hand is set up to study causal links to find out whether a change in describing a brief is different when using storyboarding than when writing a brief in the traditional way. By changing one variable for half the teams involved in a workshop/experiment where the individuals are considered to be equal, even though there are no such things as equal individuals, you can search for differences in the results. Doing experiments is a comparison between one control group and one experimental group. In this research several experiments have been performed with multiple teams.

Since the focus in Studies C, F, and G was to understand relationships between different variables, an experimental strategy was deployed, meaning that both the workshop and the experiment were set up in order to understand causal relationships between different variables, even though in Study C a more explorative strategy influenced the workshop. In the analysis the relationship between innovation making and innovation telling is explained. The experiment in Studies F and G was set up in order to test the difference between two ways of performing a brief, clearly explaining the relationship between input, method, and output.
The research process

The following will explain how the research strategy in this specific research is connected to the different phases of the design research methodology (Figure 2.7).

![Diagram showing the strategy of the research and connection to the studies performed.]

**Research clarification**

The research clarification contains studies performed in order to understand how design thinking and visual thinking affect the front-front end of innovation (Studies A and B). In these studies an explorative approach has been used in order to develop knowledge and identify gaps in the context to which this research can contribute.

**Study A**

In Study A, a total number of nine open interviews were performed at the company IDEO. I spend in total two weeks at IDEO Boston office in Massachusetts, and paid one visit to IDEO head quarters in Palo Alto, California. During these weeks, the interviews in combination of several informal conversations and hours of observations, was resulting in enhanced knowledge of the way IDEO work. This initial study focused on the role of design thinking in the specific activities in the front-front end of innovation. The strategy was to do a case study at a company considered to represent “best practice”.
A literature review was performed in order to understand the case company and success factors connected to new product development. The relationship between these success factors and the theory of the reflective practitioner (Schön, 1991) was used in the preparation of the interviews. During the interviews two researchers were always attending and two open questions were posed. One of the researchers took detailed notes and one asking questions and taking assorted notes. The process for the interviews is explained in detail in Figure 4.2. During my stay at IDEO several informal conversations with managers and designers were performed along with observations of project meetings, both formal and informal. Field notes were taken and compared with the interviews and earlier research regarding IDEO. A search for patterns in the material collected started and this clustering of information was conceptualized into the “IDEO way”. In order to aggregate information the concept was compared with earlier research on the IDEO process. This resulted in “key domains” at IDEO. A final analysis was performed, mapping competencies at IDEO with different media used in order to perform the “reflection-in-action” using the theories of Schön (1991). This resulted in initial knowledge of design thinking for innovation and opened my initiated the importance of visual thinking and narrative in the front-front end of innovation. This study developed knowledge about best practice of design thinking, as well as designers’ use of visual thinking and narratives.

**Study B**

Study B was based on interviews regarding visual thinking and its relation to the reflective practice paradigm was analysed. The interviews were performed at 26 different companies in order to put together an overview of the use of visual thinking. The strategy in this study was to do a multiple case study at 26 different companies in order to create knowledge of visual thinking in the front-front end of innovation.

A literature review was performed in order to understand design processes, visual thinking and frame challenges in the front-front end of innovation. This became a foundation for the interviews performed. The questions were semi-structured even though open questions arose during the interviews. The interviews were recorded and notes were taken. A clustering of that similar within categories was performed to further analyse the material. The approach to visual thinking and type of visualization used became two areas of interest. These areas were further abstracted using the theory of the reflective practitioner (Schön, 1991) in order to develop knowledge of visual thinking in the front-front end of innovation. The results from this study gave insights into how visual thinking affect innovation at the front-front end of innovation.
Descriptive study 1

Descriptive study 1 focused on exploration of storyboarding in developing knowledge about the situation to design for and as a reflection tool (Studies C and D).

Study C

The focus in study C concerned how we can make sense of innovation by following how people relate to stories of an idea, and in this way develop knowledge regarding the role of narrative in the front-front end of innovation. The idea followed was an idea developed in the context of a larger project called “The house on the moon”, which aims at putting a small red house on the surface of the moon. The new idea was a way to gather funding for “The house on the moon” project with a service called “moon message”. In order to develop knowledge of narrative for innovation the strategy for this study was developed. Since an initial knowledge of the importance of narrative in the front-front end of innovation was developed in study A a literature review was performed to develop a framework to use in analysing the data, this framework was also used as a foundation for the workshop to be used as data collection. The framework was conceptualized to build up the concept of innovation making and innovation telling to understand an innovation process that was studied longitudinal.

The workshop was developed based on the process of naming, framing, moving and reflecting (Schön, 1991), and consisted of six phases. The workshop was performed with invited people with different backgrounds and competences in order to facilitate diversity, this since multidisciplinary teams often are used in innovation projects. During the workshop field notes were taken and the material developed was collected after the workshop. The observation and the work material was analysed using pattern matching where the theoretical framework was used. After the workshop a time of shadowing was performed in order to follow what was happening with the idea. This was analysed together with the findings from the workshop and then conceptualized to create knowledge regarding narrative for innovation. By staging this workshop and follow how people relate to the story of the “moon message” idea during the workshop and after, knowledge regarding innovation from the perspective of innovation making and innovation telling was developed.

Study D

Study D used storyboarding as a tool to reflect on projects carried out does not have a direct connection with the objective unless you see the innovation process as a loop using lessons learned from previous projects as a starting point for new projects, which is something that I do. The theoretical areas of design thinking, visual thinking and narrative developed so far together build the method of storyboarding. With this background my interest in storyboarding grow and an initial literature review concerning narrative in visual communication was performed in order to develop a framework to use analyzing the data collected in this study.

The strategy for this study was also to use workshops to collect data. The work-
shop was developed in two steps using previous workshops as a foundation. The workshop was tested on two PhD students in order to evaluate the workshop and make some adjustments. The data collection workshop was performed at two multinational companies with in total 6 teams, a detailed description of the workshop is presented in Figure 4.4. The workshops where recorded and transcribed by the team (consisted of three PhD students) in this study. The observations of the workshops, and the transcribed conversation together with the work material where analysed in the team using the theoretical framework developed. Patterns where identified and conceptualized into new knowledge regarding storyboarding in reflection capturing lessons learned. The outcome of this phase was a deep knowledge of narratives and their connection with innovation as well as initial knowledge of the power of storyboarding in teams.

**Prescriptive study**

During the Prescriptive study (Studies E and F) a methodology was developed and an initial test was performed in order to understand how innovation management could benefit from using storyboarding in the front-front end of innovation.

**Study E**

This study was performed in an explorative manner comprising 24 workshops with in total 54 teams. The workshops where held at different places within the broad framework of an exhibition called “tipping point” held at Kulturhuset, the cultural centre in downtown Stockholm. The focus of the workshops was to develop ideas regarding climate smart lunches and through this increase knowledge about environmental challenges the world faces today. The interest in using storyboarding in the front-front end of innovation guided me towards exploring storyboarding in new ways. In order to find out what role storyboarding can have a methodology for idea development was initialized. Using the theories developed by Schön (1991) the methodology was developed and a process of evaluating and refining started.

Three tests were performed in order to come up with the final methodology. After each of these tests a discussion with the participants was performed in order to capture their experience and refine the methodology in accordance with this. Each of the tests was performed with new teams and with a diversity of the people in the teams. The 24 workshops where performed with help from students educated to run these kinds of workshops and involved in testing the methodology. Material was collected from the workshops and open interviews with the students facilitating the workshops were performed. A clustering of the material was executed with a focus of the situation described in the storyboards, and the role of storyboarding in team idea development. This enhanced knowledge of what kind of situations that was described using storyboarding and insights about the role of storyboarding. A conceptualization abstracting the findings into concepts was performed to meet the next step in the research, comparing storyboarding with the traditional way of describing a brief, writing document. This study resulted in deep knowledge of storyboarding and how it affects the briefs.
Study F

Study F was an explorative experiment to understand the difference between briefs created in a traditional way using written documentation and the brief using storyboarding. The experiment was set-up in the context of a concept development course at Mälardalen University and eight teams participated. In order to develop knowledge of the role of storyboarding in the front-end of innovation an experiment was designed.

The methodology developed in study E was used as a foundation for the experiment, with one significant difference, half of the teams used storyboarding for the framing phase and the other half wrote documents. By changing one variable a comparable material is developed, this material was collected and analysed with a focus on similarities and differences using a hermeneutical approach searching for patterns. The patterns were then clustered and developed into theoretical concepts. These concepts where further abstracted to three hypotheses. With these eight teams, four working with storyboarding and four writing a brief, the knowledge regarding storyboarding was applied and three hypotheses were formulated.

Descriptive study 2

In Descriptive study 2 the hypotheses were set up to be tested in a series of experiments with students.

Study G

Four experiments were performed resulting in 17 briefs (nine storyboards and eight written documents). The total number of teams involved was 22, due to the fact that the experiment was different in setup. Three experiments were held at Mälardalen University and one at the National Taiwan University of Science and Technology in Taipei. The strategy of experiments was chosen in order to study causal links to find out whether a change in describing a brief when using storyboarding then when writing a brief in the traditional way. The layout of the experiments were the same as study F, however the “area of interest” was changed. Also the composition of the teams differ from using diversity of students in study F to using students from the same educational programs in three out of four experiments in study G. Every experiment was monitored and facilitated by the author and monitored by either four graduate students or a research colleague, and three of four experiments were filmed.

The material from the experiments (scenarios, storyboards and notes) were collected and analysed together with four graduate students to avoid bias and discuss a common frame to use in the analysis. The focus was to understand the situation described in the storyboard and how this situation is described. Regarding hypothesis 1, meaning vs. function, the material was interpreted with focus on if it contained meaning or function. To find meaning a search for human interaction and involvement was employed, while the search for function was focused on technical implications and instrumentally described situations. In hypothesis 2, broad vs. narrow, the ma-
terial was analysed with a focus on the situation described and if this was within the “area of interest”, or if the area was stretched to incorporate parts outside the initial focus. When analyzing hypothesis 3, regarding ambiguity, a hermeneutical approach was employed exploring the material without any prerequisites. First every team’s material where analysed separate in order to understand each material as a whole finding patterns in the data. This resulted in knowledge regarding the situations described and used to compare the observed patterns in relation to predicted ones, using the hypotheses to create new knowledge regarding storyboarding. The findings where then conceptualized in regards to the theoretical framework with a focus on similarities and differences using a hermeneutical approach developing conceptual conclusions. The results from this study constitute the main knowledge of using storyboarding at the front-end of innovation and are of interest for support for innovation management regarding sketching and negotiation involved when storyboarding.

2.4 Quality of the research performed

In this section the theoretical framework used to evaluate the research is presented and then the quality of the research regarding validity and reliability is discussed. According to Golafshani (2003) “Reliability and validity are conceptualized as trustworthiness, rigor and quality in qualitative paradigm” (p. 604). In qualitative research validity is used widely and refers to how well you measure what you want to measure. Reliability on the other hand, concerns to what extent a study may be repeated and present the same results, to some extent, in qualitative research, you can say that reliability is obtained if validity exist.

According to Merriam (1994), the aim of research is to produce valid and sustainable results. The findings of the research must be examined critically. This is true of the methodology used as well. The methods for this evaluation are associated with the research strategy and must be selected according to the strategy. Evaluation has two components, verification and validation. Verification is the accuracy in relation to the practical use of the findings. Validity is associated with the relevance of the research. Another important part of evaluation is to check whether the method is stable and can repeatedly come up with the same results, known as consistency. Arbnor and Bjerke (1997) describe consistency as reliability and state that “validity requires reliability”. This means that reliability exists when validity is established.

According to Svensson and Starrin (1996), the term validity is used widely in quantitative research. The term refers to how well you measure what you want to measure. Quantitative methodology is used to numerically determine validity by comparing results obtained with the supposed truth. In the case of qualitative studies, there are many opinions regarding how to look at validity. Some believe it is about authenticity, credibility, and understanding, while others believe that validity is a good description.
Cross (2007) argues that the characteristics of best practice in design research with validity are that it is:

- purposive – based on the identification of an issue or problemworthy and capable of investigation
- inquisitive – seeking to gain new knowledge
- informed – conducted from an awareness of previous, related research
- methodical – planned and carried out in a disciplined manner
- communicable – generating and reporting results that are testable and accessible by others

Andreasen (1996) describes characteristics of good research design. He suggests another basis of the evaluation for validity that follows the one above. Research should be focused, based on theory and a strong research paradigm, conducted according to good research craftsmanship, multidisciplinary, and published. In addition, the findings should be used or implemented.

The ability of researchers to repeat the study performed and come up with the same result and conclusion as the first researcher is what reliability is about. In systems thinking, reliability focuses on what the measurements can be used for and not how precise they were during the case study. Consequently, in contrast to the analytical approach, systems thinking does not consider reliability to be as important (Arbnor and Bjerke, 1997). Reliability could be difficult when studying human behaviour, which is dynamic and not static (Merriam, 1994). Yin (2009) also discusses reliability. He finds it possible as long as other researchers have all the documents that the first researcher had and all the methods used by the first researchers are well documented. Yin (2009) also suggests that

“the general way of approaching the reliability problem is to make as many steps as operational as possible and to conduct research as if someone were always looking over your shoulder.” (p. 45)

Yin (2009) points out the need to use an analytical approach for the analysis of research data. Merriam (1994) describes analysis as a complex process that moves back and forth between concrete data and abstract concepts, but also between inductive and deductive reasoning and between description and interpretation. What researchers do to create meaningful results is not some logical process; it is rather intuition and the researcher’s sensitivity to the information. There are several methods for analysing qualitative data. In this research, the following methods are used, more or less for all data analysis.

Pattern-matching logic is one of the better methods for analysing case studies (Yin, 2009). This technique is mainly based on comparing the empirically observed patterns with predicted ones. According to Merriam, the human mind quickly and
easily finds the patterns that arise. However, it is important to note sustainable support for the current pattern (Merriam, 1994).

The aggregation of information, clustering that is similar within categories, means that one can do further analysis by conceptualizing the data that are similar in characteristics or patterns (Merriam, 1988). To deepen this analysis, we can abstract and reorder the information for the highlighted categories and characteristics that may be included in the theory created.

An appropriate method of analysing data is an intuitive approach by which the researcher focuses on the conclusions that are reasonable and logical (Merriam, 1994). The method works as a kind of guide that draws the researcher’s attention to what appears to be reasonable and proper.

Factoring is a categorization of the encoded data done to facilitate comparison. Development of theoretical concepts is a method to reduce a host of data into meaningful concepts (Merriam, 1994).

This overview of research design explains the theory of analysis and data collection methods and their use in this specific research. However, in order to fully understand the validity of the research performed, a description of the different stages in the research will be discussed below. In the next section I will discuss and evaluate the quality of the research with a focus on validity and after that section continue with a discussion on reliability. Even though validity and reliability is questionable within qualitative research the following discussion is provided.

2.5 Reflection – validity of the research performed
This research has been conducted using a systems approach focusing on case studies and experiments to explore and explain storyboarding in team pre-brief activities. And in that way develop knowledge of the challenges involved in framing and re-framing opportunities for innovation. In this section I will discuss the quality of the research regarding validity. The use of validity could be questioned with regard to qualitative data, however, in accordance with Cross (2007) I will examine this research validity based on the following characteristics:

- Purposive – based on the identification of an issue or problem worthy and capable of investigation
- Inquisitive – seeking to gain new knowledge
- Informed – conducted from an awareness of previous, related research
- Methodical – planned and carried out in a disciplined manner
- Communicable – generating and reporting results that are testable and accessible to others
The discussion is divided into four steps since there is a difference concerning how validity can be achieved regarding how the research has been performed. The four steps follow the DRM. They are Research clarification, Descriptive study 1, Prescriptive study, and Descriptive study 2.

**Research clarification (described in section 4.1)**

In the Research clarification study the purpose was to understand and develop knowledge about how design thinking and visual thinking affect the front-end of innovation. Since the success of innovation is highly dependent on activities performed in the front end of innovation the focus was to understand these activities in depth using case study research. Case studies enable several data sources making a triangulation possible, in these studies interviews have been altered with observations and compared with existing literature. In this way a conscious search for new knowledge is intended. By defining gaps in the theories in which this research can be integrated new knowledge can be developed. The foundation springs from related research previously done by other researchers but also through interviews at companies performing at the front-end of innovation both in Sweden and in the USA. The reason behind this could be found in the researcher’s own necessity to develop knowledge closely linked to the focus. In this specific area there was a need to complement the literature with new knowledge bridging the gap between designerly thinking and design thinking as well as develop knowledge of visual thinking. The studies performed were planned in order to support knowledge development in a descriptive way, a literature review was initially performed in order to prepare the interviews. The companies were chosen in accordance with a broad perspective of understanding current practice, but the availability of the companies was also an important aspect to consider. The best-practice company was chosen since it is one of the best companies in the world to develop new products and services, focusing on design thinking methodologies and with a human-centred approach. The company, IDEO, is also well documented by several researchers who have performed studies on how it operates. One could argue that a literature study could have been enough. However, firsthand information and questions targeting the core of interest would contribute more on the subject. Through this study knowledge was developed regarding design and visual thinking at the front-end of innovation; a theoretical gap was also identified regarding how framing and reframing of opportunities for innovation are executed in pre-brief activities. The results from these studies have been published in one journal article (Wikström and Jackson, 2012b), one conference paper (Wikström and Jackson, 2012a), and in my licentiate thesis (Wikström, 2010).
Descriptive study 1 (described in section 4.2)

The gap identified opened up for two descriptive studies in an attempt to explain and explore how stories affect both the development of ideas and the reflection about projects carried out using storyboarding. This connects design thinking and visual thinking to a narrative and enhance knowledge in how stories in general and storyboarding in specific can contribute to pre-brief team activities performed when developing design briefs. These studies were planned and conducted as workshops together with other researchers; the companies involved were chosen due to availability. Whether this has affected the results is difficult to say, but several companies have run the same workshop afterwards (not included in this thesis due to late implementation), where the analysis led to the same results. The area of framing opportunities for innovation using storyboarding has not been investigated in depth earlier. Therefore the development of a theoretical framework for design thinking, visual thinking, and narratives was initiated. This framework builds on previous research regarding these specific areas, and a combination of them comprises the framework developed in order to analyse how innovation making and innovation telling constitute two sides of innovating. The results from these studies have been presented in two conference papers (Wikström and Berglund, 2011, Wikström et al., 2011). The findings from this phase highlight storyboarding as an interesting method in framing opportunities for innovation. A deep knowledge of the combination and use of visual thinking and narratives was developed and constituted the foundation for the next phase.

Prescriptive study (described in section 4.3)

This knowledge encouraged me to work out a methodology for idea development used in the Prescriptive study. The methodology (DoTank) was developed in order to understand the use of storyboards in practice when framing opportunities for innovation. The development of the methodology can be seen as a design project in which several iterations and visualizations were performed. The development of the methodology started by a set of criteria needed to be fore filled, a short timeframe and visual tools supporting design thinking, visual thinking and narrative was the most important. A process of performing workshops started. Three workshops where held and the methodology was redefined after each workshop before a final version of the methodology was presented. In each of these workshops three to five teams participated and after each workshop a discussion on the methodology was initiated. The final methodology was implemented in two studies in order to explore and understand the characteristics of storyboarding. The theoretical framework was finalized in order to analyse the data collected. Since this phase was also carried out in an explorative/explanatory way, the planning of the research was conducted along with the development of the research and knowledge regarding the methodology. In Study E the participants were not picked out to participate but could sign up for participation. This may have affected the result regarding lack of knowledge
in designing and briefing activities. However, as we compared the difference between these non-designers with results from design students and other designers, we found that the findings were generalizable across knowledge boundaries. Study F was planned and performed as an experiment with students as participants with the aim of analysing the difference between storyboarding and writing as pre-brief activities. The findings developed knowledge of storyboarding as a method along with a development of three hypotheses that needed testing. The result was presented in two conference papers (Wikström and Verganti, 2013a, Wikström and Verganti, 2013b).

**Descriptive study 2 (described in section 4.4)**

Study G was planned in order to test the hypotheses. The setup of this study was to run four DoTank workshops, the material of which was collected and analysed. Three explanatory experiments were performed in Sweden and one in Taiwan. The experiment in Taiwan was conducted in order to verify the results from a cultural perspective; students were involved in all experiments with a similar background in design, innovation, and information design. The experiments were the last step in this research in order to test how storyboarding differs from writing documents in order to frame opportunities for innovation developing knowledge regarding storyboarding (as a process tool) used in pre-brief activities. The students involved in these experiments had varying knowledge regarding pre-brief activities, but the result again showed that this had very little or no influence on the findings. The results from this study were presented in a conference paper (Wikström et al., 2013).

2.6 Reflection - reliability of the research performed

As described earlier my standpoint on reliability is; reliability exists when validity is established. Reliability will be discussed in relation to each of the seven studies performed, but presented in steps in accordance with the DRM. Some generalized parts can be seen in the two case studies performed regarding research question 1 (study A and B) as well as in the workshops and experiments regarding research question 2 (study C-G). To what extents this research is replicable is dependent on how well documented the research is. Within the case studies (study A and B), reliability is difficult to achieve since it also depends on the state of the company and the people interviewed and observed besides the documentation. In these case studies the documentation is varied from well described (in study A) to not so well described (in study B). This, of course, affects the reliability of these two case studies. However, I find the reliability regarding research question 1 to be acceptable since triangulation is applied, using multiple sources of evidence, interviews, observations, and enfolding literature on the subject. On the other hand, the reliability regarding research question 2 is considered high since the documentation is well done and the studies build on each other applying a triangulation of data sources. This enables high repeatability and controlled biases.
Research clarification (described in section 4.1)

In study A the interviews were conducted with two researchers present and field notes were taken. After the workshops a process to avoid bias was performed with two debriefing sessions with transcribing the notes in between. Even though these steps were taken reliability is considered vague since replication is highly dependent on the state of the company and the people interviewed. In study B the interviews were conducted with one researcher present, the interviews were recorded but not transcribed. The analysis was performed by the author but all the results where discussed with research colleagues. This study is also considered to have vague reliability dependent on the complexity of changed circumstances in the 26 different companies regarding state and people involved.

Descriptive study 1 (described in section 4.2)

Study C, the Moon Message, is well documented with detailed workshop description and field notes. All the material developed during the workshop is available, two researchers were involved in the data collection and during analysis. However, reliability in this study is considered vague since it is difficult to rearrange a workshop only stated once with these specific people. Also the project is developed since then so a new idea would be needed. It is, however, likely that when following a new idea through the eyes of innovation making and innovation telling the same results would appear. In study D the reliability is considered high since the documentation is well done. A methodology is developed and tested with one pre-test and two separate workshops at two companies (in total six teams) deriving at the same results. Three researchers performed the entire study with the author as main responsible of this specific part. Several other companies outside this research have adopted the methodology ending with the same result.

Prescriptive study

The reliability in study E is difficult to determine since it involves development of the DoTank methodology as well as 24 workshops. This development process is highly dependent on the explorative studies performed earlier, regarding design thinking, visual thinking and narrative in the front-front end of innovation, in combination with knowledge regarding idea development. So, specific knowledge regarding this is considered to be a prerequisite for developing the DoTank methodology. However, if this can be achieved the development process is most likely repeatable. When it comes to the 24 workshops performed a variety of people attended and since no difference was detected the repeatability must be considered high and therefore also reliable. The first controlled experiment, study F, is considered to have high reliability since the experiment set-up is well documented and the teams consisted of students from different educational programs, engineering, innovation, and information design. The material was collected and analysed together with a colleague to avoid biased results due to pre-understanding or fixation.
Descriptive study 2
The evaluation of storyboarding, study G, is considered to have high reliability since the set-up of the experiments are well documented. The four experiments performed had students from different educational programs attending, engineering, innovation, and information design. This shows that previous knowledge within one specific area does not affect the results. Also, one experiment was held in another culture (Taiwan) proving knowledge about the cultural aspects and that culture do not interfere with the results. The material was collected and analysed together with four graduate students who where assisting the experiments. The findings were discussed with colleges at the university but also presented and discussed with managers and designers at IDEO.

2.7 Summary
Validity concerns the generalizability of the findings, and in this research the results achieved could be generalized even though the setup of the experiments was specific. This is due to the fact that storyboarding has been tested in a number of different settings and the results have come out the same. Even experiments in a different country, with a different culture, were performed and yet the same result was achieved. Also the analysis was done together with at least one other researcher and the findings have been discussed with practitioners in different settings as well as with other scholars.

The consistency of the research is difficult to state since it involves so much human interaction, and consistency is about another researcher performing the same research coming up with the same results. The initial studies would lead to identifying the gap of knowledge regarding the pre-brief activities in framing opportunities for innovation. The foundation of storyboarding can be found in the theoretical exploration of design thinking, visual thinking and narrative. However, when it comes to the experiments performed in Descriptive study 2, it is most likely that another researcher will come up with the same results. This is due to the rigidity of the experiments and the clear results of the analysis. However, there might be some difficulties for another researcher to have the same conditions and competence to understand the data and establish the same connections between the different areas of interest in the conclusion.

So, regarding validity and reliability on this research it can be summarized in the following way. Regarding the studies performed in order to answer research question 1 validity is considered to be strong while reliability is weak, on the other hand regarding the studies concerned with research question 2 validity is acceptable while reliability strong.
3 Theoretical framework

In this chapter a theoretical framework regarding the reasoning behind creating a brief with a focus on knowledge regarding the differences between storyboarding and written documents is presented. First a review of the three areas building the theoretical framework of storyboarding in pre-brief activities and their relation to innovation will be discussed; design thinking, visual thinking and narrative. Ending with a review of the origin of the idea of using storyboarding at the front-front end of innovation will then be presented which is used to understand the experiment, and finalizing with a review of state of the art in the area of briefing, framing and reframing.

3.1 Design thinking in innovation management

The development and design of new products and services in product development and engineering design originated from and is often based on problem solving (Pahl et al., 2007). Research in the area has its origins in systems theory and the design science paradigm influenced by, for example, Hubka and Eder (1988 and 1996). The ultimate goal is to quickly present an economically manufactured product to the market. For most producers, this is done by working through a chain of decisions: first establishing clear objectives for the product, then identifying the target market segment, and finally trying to systematically determine the customers’ desires or needs. Structured design methods have been developed in engineering design by, among others, Ulrich and Eppinger (2003) and Pahl et al. (2007).

The design process is a model for the application of design in product development. It is part of a company’s entire development process and is used to achieve successful, creative results through the medium of design skills and know-how. The design process can be applied to many different areas and projects that concern processes, messages, goods, services, or environments. A review of these models has been done thoroughly by, among others, Clarkson and Eckert (2005) and Cross (2008). However, according to (Utterback et al., 2006), there are problems in communicating the complexity of the iterative nature of the design process.

For the development of integrated and complex products, engineering and subject-specific development processes based on problem solving are often not enough. It is uncertain whether problem solving alone can be the tool for developing even simple products or services as we are less open to the variety of opportunities that arise in the process. When approaching a problem, the cognitive mindset required to solve the problem differs from that needed when searching for opportunities in creating something completely new. But, of course, we need both thinking styles in collaboration (Drucker, 1998).
As early as 1986, Takeuchi and Nonaka presented their rugby approach. This involves a process with overlapping phases unlike the sequential process supported by the stage-gate model. Takeuchi and Nonaka describe three changes that companies have to consider when moving towards speed and flexibility in making new products. First, the management needs to recognize that the development of new products is an iterative and dynamic process. Second, a different kind of learning has to be adopted from all levels of the organization towards a broader base of knowledge to challenge the status quo. Third, a different mission for new product development needs to be assigned by the management, one that sees new product development as a catalyst for change in the organization.

The concept of modern design thinking is central in the innovation strategy of many organizations (Martin, 2009). In this new context in which design thinking is used, (Dorst, 2011) makes a useful contribution elaborating one core design practice: frame creation, an interpretive way of developing understanding from the explanation of reasoning processes of designers as “design is abduction” (Roozenburg, 1993) to five levels that design practice can relate to the practice of an organization. One level is more interesting and intimately linked to organizational innovations than the others; that level, “the creation of a new frame through the investigation of themes” could, according to Dorst (2011) be linked to 50 years of design research and terms like “entrepreneuring” (Steyaert, 2007) and “effectuation” (Sarasvathy, 2001); these terms have been used to promote knowledge of innovation and entrepreneurship. This opens up for enhancing knowledge regarding innovation through design thinking in general and the interpretation of innovation making in particular.

**From designerly thinking to design thinking**

The concept of design thinking has been around since Rowe (1987) first used it in his book of the same name. However, studies of design activity and behaviour go further back. Simon (1969, 1996), Lawson (2005), Cross (1982), and Schön (1991) formed, with their different backgrounds, the concept of designerly thinking. Charles Burnette describes design thinking as:

“a process of creative and critical thinking that allows information and ideas to be organized, decisions to be made, situations to be improved, and knowledge to be gained” in the IDeSiGN curriculum. (http://www.idesignthinking.com/main.html, accessed on 19th of May 2013).

As explained in the introduction, design thinking is used to explain designerly thinking, rooted in the academic field of design, in an innovation management context (Johansson-Sköldberg et al., 2013). There is also a need to link these two perspectives together, the theories of designerly thinking to the practice oriented field of design thinking. This section is one way of bridging this gap and the way I use the theories is to connect theory with practice and support innovation management with more knowledge regarding the designerly ways of knowing (Cross, 2007, Cross, 1982).
Johansson-Sköldberg et al. (2013) provide a useful frame in the development of design thinking from the 1960s with a focus on what designing is and how it can be developed as a process towards today’s focus in management discussions on development of new business proposals and innovation. They categorize the theoretical perspective of designerly thinking in five sub-discourses, with the foundational work(s) in parentheses:

- Design and designerly thinking as the creation of artefacts (Simon, 1969).
- Design and designerly thinking as a reflexive practice (Schön, 1983).
- Design and designerly thinking as a problem-solving activity (Buchanan, 1992 based on Rittel and Webber, 1973).
- Design and designerly thinking as creation of meaning (Krippendorff, 2006).

In this research the theories develop by Schön (1991) regarding reflection in action as well as Lawson (2005) and Cross (2007) regarding the designerly way of knowing is central. This is combined with the work of Verganti (2009) who builds further on Krippendorff (2006) about creating meaning.

Johansson-Sköldberg et al. (2013) also provide a categorization on design thinking, in what they explain as:

"design practice and competence are used beyond the design context...for and with people without scholarly background in design, particularly in management." (p.123)

The three categories are as follows, with the foundational work(s) in parentheses:

- Design thinking as design company IDEO’s way of working with design and innovation (Kelley, 2001, 2005; Brown, 2008, 2009).
- Design thinking as a way to approach indeterminate organizational problems, and a necessary skill for practising managers (Dunne & Martin, 2006; Martin, 2009).
- Design thinking as part of management theory (Boland & Collopy, 2004a).

In this field the work and practice of IDEO has influenced my work. Looking at a company who is evidently one of the best at what they do in order to theoretically explain their way of working, linking design thinking to designerly thinking.
Simon defined design as a transformation of a situation into a preferred one; designers are “concerned with how things ought to be … in order to attain goals and to function” (Simon, 1969, 1996). Simon also argues design as “satisficing”, settling for the good-enough (Simon, 1975), rather than “optimizing” or “maximizing”, meaning the strategy of looking for an optimal solution with the logic of design as finding alternatives by which the designers learn about the problem at hand by trying out these alternatives (Lawson, 2005). Cross (1982) also agrees with this, stating that:

“Designing is a process of pattern synthesis rather than pattern recognition. The solution is not simply lying there among the data, like the dog among the spots in the well known perceptual puzzle; it has to be actively constructed by the designer’s own efforts” (p. 224).

This means that designers solve problems by synthesis, coming up with solutions that are good enough to solve the problem, compared with problem solving by analysis, trying to find the best or optimal solution to solve the problem (Lawson, 1979). Cross (1982) discusses the “designerly” way of knowing as “a reflection of the nature of the design task and of the nature of the kinds of problems designers tackle”; consequently, when creating knowledge regarding designers’ thinking, both the task of the designer and the problems that designers face in their everyday work must be taken into consideration.

This solution-focused strategy (Lawson, 2005) that designers employ in order to solve problems is also connected with designers’ reasoning activities. This is where the work of Schön (1991) with his theory of the reflective practitioner” is meaningful. Schön framed the professional practice with reflection and learning processes. This new theoretical frame gave insight into how professionals think about doing something while doing it. Schön describes this as reflection-in-action that hinges on the experience of surprise. In designing, this is exemplified by the conversation that the designer has with the sketch. In this conversation time is an important factor in reflection-in-action, and the action-present zone of time that Schön describes could be very small, as in the conversation that designers have with their sketch, but could also stretch over minutes, hours, days, or even weeks or months. The action by design professionals can be transferred into the field of innovation making. Schön (1991) describes design as a reflective conversation with the situation; the designer

“shapes the situation in accordance with his initial appreciation of it, the situation talks back, and he responds to the situation’s talk-back” (p. 79).

Another way of understanding this could be as a type of reframing of the problem space justified by the discovery in the conversation with the situation. When reframing problems, the mindset focus shifts from convergent to divergent thinking as well; this explorative mindset is an important characteristic of design thinking (Howard et al., 2008) and in innovation making (Van de Ven et al., 1999, Rhea, 2003).
Rowe (1987) explains this strategy as heuristic reasoning, in which it is impossible to structure the process in advance in steps needed to be completed in order to come up with a solution to a wicked problem, wicked problems being analogical to ill-defined or ill-structured problems. Design practice then, as described by Goel (1995), is “the process of transforming one set of representations (the design brief) into another set of representations (the contract document)

As Krippendorff (1989) argues, “designing is a sense creating activity”, and we need to consider the notion of making sense of things when describing what designing is all about. Krippendorff (2006) develops his theories and puts designers creation of meaning in center and give five applications of the concept of meaning that have human-centeredness in common. These five complementary manifestations of meaning can be found in: perception, reading, language, conversation with others and as re-representations.

“Meaning is a structured space, a network of expected senses, a set of possibilities that enable handling things, other people, even oneself. They guide action much as a map shows all the possible paths from where one stands.” (Krippendorff, 2006, p. 56).

The action that eventually creates meaning is thus closely connected with sense-making. Nielsen (2009) connects sense with meaning in a model with two different tracks, one using perception and the other using conversations with others (Figure 3.1). This conversation with others is a way of understanding the framing that teams deploy in order to understand or make sense of a problem at hand.

![Figure 3.1. Model from Nielsen (2009).](image)

However, the processes of sense and meaning are always individual, and in order to understand someone else’s understanding Krippendorff (2006) (p. 70) explains a “second-order-understanding” where meanings are seen as “recursively woven into interaction with others”. Since meanings are held by others, you need to interact with them to create an understanding of their understanding. This second-order-understanding can be achieved by conversation, since it is dialogical in nature. By interacting with others, listening to their stories (narratives), a window is provided into these individuals understanding (Krippendorff, 2006).
Krippendorff (2006) also make a point in arguing about different stakeholders’ importance in the outcome of the design process, where he also state that the literature so far has focused on THE users’ role in designing and not so much about stakeholders’. Even though human-centered design mainly embraces users’, THE user as a stereotypical user is avoided. This means that instead of the stereotypical end-user Krippendorff (2006) suggests “a network of stakeholders”, where social processes becomes what drives designing. This is also supported by Brown (2009) who suggests that in the effort to make radical innovations, a survey of customer needs may not be accurate information (Brown, 2009). Instead, according to Verganti (2009), you need to focus on listening to the design discourse, interpreting signals, and addressing these signals. These three actions of Verganti constitute the foundation that enables companies to leverage the design discourse.

In this way the work of Krippendorff is extended by Verganti (2009), into the field of innovation, who argues that innovation in meaning is equally important as technology innovation. Focusing on the interpretation of the information gathered or being, as Verganti (2009) calls the people involved, interpreters of information, is what constitutes the difference between user-centered design (involving THE user) and design-driven innovation where the focus is on creating radical innovations with a new meaning. The step between “listening to the design discourse” and “interpreting signals” constitutes the frame of understanding and creating the design brief. This brief is what drives the design process but, most importantly, clarifies the opportunity for innovation, returning to the importance of framing the right problem and formulating a design brief that takes advantage of the opportunity understood by the information gathered.

Design, design thinking, and design methods and tools are resources that should be better utilized and could be better integrated in future management strategies (Utterback et al., 2006, Brown, 2009, Verganti, 2009, Johansson-Sköldberg et al., 2013). This emphasizes the importance of design thinking and methods for the realization of new innovative products and services as well as the integration of designerly thinking with design thinking.

Edeholt (2008) compares the archetype of engineers as “problem-driven forecasters”, designers as “solution-driven back casters” and artists as “provocation-driven back casters” and builds further on this model by adding the economist as a facilitator leaning on “solution-driven forecasting”. By this Edeholt discusses innovation on a philosophical level and concludes that diversity is central when connecting integrated product development with innovative product development through openness towards the intuition-based understanding and creativity and the interaction with an understanding based on rationality. However, what is interesting in this model is that it is closely connected with learning styles and the way Beckman and Barry (2007) discuss innovation as a learning process. So what we need is both to have an opportunity-finding mindset like designers have and combine this with a problem-solving mindset found with engineers and economists.
In the gap between the divergent and convergent approaches, Tassoul and Bu-
ijns (2007) make an interesting contribution when highlighting clustering as a step
between the divergent phase and the convergent phase instead of being a part of
the convergent phase. In the problem statement phase clustering is characterized
by inventorizing and combining of the issue/area of interest. This contributes to
the area of this research by making connections in the transformation of data to
information, exploring the thoughts and ideas from team members, and building
an understanding of the design space in the team. This work is connected with the
work of Beckman and Barry (2007, p. 36) where they discuss the ultimate purpose
of framing:

"The ultimate purpose of the framing step is to reframe, to come up with a new story to tell
about how the user might solve his or her problem or to come up with a new way of seeing the
problem, which in turn will allow the team to come up with new solutions"

There are no standardized techniques to use to frame a problem. The approach
to the problem plays a significant role when framing an area of interest (situation).
There is, for example, a dilemma of what approach should be used to frame the
problem when choosing between rigour and relevance. For some cases rigour is very
important, but the rigour might add some constraints that could be of importance
for a solution that could have a social influence. An approach focusing more on
relevance might give an opportunity to engage more important and challenging
problems but would on the other hand forsake technical rigour (Schön, 1991).

The development of new products and processes is not straightforward. The pa-
radox is how to decide on the whole process without knowing the parts, while
the parts in turn depend on decisions regarding the whole. This challenge is often
described as being met by a constant iteration between the whole process and the
parts. Yet how is this solved in a large organization designing complex technical
systems? The use of work structures, explicit processes, and efficient tools is often
emphasized.

In design the approach to limited and uncertain information is also to create a
possible solution, a search for what might be. Designers rely heavily on the abduc-
tive process (Roozenburg and Eekels, 1995), when it comes to both problem fram-
ing and problem solving (Dorst, 2011). In fact, abduction is an intrinsic part of the
designer’s reflective practice (Schön, 1991) and use of prototypes (Schrage, 1999).
Where prototypes is a way of visually explain the concept, stimulate visual thinking
in order to develop new understanding and deeper knowledge about the situation.
3.2 Visual thinking in innovation management

When connecting the area of visual thinking to innovation management and design practice Arnheim (2004) plays an important role, describing how concepts take shape in the realm of thinking with images.

“If thinking takes place in the realm of images, many of these images must be highly abstract since the mind operates often at high levels of abstraction. But to get at these images is not easy”. And he goes on. “At best, mental images are hard to describe and easily disturbed. Therefore, drawings that can be expected to relate to such images are welcome material” (Arnheim, 2004, p. 116).

So the use of external representations is useful when thinking, even if these images are abstract and maybe only meaningful for the one creating them. Henderson (1999) compares the use of sketches and drawings to building blocks bridging gaps between designing and production, and since these visual representations are developed and used interactively, they serve as social glue between individuals and teams.

“Sketching is connected with thoughts that are in visual format. As an interactive tool, sketches are the most direct way that an engineer can contribute to a colleague’s conceptualization of an idea – by giving form to concepts pictured in her or his own mind” (Henderson, 1999, p.81).

Thus, the abstract images serve as social glue in the teams and help framing the situation of interest. Taking this idea of visual thinking into the area of understanding the information gathered can create new meaning to the phase of framing and reframing the problem space for innovation management.

The use of tools for understanding, interpretation, and explanation such as sketches is important for designers. Sketches are also central in Schön (1991) explanation of how professionals interact with the situation at hand. Being visual opens up for comments from others, and if the action-present time frame is longer, a stimulus of interaction is supported. Thus, visualization is actually an enabling technology supporting development work by allowing a structuring of information to communicable stories.

Our brain acquires information from the visual environment one to three times per second (Ware, 2008). This external information becomes the content of our visual working memory. To be able to facilitate this memory process successfully, external cognitive tools must be developed to compensate for limitations in human memory and information processing at the same time as they take advantage of them (Tversky, 1999). A cognitive tool can be a sketch, a map, a chart, or a poster of some kind; in this case the storyboard is such a cognitive tool. Visual representations relieve the pressure on memory since they externalize memory and reduce processing load by allowing the understanding to be based on external rather than internal representations (Tversky et al., 2007). When working memory is released,
new information can be processed and creativity stimulated. On the other hand, representations, pictures, figures, and text affect the memory. As such, a story can easily change direction since the representations generate new ideas (Eriksson, 2009).

Visual thinking supports different steps in a development process. The main goal should be the possibility to use visualization in every part of the process, for example in communicating ideas between different parts in an implementation process. It saves time and brings thoughts into a structured and supportive shape. Being aware of shape and function of the visualization during the product realization processing time and in every step of an innovative progression will surely improve the final result in every sense. These communicative processes are not strictly in the explicit product development process. They also exist in phases affecting the process, such as planning the scenario, observing the user, understanding the user, explaining the gathered information, and communicating this to the members of the team. The understanding that comes with the visual communication of all this information improves the overall performance of the design process and conveys information to the entire group. To make this happen, the team members must understand each other’s information needs (Clarkson and Eckert, 2005).

Also, creativity is enhanced by allowing designers to interpret sketches and create new knowledge through them. The designer views this as interacting with the sketches in a conversation-like manner: the designers see more in their sketches than they put in when they drew them, and these insights drive further exploration (Schön, 1991). In creative processes, one often refers to a five-step model that includes preparation, incubation, insight, evaluation, and elaboration.

"This classical analytic framework leading from preparation to elaboration gives a severely distorted picture of the creative process if it is taken too literally. A person who makes a creative contribution never just slogs through the long last stage of elaboration. This part of the process is constantly interrupted by periods of incubation and is punctuated by small epiphanies" (Csikszentmihalyi, 1997, p.80).

If we do not take the framework too literally, as Csikszentmihalyi suggests, this description of a creative process can be useful in communicating what actually happens in this process. Figure 3.2 shows how this process can be linked to the conversation designers have with their sketch.
Sketches facilitate both individual thinking and interactive communication because they allow these processes to occur simultaneously; they become group-thinking tools (Henderson, 1999).

If we focus on how our brain works regarding these questions, we find that that process is linked to our way of creating understanding in what we see. We also discover that this understanding raises new questions that stimulate other parts of our brain. Every second, billions of bits of information hit our retina when we look at the world. However, we actually see only about one thousand bits. That is because we sort the information bits into things we need to see. This means that we need to have already made sense of a problem in order to be able to see it. Otherwise we would only be looking at the problem without creating any understanding of it.

As we have discussed already, our understanding is based on an interaction between internal and external images. Hansen (2007) points out that individuals use three different ways of receiving information: external, internal, and a combination of the two.
Roam (2008) maintains that sketches can be used to define problems from the questions who and what. What he actually does is encircle the problem by asking what is going on and who is in charge. By putting a mark on a sheet of paper, he visualizes the problem. But the sketches do not show the appearance of the problem and the person responsible; rather, they represent the metaphor “encircle the problem”. We talk about problems in terms of quantities, but in reality they cannot be measured. Roam asks: How many problems? This question can be visualized if the problem is compared with other troubles that are less important or more urgent. In an abstract graph, the proportions of the problem will be tangible. The question “Where?” is related to location.

Visualization can be either topographical or metaphorical if the problems are located in the organization and the visualization goes from abstract to concrete. By grading the problems, it is possible to make a scheme for scheduling and timing answering the question When? A sketch of the workflow or scheme will help the people involved to get an overview of the whole process. Roam puts forward that a flowchart can be useful for the discussion of how to act, and a multiple-variable plot can explain why.

Roam’s ideas for how sketches can be used in problem solving and the selling of ideas make sense. Yet they also raise questions. First, he does not discuss the relationship between sketches and verbal comments. He frequently uses text in his sketch examples in his book (Roam, 2008) and in his lectures. Without the accompanying text, the sketches would be useless. Second, it is important to make clear that many problems cannot be solved with images. Third and finally, he does not seem to be aware that many of his examples are visualizations of metaphors; consequently, the sketches are highly abstract. So if we use what our senses perceive with what our mind’s eye sees, our imagination, and combine these we get visual thinking.

Ware (2008) points out that we can only do one visual task at a time, and we can only do one verbal task at a time as well. However, when combining visual and verbal modalities, our brain is most effective. So if we use what our senses perceive with what our mind’s eye sees, our imagination, and combine these we get visual thinking. And, as quoted earlier,

“The combination of imaginary with the real is what makes visual thinking such a marvel and is a key part in the internal-external dance of cognition” (Ware, 2008, p. 179).

This imaginary thinking involved in visual thinking connects back to designers concern “with how things ought to be” and this also combines the imaginary thinking involved when telling stories, thus connecting narrative theory to the framework.
3.3 Narrative in innovation management

There is a call to enhance knowledge regarding the process of innovation in more depth and its relation to everyday practice (Blake and Hanson, 2005, Miettinen, 2002). As an answer to this call, this section aims at highlighting innovating – the doing of innovation – from the perspective of innovation telling and innovation making, the narrative of an innovation process. These aspects of innovating are entwined and woven together in practice, but as will be demonstrated here, they also make up two lenses to understand how innovating is shaped in social processes. Moreover, they seem to fill different roles in practice.

In modern social science, language has become used extensively to analyse individuals, organizations, and societies from many different perspectives. Language-sensitive approaches have thus been advocated and increasingly applied to organization studies in general (Alvesson and Kärreman, 2000) and are here proposed to contribute with new perspectives in the study of the innovation process. There are, however, different views on the study of text, from text interpretation and deconstruction to narrative analysis and discourse analysis in a variety of ways (Gergen, 1999, Calás and Smircich, 2006); (Laclau and Mouffe, 1985, 2001). Philosophically, the methodology of narration can be traced back to the works of MacIntyre (1984), where the reflexive ability of individuals to develop independent views despite an overwhelming complexity and influences of society. Narratives are not only constructions of meanings but are a way for individuals to organize their life and create order by connecting different parts of life into a coherent whole (Abbott, 2008). Narratives are also proposed to be an important means for making and moving ideas in an organizational setting (Whittle and Mueller, 2008, Brown, 2009). Any organization involved in innovation should of course be interested in learning, in listening to stories, and in teams interpreting the meanings of them to support learning (Reissner, 2005).

Despite various standpoints taken in the different approaches they all share the idea of problematizing the belief in language and the truths and information that it conveys (Alvesson and Kärreman, 2000). In short: language has its limitations, concerning both content and implications of information. There is, for instance no valid causality between what an individual says and what he or she actually does. What a person says in one context could be put in another way in another context, implying that attitudes are not stable (Potter and Wetherell, 1987). What individuals say in certain situations is thus partly a product of their own intentions, but partly also a consequence of social interaction in these situations. While taking a critical stance towards language as a source of information, one might also make the opposite claim: people really mean something with what they say and what they say should be taken seriously. The narrative approach therefore motivates viewing language as a vital means in the making of innovation, instead of seeing language as only a mirror that tells about the innovations already made.
Innovation telling and innovation making

Narratives in innovation provide a way to coordinate the future with the past within the present, Bartel and Garud (2009) explain that “individuals translate narratives in ways that activate imagination about the future in the present moment”. They conclude that narratives that are created before, during, and after an innovative effort support the organizational memory regarding its innovative experience and by that internally communicate an organization’s innovation capability. This connects the concept of storytelling with innovating; storytelling is a concept that is frequently used in narrative approaches, generally describing how stories are part of informing, persuading, and impression management (Denning, 2006). However, when it comes to how people hook up to the story – how a story is shaped and reformulated in interaction – that is an issue that does not seem to have received the same attention in narrative research. A useful contribution to understand the making of a story is made by Johansson (Johansson, 2004), who makes a distinction between storytelling and storymaking in a study of business consulting practices. While storytelling is identified as a metaphor for management consulting, with a focus on impression management, storymaking is suggested as a metaphor of the cooperative efforts in creating the story. Johansson also describes how reflection, opening the plot, and action, closing the plot, are vital parts in the process of storymaking. This opening and closing the plot serves as a negotiation of the constructions of characters, and through this process new knowledge is developed. Similarly, opening and closing the plot can be seen as the negotiation of the innovation, which emphasizes that innovating is in itself a learning process, and thus a way to develop new knowledge (Beckman and Barry, 2007).

I propose that both storytelling and storymaking are parts of the innovation process and are therefore also vital concepts to elaborate on when paying interest to what is going on when innovating. Onwards storymaking and storytelling are translated to innovation by proposing that both innovation making and innovation telling are part of the innovation process. While innovation making constitutes an analogy for “producing innovations”, innovation telling makes up an analogy for “selling innovations”. Considering that storytelling emphasizes persuasion and impression management, innovation telling is characterized by monologue and show, and on the contrary, innovation making emphasizes dialogue and enactment. From a narrative perspective then, in innovation telling, the story of the innovation is settled, fixed, and “sellable”. But in innovation making the story of the innovation is open for revision and negotiation for anyone involved. In Table 3.1 the characteristics of innovation telling and innovation making are outlined.
Following Johansson’s (Johansson, 2004) conclusions in his study of consultants, it is emphasized that storymaking is an act of reflection. Since reflection-in-action is a theoretical approach that emphasizes reflection on the situation (Schön, 1991), we propose that the theories of reflection-in-action complement the narrative theory.

### 3.4 Visual narrative, an understanding of reasoning

When Schön developed the theory of the reflective practitioner, he framed the professional practice with reflection and learning processes (Schön, 1991). This new theoretical frame gave insight into how professionals think about doing something while doing it. Schön describes this as reflection-in-action that hinges on the experience of surprise. In designing, this is exemplified by the conversation that the designer has with the sketch. Regarding this conversation that designers have, time is an important factor in reflection-in-action, and the action-present zone of time that Schön describes could be very brief, as in the conversation that the designers have with their sketch, but can also stretch over minutes, hours, days, or even weeks or months. The action in design of professionals can be transferred into the field of innovation making. As explained earlier Schön describes design as a reflective conversation with the situation (Figure 3.3); where the designer “shapes the situation in accordance with his initial appreciation of it, the situation talks back, and he responds to the situation’s talk-back” (p. 79). Also, the designer’s use of problem-solving methodologies and mindsets is related to a chain of decisions involving reflection-in/on-action. The focus of problem solving is in the naming and framing phases, where the objectives and the goal of the project are identified (Wikström and Jackson, 2012a).

In the conversation that designers have with the situation (Schön, 1991), the focus is on one individual interacting with the situation with some kind of medium (for designers, the sketch). The creation of mental models and the interaction with the medium embody the individual beliefs about the situation. Leaving these beliefs without reflection may lead to a misguided belief, described by Argyris (1990) as “the ladder of inference”. If we climb the ladder of inference without reflecting on the data we have observed, making our selection, adding meaning, making assumptions, drawing conclusions, adopting beliefs about the world, and finally taking action based on these beliefs, the situation is based on our own misguided beliefs; the way to avoid this is described by Senge et al. (1994) as communication through reflection to create beliefs that reflect the real situation.

<table>
<thead>
<tr>
<th>Innovation telling</th>
<th>vs</th>
<th>Innovation making</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Innovation telling” metaphor for “selling innovations”</td>
<td>“Innovation making” metaphor for “producing innovations”</td>
<td></td>
</tr>
<tr>
<td>Monologue and show</td>
<td>Dialogue and enactment</td>
<td></td>
</tr>
<tr>
<td>The story of the innovation is settled and fixed</td>
<td>The story of the innovation is open to revision and negotiation</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Characterization of innovation telling and innovation making
When proposing that design methodology can be used in the creation of a brief, it is actually the thinking of designers that can add value to the process, and this is the motivation for introducing the way designers think to the front-front end of innovation. When understanding how designers think, the common reasoning activities of deduction, induction, and abduction are central, and according to Roozenburg (1993), “designing is abduction”, which motivates Dorst (2011) to further develop the “core of design thinking and its application” with the creation and use of frames linked to what he calls “Abduction-2” explained as an open reasoning process with only the value to create as a known component.
However, before we immerse ourselves in this abduction-2 thinking, we first need to understand the basics behind the different reasoning patterns humans employ when solving problems. In this I follow Dorst (2011) rather simplified (Figure 3.4), and in my case somewhat modified, explanation to be applicable in this context.

<table>
<thead>
<tr>
<th>General setting of deductive/inductive reasoning</th>
<th>General setting of abductive reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHAT (thing) $\rightarrow$ HOW (working principle) $\rightarrow$ RESULTS (observed)</td>
<td>WHAT (thing) $\rightarrow$ HOW (working principle) $\rightarrow$ VALUE (aspired)</td>
</tr>
<tr>
<td>Deduction</td>
<td>Abduction</td>
</tr>
<tr>
<td>WHAT $\rightarrow$ HOW $\rightarrow$ ???</td>
<td>??? $\rightarrow$ HOW $\rightarrow$ VALUE</td>
</tr>
<tr>
<td>Induction</td>
<td>Abduction-2</td>
</tr>
<tr>
<td>WHAT $\rightarrow$ ??? $\rightarrow$ RESULTS</td>
<td>??? (thing) $\rightarrow$ ??? (working principle) $\rightarrow$ VALUE (aspired)</td>
</tr>
</tbody>
</table>

**Figure 3.4. Human reasoning activities, adapted from Dorst (2011).**

In deduction we know what is involved in the situation, we also know how (working principles) they are connected to each other (operate together) and by this we can predict the results of the situation.

By induction, however, we still know what is involved in the situation but we do not know how these things are connected with the situation but we know what the result will be. This means that we can actually calculate the working principles that connect the result with the what in the situation.

In abduction we change the results to value, since in design we want to create value and not results as facts, and the reasoning could be seen as a search for value in a specific scenario using a specific set of working principles and by that come up with the what in the situation. This way of reasoning is known as a type of conventional problem solving, a closed problem-solving approach, meaning that the working principle guides you towards the what in a way that closes opportunities for new ways of experiencing the situation of interest.

The new thing in abduction-2 according to Dorst (2011) is that the only known part in the reasoning process is the value creation, so in order to solve an equation with two unknowns, designers use a type of frame creation; combining a certain working principle with a specific value will create the what (object, service, or system) in the situation of interest. And this frame creation is the core challenge in design thinking.

This frame creation can also be seen in the sensemaking process of synthesis (Kolko, 2010a). In his “action-framework of synthesis” Kolko identifies three specific types of actions in designers’ synthesis creating positive results for both abduction and sensemaking: prioritizing, judging, and forging. The presentation of the method “reframing” is interesting in this context, of course linking back to Schön.
However, abduction was initially described by Peirce (1934/1960) as the process of forming an explanatory hypothesis and as the only logic operation to introduce any new ideas. As described by Peirce:

“The abductive suggestion comes to us like a flash. It is an act of insight, although extremely fallible insight. It is true that the different elements of the hypothesis were in our minds before; but it is the idea of putting together what we had never before dreamed of putting together which flashes the new suggestion before our contemplation”(5.181).

Abduction is primarily used when information is limited and uncertain (Mounarath et al., 2011) as it is at the front-front end of innovation. It allows the designer to make a hypothesis and test this hypothesis through interaction and further development.

When Peirce (1934, 1960) describes abduction that comes to us like a flash, acting like a strike of insight when different elements in our mind are put together, the connection with intuition seems relevant. Simon (1969, 1996) explains most intuitive leaps as acts of recognition connected with experience, so that the connection with cognitive activities and our memory triggers our intuition. This links back to the term insight and Arnheim (2004) exemplifying problem solving by insight; he claims that this can only be explained if you know what mechanisms it involves, and since insight relates to sight, Arnheim raises the question about how much perceptual awareness contributes to the problem situation. Goldschmidt (1991) also elaborates on “seeing as” and “seeing that”, proposing that:

“Sketching introduces a special kind of dialects into design reasoning that is rather unique. It hinges on interactive imagery...for the purpose of visually reasoning not about something previously perceived, but about something to be composed, the yet nonexistent entity which is being designed” (p. 140).

Arnheim (1993) takes this under consideration and explains “creative design as an interaction of arguments and moves” (p. 15), where arguments are the reasoning and exploration of the design task that goes on in the designer’s mind and moves are the drawings or sketches produced that feed the arguments. It is in this “conversation” (as Schön calls it) that development arises. This connects doing (moving) and thinking (reflecting) and makes them contemporary (Schön, 1991).
Visual narrative in the area of innovation management

In the field of using visual thinking and narratives as a foundation of innovation management two areas can be brought up as part of this framework, products or ideas for products and the field of process management.

Starting with the use of visual thinking and narratives to understand a user experience of a new product or service, much is being done. There are tools and methods for this. Buxton (2007) gives an example in the category of visual storytelling of “boarding a game to avoid boring game”, where the layout is like that of a storyboard. The use of storyboards is well documented. Van der Lelie (2006), for example, shows that storyboards can be used in product design on two levels, for experience and reflection of the visualized interactions. However, this is just another presentation in which the outcome of performing the method is used. In the case of storyboards in this research it is the making of the storyboard that creates the value.

During interviews at IDEO (Study A), a customer journey came up as a method (or tool) to visualize the understanding of a situation in order to learn more about it. This can closely be connected with storyboards since the journey describes a situation that needs to be explored. IDEO also has several other visual tools in its method cards (IDEO, 2003).

There is also an interesting tool in Soft Systems Methodology called Rich Picture (Lewis, 1992). This tool is mainly used to learn about ill-defined problems using symbols and sketches in a mind-map-like manner. These representations often contain both the structure of a situation and the process. When creating a rich picture, the individual learning about the situation is in focus, but most rich pictures are developed by teams, which leads to shared understanding about the situation. The utility of the rich picture is in the finished representation, where other stakeholders can acquaint themselves with the representation and learn more about the situation. Berg and Pooley (2011) argue that a structure evolution is needed by providing a common key of symbols to the rich picture. However, the use of schematic images can also distort the values one seeks to uncover by using sketches that are drawn by hand and in a situation where reflection is actually aided by the time spent on each sketch.

There are several streams to follow when exploring the field of visual narrative in innovation management attention in processes. There are visual planning tools and process mapping tools to describe processes in order to communicate. One interesting tool in this area is the A3 visualization used at Toyota, a format that has been further developed by Shook (2008) as a management process. Even if the A3 process is widely used for “innovating, planning, problem-solving and building foundational structures for sharing a broader and deeper form of thinking” (p. 1) it still uses a communication perspective on visual thinking. The first step in the A3 process is to define the current situation by examining the actual situation and “go see, ask why, show respect” (Shook, 2008).
However, despite the importance of design and visualization in strategy work, it has only recently become a central issue in management thinking (Chanlat, 2006, Liker, 2004). The notion of visual management (Greif, 1991) belongs to the field of visual communication. It mirrors lean production in factories from a visual communication viewpoint. Visual management focuses primarily on visual control in factories but also on the intricate relation between visual communication and management. Still, visual communication should not be isolated from management (Greif, 1991). Even though there are visual thinking tools available, there is a need for complementary visual thinking tools in the field of innovation management. Benner and Tushman (2003) state that:

“process management and its associated technologies and philosophies are conservative and resistant to anything but incremental or competence-enhancing innovation” (p.253).

This statement is quite provocative since almost all companies use some kind of tool for process management. What is needed is to take advantage of the exploitation of process management but not constrain the exploration required for long-term adaptation.
### 3.5 Storyboarding, framing opportunity for innovation

This section will introduce the theoretical hypothesis that will be explored using the experiment with storyboarding as a visual narrative tool for framing and reframing a situation of interest. The purpose of any narrative is to capture the thread of the audience (Ware, 2008); however, when creating a storyboard in teams, the narrative is developed in negotiation and over time and the thread is not visible from the beginning. Pimenta and Poovaiah (2010) make an attempt at defining visual narrative and make a useful contribution to framing visual narrative in the area of visual studies. Their view is on the finished narrative and not the making of a storyboard. However, there are some interesting thoughts about what they call static visual narrative (SVN), and some of their defined characteristics can be used in the making of the storyboard as well; in the following these are commented on with regard to their applicability in this framework.

Since the visual occupies a surface medium, the story unfolds over space.

This means that in the making of a storyboard it does not only unfold over space; it is created over space.

The visual is fixed but the viewer’s eye is mobile.

Since the visual is created in the situation and the viewer is the creator of the visual and the story, this opens up for the imagination of the story to come into the mind’s eye.

The sequence of viewing the story is not determined but the viewer decides the sequence in which to view.

This is also the case in creating the story and since the story is modified on transferable post-its, the sequence of the modules can be altered and the story under development rebuilt.

The viewer is in control of the time taken for viewing the SVN.

Since the viewer is also the creator of the storyboard, the time for creating the story can be altered, stimulating reflection-on-action.

The visual only provides cues to the story in form of visuals.

These cues are also cues to be interpreted in the mind of the entire team. A negotiation in the teams will occur in order to continue the story.

When creating a storyboard, you represent a story with sketches using visual thinking and a narrative in an interactive way. The story is intimately connected with the sketches and it follows the reasoning activities involved in sketching, towards an understanding of the situation of interest. The process is intertwined and woven together, and this is what is interesting, the reasoning activities in the situation of both visual thinking and narrative. When stories are told, a construction of meaning simultaneously occurs, as a search for the next step in the story, the next blank in the storyboard. This search could be explained by something that we look for in a
narrative to resolve or close (Abbott, 2008). The modularization of the story, defining parts in the story that could be visualized, stimulates a surprise in the story that supports creative thinking and the idea generation that takes place. The surprise is stimulated by the gaps that are created between the blanks in the storyboard by the term closer in narrative theory. The word closer is important in narrative theory and is triggered by either suspense or a surprise in the narrative. The sketching of the story is a creation of meaning, shaping reality, a co-construction in a dialogue by joint efforts and interaction among people. The situation is sketched in order to make sense; this relates to reflection-in-action in the iterative process of creating new knowledge by defining and refining the situation.

The interactive reasoning activities of visual thinking and narrative could also be understood using a divergent and convergent approach, and in the gap between these a step of clustering could be added (Tassoul and Buijs, 2007). This contributes by transforming data to information, supporting the development of a design space that is built on the team’s understanding of the situation. This clustering also supports the creation of a common mental image of the situation.

What happens when telling stories is that you pick a situation to focus on. This situation constitutes a part of a culture; when knowledge is developed about this specific situation, knowledge is also developed about the culture in which the situation occurs. As Beckman and Barry (2007) explain culture plays an important role in product choice, usage, and resistance, and with this knowledge we can understand the meaning in the situation. The idea behind this is that by telling stories you can understand the culture in the situation and through this create meaning in the situation, both by making sense of the situation and by opening an opportunity for innovation of meaning.

When using storyboarding in the sense that is described, in the field of briefing, framing and reframing is the core field in where this research contributes and adds new knowledge. In the following section a review of “state of the art” regarding research in the field of briefing, framing and reframing is presented.

**Briefing, framing and reframing**

When understanding an organization’s needs and resources, the process of briefing, matching objectives and mission to future visions and goals, is central. The process involves problem formulation and is about identifying and communicating intangible needs and specifying the quantifiable. The decisions and actions needed to be taken in order to solve a problem are formalized in a brief (Blyth and Wortington, 2010). Depending on the design challenge identified, the specifications of the design brief can differ in shape and format. In most cases, a design brief is a description of a project that requires some form of visual design (Phillips, 2004). The basic context of a design brief is the background of the problem including a wish or a demand, not a solution (Cross, 2008). The most common format is a written brief designed in a way that inspires and motivates the designer to create great work sa-
tisfying the client. What to include in the design brief will be decided based on the specific project needs (Best, 2006). The brief should be easy to read and track and is usually written in a narrative format or in a bullet-list format (Phillips, 2004). The outcome of creating a design brief is dependent on how the process of framing and reframing the area of interest is accomplished.

In order to define a brief there is a need to comprehensively understand the context in which the problem exists, which asks for an in-depth analysis regarding the technological perspective as well as contextually (Gassmann and Zeschky, 2008). Regarding this understanding there are difficulties connected with the existing products and technologies used, and the contextual analysis often relies on market research.

When managing innovation there is a lack of tools and methods for management. Verganti (1997) points at seven principles that need attention, of which one is closely connected to the phase of problem formulation, namely the need for harmonized objectives, and concludes that there is a great need for “instruments” to support management. The interface between managers and designers is often neglected; Petersen et al. (2011) state that the design brief is identified as a key bridging tool between designers and company program managers.

As a designer you use the reflective conversation with the situation (Schön, 1991) as a way of making meaning related to the data collected. Kolko (2010b) describes this meaning-making as design synthesis closely connected with sensemaking as “deeply related to a process of ‘socialization’, whereby those with ideas and data share that with others in an effort to actively disseminate information and build consensus”. This social process in making meaning of the data collected in order to understand the design space is something that Hey et al. (Hey et al., 2007) studied. In their research they observed teams performing at the front end of innovation, framing and reframing the situation. They found four phases of framing and reframing in design teams. These phases were “pseudo-frame setting”, “individual frames made explicit”, “conflicts made salient”, and “common frame negotiated”. Their conclusion is to encourage design teams to focus on raw user data to guide their activities in the early phases, and the sooner an iteration (doing all four phases of framing and reframing) is performed, the sooner the students will be able to get a shared understanding of the needs of the users and, as they call it, “get on the same page”.

As a designer you tend to reformulate structured problems into ill-structured problems (Thomas and Carroll, 1979), which implies that the designer will look at the problem definition as a map of unknown territory (Jones, 1992) there to explore and not as a definite road to follow. When solving ill-structured problems you must go through two phases. First you need to structure the ill-structured problem and then solve the well-structured problem (Simon, 1969, 1996). These two stages have been adopted by many researchers. Akin and Moustapha (2004) argue that problem structuring is a prerequisite to problem solving:
“Problem structuring consists of a series of transformations converting an ill-structured problem to a well-structured one” (p. 43).

The aim of briefing is to frame and reframe a problem so that an actual and shared view of the problem can be created. When a brief is formulated, framing describes the scope for a design problem and could be seen as a flexible constraint on the problem (Kolko, 2010b). Looking at a frame from a design perspective, it can be described as the most important creative step that must be done in order to create a unique solution. The phase of framing the problem is of great importance for the success of innovation, as mentioned before; it does not matter how well the process is managed or the design is realized if it is based on the wrong assumption regarding the problem (Cooper, 1988). This means that it is crucial to understand and frame the problem in a way that the opportunities for innovation are in focus in order to know what to bring into the design space. Framing is executed in order to find the deeper reasons for the problem presented by the client, at the same time as it gives the designer a new perspective (Paton and Dorst, 2011). According to Schön (1991), a frame comprises the context of a problem together with a set of named categories, which creates certain conditions for the problem solving. These conditions are essential in order to be able to use technical expertise to solve the problem.

When framing and reframing a situation, a divergent/convergent approach is applied and an opening and closing of the plot takes place. This plot is characterized by a series of events that constitute the actual situation and the act of surprise in constructing the story explaining the situation.

There is a difference between individual frames and frames made by teams. All members of a team create their own frame based on individual assumptions and knowledge. A frame made by a team needs a great deal of communication to be shared, and a frame that is not shared by the team often results in tensions and conflicting ideas, which counteracts consensus (Hey et al., 2007). The more aware a team or a person is of their personal frames, the more opportunities for new ways of framing the problem arise. This also makes it possible to emphasize the values that are important for the problem and its solution and to leave out those values that are not important. An awareness of the personal frames often brings up the dilemmas in the situation and makes the team aware of them (Schön, 1991). Valkenburg and Dorst (1998) discuss the importance of frames in design teams; their research indicates that the development of frames is important.

Beckman and Barry (2007) emphasize three means of extracting information from a vast array of observational data; the first is concerned with the identification of stories, an approach to what they explain as a way of connecting the team with the emotional aspects of the area of interest. The second approach is to identify interesting dimensions of user behaviour and create two-by-two matrices from these findings. The third approach is to connect framing to a timeline; describing what is going on over time is a way to add information to an “era analysis”.

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Another way of understanding this could be as a type of reframing of the problem space justified by the discovery in the conversation with the situation. When reframing problems, the mindset focus shifts from a convergent to a divergent approach; this explorative mindset is an important characteristic of design thinking (Howard et al., 2008) and innovation making (Van de Ven et al., 1999, Rhea, 2003).

However, there are also some general difficulties that can arise when framing and reframing a situation. Fixation of either the client’s idea of the solution or the designer’s initial idea can be a barrier to innovative ideas (Paton and Dorst, 2011). Some designers might experience fixation when looking at solutions and designs performed by other designers or be restrained by knowledge about the usage or properties regarding the problem or object in focus (Purcell and Gero, 1996). Approaching the situation using a mental model based on problem solving can restrain the designer at the front end of innovation processes (Paton and Dorst, 2011). However, there are psychologists arguing fixation as normative but malleable (Smith, 1995).

There could also be a problem with biases in problem finding, according to Hurmelinna-Laukkanen and Heiman (2012). They highlight three areas in which managements need to make choices. The first concerns process selection to overcome bias in problem formulation, the second is problem selection matching problem types with firm capabilities, and the third is to match governance mode with knowledge hazards and search processes. In problem finding, an awareness of existing biases could lead to a conscious discriminating alignment connected with bias/process.

3.6 Summary

This chapter has presented a framework regarding design thinking, visual thinking and narrative in the front-front end of innovation with specific interest on innovation management. The conceptualization of these theories to storyboarding is presented. The implementation of storyboarding in the field of briefing, framing and reframing is described. Finally previous research regarding the areas of briefing, framing and reframing is presented.
4 Presentation of studies and empirical findings

This section will present the different studies. The structure follows the phases of DRM, research clarification, descriptive study 1, prescriptive study and descriptive study 2. The reporting has also been standardized in every study to support the reader. First an introduction and aim of the study will be presented, then the research approach are outlined followed by the results and evaluation of the results. The conclusion summarizes the findings and last the continuation is described. After each phase in the DRM a reflection finish the section.

The different studies performed are visualized over time in Figure 4.1. This shows that there are parallel studies going on at several times and the chronological order is not consistent. This is mainly in study C, where knowledge regarding narrative in innovation is developed. This study is influenced by study A that have enhanced and brought a deeper knowledge about narrative in innovation.

The different studies provided a foundation for enhancing knowledge regarding the use of visualization as well as insights into what aspects are important for supporting management in their endeavour to achieve success in innovation making. The idea of using storyboarding came up during 2009, and a process of enhancing knowledge in how storyboarding can be used in different parts of innovation processes started, interviews with project leaders from the film industry alternated with testing storyboarding on students and discussing with colleagues. These tests resulted in using storyboarding to capture experiences from performed projects and at the same time the idea of using storyboarding as a method to synthesize information at the front-front end of innovation came into my mind and three studies was performed in order to understand storyboarding in team pre-brief activities.

4.1 Research Clarification

The research clarification contains studies performed in order to understand how design thinking and visual thinking affect the front-front end of innovation (Studies A and B). In these studies an explorative approach has been used in order to develop knowledge and identify gaps in the context to which this research can contribute. In Study A a total number of nine open interviews were performed at a company; there were also several informal conversations resulting in deep knowledge regarding the case company and best practice of design thinking as well as designers’ use of visual thinking and narratives. Study B was performed as a reanalysis of 26 interviews regarding visual thinking and the connection with reflective practice. The results from these studies gave insights into how design thinking and visual thinking affect innovation at the front-front end of innovation.
Figure 4.1. Timeline, visualizing the different studies over time.
Based on the objective and the initial exploration of the field, the purpose of this study was to discuss and analyse how design and design thinking contributes to the incorporation and management of innovation in development work. Specifically, the question is how design and design thinking can contribute to an innovative development process in a conscious, controlled, and cost effective way. The subject will be reviewed from a theoretical and a practical point of view. In order to analyse and build knowledge of the design thinking phenomenon in practice, this study will analyse a case study based on interviews at IDEO, a company successful in its work with innovative development using design thinking.

**Research approach**

The development process of products and processes is not straightforward. The paradox is how to decide on the whole process (without knowing the parts), while the parts in turn depend on decisions regarding the whole. This challenge is often described as being met by a constant iteration between the whole process and the parts. Yet how is this solved in a large organisation, designing complex technical systems? The use of work structures, explicit processes, and efficient tools is often emphasised.

Several researchers have concluded and specified success factors for efficient and effective product realisation. Categories such as market, technology, environment, and organisation are often found to impact the success of product development. However, one question is how these factors are related and connected to design and design thinking. What is the relationship between the factors and the reflective practice within design?

Schön developed the theory of the “reflective practitioner”. In doing so, he used reflections and learning processes to define the professional practice of design. This new theory provided insight into how professionals think about doing something while actually doing it. Schön describes this as “reflection-in-action”, which is based on the experience of surprise.

In summary, the analysis of success factors for innovative development, and the relationship to reflective practice, shows the relevance of analysing how design and design thinking can contribute to a structured innovative development process. Some reflections on this is how design thinking works in practice. How does one handle the complex situation of being successful in design and innovation, and how does a successful innovation company actually do it. Further, how are new ideas generated, and what part does design thinking play. This study will further examine how the company IDEO works, comparing this with success factors and Schön’s paradigm of the reflective practice.

The empirical research presented in this study has been conducted in collaboration with Prof. Mats Jackson through qualitative investigative methods in order to analyse how design and design thinking is used and integrated in innovative deve-
lopment work in practice. A case study has been performed at IDEO in accordance with the guidelines identified by Yin (2009). The case study was started with an initial literature study where theory related to innovation and design was reviewed. The later study at IDEO was done in an explorative manner, with the purpose of analysing how companies do innovative development work.

IDEO, one of the leading design and innovation firms in the world, has become successful through the systematic use of tools and methods that stimulate creativity, new ideas, and diversity. This brings innovation to the very heart of the organisation. IDEO has been included in Fast Company’s list of the top 25 most innovative companies, has been ranked as one of the most innovative companies in the world by the Boston Consulting Group, and has won more IDEA awards than any other design firm. These merits justify choosing IDEO when seeking to understand how companies work to create new innovations through the use of design thinking, the approach IDEO uses.

The case study at IDEO was conducted in 2010 and 2011 and involved interviews and visits in Palo Alto, California, as well as Boston, Massachusetts. The specific goal of the study was to analyse IDEO’s development process and, specifically, how such an innovative culture has been built that has generated many different innovative products using design and creativity. Looking at the best practice of a design and innovation firm, the goal has been to understand the integrated activities and approaches with regard to how design and design thinking lead to innovative development. The following questions were posed:

Why is IDEO successful in generating new concepts and products?

The first question is an open question with subjective answers. Still, it is interesting to explore how those responding view the company and whether any specific success factors are mentioned.

What does IDEO’s design process look like, and what are the formal steps and decision points?

This question was initially posed based on the notion that there is a need for an explicit and normative process for managing development and innovation.

Are any specific tools used to help the creation of new ideas?

In this question, we search for specific tools supporting and helping the process. The idea is to learn and explore work practice through the actual work of generating ideas and concepts.

Data collection was based on a theoretical review and interviews performed at IDEO on two different occasions. The total number of interviews was nine, and the interviewees were designers, project managers, behaviour scientists, marketers,
and engineers. The process of performing the interviews and the analysis after was performed as described in Figure 4.2. Since we were two people attending the interviews we had two set of notes that was compared and transcribed and then compared again before the analysis.

Figure 4.2. The process of the interviews.

Results

Regarding the success of IDEO, the following characteristics can be identified:

- An empathic way of understanding the human involved with the object to be designed.
- A flat structure of the organization and the use of multidisciplinary teams in the projects.
- An efficient use of methods supporting idea generation in different ways.
- An ability to always use visualizations to communicate within the team and with others.

When the answers connected with the second question were synthesized, some difficulty arose, due to the fact that four processes were visualized in order to explain the different steps and decision points during project execution. The different processes had four to nine steps, explained by one respondent like this.

"The process is developed since 10 years ago with seven steps down to four. The change has also been towards more experimental. If you have followed the process a few times you start to mix it. The process is an open structure were you adopt to the situation with many iterations."

The following presentation is a synthesis and an explanation of the steps from the four processes. This statement "The idea of process doesn´t exist" from a senior designer forced a rethinking of the idea of process. The way IDEO work is therefore seen more as a framework with three key areas, inspiration, ideation, and implementation.

The study shows that inspiration and information gathering are important in design thinking in order to fully understand the context of the observed area and to
gain insight into the problem. You collect information in order to share it in the project team. Storytelling is used and is important to create a common mental image of the area observed. Since the work is focused on human-centred design, the aim is to understand humans on multiple levels: social, cultural, cognitive, emotional, and physical. This becomes the foundation of the synthesis of the information gathered and the stories told. The stories help provide a framework for creating ideas, as well as making clear what the design problem actually is. Stories also help to scale and frame the design problem, thereby making it easy to formulate a design brief. The stories help navigate ideas through an organization because of their richness of available intersections for interpretation and openness to feedback. Stories are useful because they are based on specific events, not just general statements. They provide the design team members with concrete details that help them (and us) imagine solutions to particular problems. In this way, IDEO creates a story about a product before it exists.

When ideating, the focus is on creating opportunities based on a need, creating many possibilities through divergent/convergent thinking. This ideation aggregates, edits, and condenses what is learned. It enables the team to establish a new perspective and identify opportunities for innovation. In this phase, most designer teams work together in a workshop format to translate what they hear from people (stories) into frameworks, opportunities, solutions, and prototypes. During ideation, people move from concrete to more abstract thinking in identifying themes and opportunities and then back to concrete thinking, with solutions and prototypes. Build to think is the mantra of ideation. One can see this as a source of learning by making in order to further evolve ideas. The use of prototypes at IDEO speeds up the process and shows strengths and weaknesses explicitly.

Implementing the solution is based on engineering with a focus on developing, expressing, and executing the vision of the project. However, this phase also includes experimenting and navigating ideas and concepts through the organization. The use of storytelling seems to establish the emotional connection needed in order to achieve hook-up and buy-in to the idea. Stories seem to function as glue between people and things. A story also indicates that a journey has started and that this journey does not stop until the new product reaches the market and becomes successful. In this phase, the strong engineering, design, and social science capabilities in IDEO work together to create the solution. They also provide help with the path to the market and with a communication strategy for the solution.

This process, very much a generic one, is the way IDEO works today. The process has been developed over the past ten years and has become more of a mindset than an actual process. The mindset supports the process and gives guidance and structure to the work. However, one needs to always be open for change and to adapt to the situation, as one of the interviewees said. There is a great deal of frustration and ambiguity involved in the process. This springs from the fact that you have no idea what the solution is and sometimes you do not even know the problem.
Coming to the last question about the tools to help creativity and the creation of ideas, one thing strikes us as central in all interviews: the use of visualization throughout the project. The approach to visualization became extremely clear during the interviews, when seven out of nine respondents actually used sketches in order to answer and explain their answers to the questions. As shown above, in the three areas described as the foundation of IDEO’s work, visualization is used in all parts of their approach. As we have discussed earlier, visualizations are central to the reflective practice theory.

IDEO uses visualizations to be able to understand the problem and try out the solution with a focus on and for people. The nature of using visualizations could be explained by some quotations from the interviewees: “It can look bad”, “I can show you what I mean”, “I’m telling a story with my sketches”, and “Anything that will show you the idea”. They use a shift in the usual mindset: you should not think about what to sketch, but sketch to think.

**Evaluation of results**

Regarding further evaluation of the findings I spend one week during winter 2013 at IDEO Boston to present the results. Several of the senior employees agreed about the findings presented and deepen my knowledge regarding their approaches and the way they create understanding of the problem. The employees not as experienced asked about the process and argued that it exists, however, one of the senior explained that the process exists as a framework, but in order to be innovative you can not follow any process. You need to follow the synthesis of the information. During this stay at IDEO Boston I had the opportunity to attend several meetings and creative sessions. And in these internal meetings the importance of narrative became observable to me. I did not attend any meeting without questions about the story of the problem or questions to clarify what is happening in the situation of interest. The importance of storytelling is evidently of great importance at IDEO.

So, the results is evaluated by other scholars as well as internal employees at IDEO, this validates the results and justifies the approach.

**Conclusions about the research approach**

It is found that a conscious and focused way of working with design and design thinking supports successful innovative development work. However, the people involved in the projects constitute the most important part of this work. They need to be disciplined and eager to learn new things. This requirement leads to an assumption that curiosity is an important characteristic among these people. The need for explicit and normative processes for managing development and innovation is crucial, in terms of how people hook up to the approach. It is not crucial in terms of a tool for guidance or as a gate process. One could say that the idea of process does not exist. Despite this, design exists from day one. The tools and methods used are many, and they are commonly used for development work and designing. The important factors here are to be visual in all phases, stay focused on the challenge, and perform with a high degree of accuracy.
It becomes clear that information sharing takes place in the inspiration and information gathering phase. Every part of the information gathered is transformed to a visual medium. For example, observations become storyboards, interviews become mood boards, and research is translated to “sacrificial concepts” to take out for testing. Everything is done to create a common mental image of the area of interest and to be able to discuss. These insights are seen as fuel for innovation.

The creation of information is fundamental for the ideating phase when information is recalled due to the intuitive response to a design situation. Expressing a thought or idea occurs when you extract your ideas from your head and prepare them for communication in a move towards shared understanding and exploration.

These expressions become experiments when entering the implementation phase. The experiments are tangible and function as learning objects. Specifications of the solutions become visible and are the motivating force behind the validation of the solution. The communication is supposed to work outside the team, and stories are told in a visual way, either by storyboards, films, or animations. The visualization of the way to reach the solution tends to be important when it comes to understanding the choices made and the ownership of the solution.

This speaks for the use of a visual mindset in developing new products, processes, and services. The use of visualization at IDEO could be described as a defining feature of a company at the very top of its industry.

**Continuation**

The case study at IDEO provided me with deep knowledge concerning design thinking. The connection to reflection-in-action provided initial knowledge regarding IDEO in the academic discourse of designerly thinking. When understanding the process of IDEO more as an approach using a reflective conversation with the situation inspired me to deeper explore the connection between the reflective practice and the early phases of innovation and in specific the visual thinking involved in the reflection-in-action.

More, the use of visual thinking as a central approach at IDEO provided me with enough arguments for suggesting the language of IDEO as visual. The fact that data is transferred to a visual format and that this data also is told in many ways and situations also speaks for bringing in the narrative theory. So, in order to understand the visual thinking involved in design practice I analyzed 26 interviews that I made during an early multiple case study regarding the use of visualisations in design practice. This study is presented in the next section. Regarding the use of narrative, new inspiration and knowledge was gained that was put into action in the Moon Massage project described in section 4.2.1.
4.1.2 Study B, Understanding visual thinking for innovation

For my licentiate thesis I made interviews with 26 companies on their use of visual tools and methods (Wikström, 2010). The data were rich and for a journal article in Design Management Journal an analysis of the data was performed using the reflective practice framework of Schön (1991). When using Schön’s theories of the reflective practitioner to analyse the use of visualization as a supportive tool in design projects, the practice of designing can be understood and new knowledge can be developed to improve the situation for management as well as for teams. This can give deeper knowledge regarding designing as well as insight into how communication between management and teams can be improved. This new way of looking at the data gave new insights into the support that visualization can give management at the front-front end of innovation. The reason for this reanalysis was to understand the support that visualization can bring to the management of innovative development, especially regarding the reflective practice in the early phases of design projects. The following is a presentation of the study.

Research approach

The research has mainly been conducted through qualitative investigative methods, with the aim of analyzing design projects in industry. The data collection was performed using semi-structured interviews, observations, and search in archival documents. The interviews conducted in Phases A and B (Figure 4.3) were mainly semi-structured. However, open questions arose during the interviews. The respondents were industrial designers, product developers, innovators, innovation managers, and project managers. The case study started with Phase A, an initial literature study in which theory related to design processes and design management was reviewed. This review created a foundation for the interviews and helped frame the challenges related to the initial problem area. In Phase B, the knowledge of and justification for current practice within companies today have been achieved using interviews and participatory observations, converting raw data into analyzable data using pattern matching and clustering. The results of these empirical studies have been analyzed using an intuitive approach, focusing on the conclusion that seems reasonable and logical, and analyzed in detail using the reflective practice paradigm. To gain knowledge of how and why visualization is used when executing design projects, the interviews illuminate the subjective experience of the situation. Further, the use of the grand tour enables a reconstruction of the significant part of the experience. The grand tour is an ethnographic method used in interviews to help understand activities or events and create knowledge of the elements included and how they interrelate. This kind of interview creates an open climate in which insight is gained in a natural way.
The purposes of Phase A were the following: to get a clear picture of how and why visualization is used in product development projects today in industry; to clarify the problem area; to find out what expectations you can have of this research; and to identify how current knowledge and theory appear. A literature study was carried out to get a clear picture of the latest practice and scientific use of visualization in design practice. The researchers studied the various orientations of the literature, whose topics included design management, visualization, product development, innovation management, design, innovation, and product realization. The sources studied were books and academic papers published in conference proceedings and journals.

Phase B involved clarifying and exemplifying the problems that exist in the current situation and identifying those factors most suitable to improve the situation. A clear description of the important factors in using visualization in the design practice and the gaps identified in the companies led to a deeper knowledge regarding the issues behind the challenges.

When making the connection between the reflective practice and the current practice of designing explored in this specific case study, four points can be noted:

**The iterative nature of designing**

The generic design process is a conceptualization of designerly ways of knowing and doing. However, although the process is often described in a linear way (in order to be communicative), it is in fact more of an iterative process of moving and reflecting and testing the moves towards the naming and framing.

**The designer’s conversation with the situation**

The use of tools for interpretation and visualization (such as sketches or models) is important for designers. It is also central in Schön (1991) explanation of how professionals interact with the situation at hand. Being visual also facilitates comments from others. Thus, visualization is actually an enabling technology supporting development work. Also, using problem-solving methodologies and mindsets is related to a chain of decisions that involve reflection in/on action. The focus of problem solving is on the naming and framing phases, in which the objective and the goal of the project are identified.
The design challenge

The focus on understanding the issues and describing the core of interest and key questions regarding the design challenge is related to naming and framing. When understanding the interaction between the issues and the user in question, the designer needs to understand which questions are relevant for the user involved. This is one of the activities involved in naming. When framing the area of interest, the designer needs to describe the core of the project and what the relevant questions are with regard to the issues. This depends very much on having an end-user perspective and focus as well as a holistic view of the product.

The creative mindset

Creativity is needed when the designer makes his or her moves towards a solution or creates an idea of the solution. These moves often trigger an intuitive response to the situation that demands creativity. Using opportunity-finding methodologies and mindsets is central when making moves towards a solution. The element of surprise is central, and the difficulty lies in being able to relate to surprises and create new knowledge from them.

Results

These remarks give reason to argue that the challenges regarding the management of design work and its application in practice can be analysed using the reflective practice paradigm developed by Schön (1991). This is also a conclusion made by Valkenburg (2000).

A central part in all projects is communication, and design projects are no exception. However, according to Eckert (2001), designers often fail to recognize that many problems are communication problems. This indicates that the challenges involved in managing design projects need attention, from both management and design teams. When analysing the data, one can see that problems in the early phases of designing negatively affect future phases in the way problems are framed and moved towards the final solution. Thus, a structured use of visualization throughout a project creates a meaningful communication of the creativity needed and manifested in the design work. The visualizations also constitute a track record of decisions made during the project. This involves management of the creative work of reflective practice and establishes ownership of the output as well.

When considering the results from this case study, one can argue that management and teams involved in design projects do not understand each other’s needs, and that creates misunderstandings regarding how to execute design projects. In the interviews 24 out of 26 state that management focus on solution-based visualization types in first hand. As a result, it conveys a message to the team to focus on solution-based visualization types, such as drawings and 3D CAD. However, this displacement of the focus results in a mindset shift as well, going from a divergent towards a convergent approach. This results in an attenuation of the explorative phase that is needed in the early phases of design projects in order to identify and
understand the problem at hand. The first challenge is, therefore, for both design teams and management to understand the reflective practice that drives designing.

There is a need for creativity in all parts of design projects. However, this creativity depends on the atmosphere and climate of an organization. This is where management plays an important role in creating the employees’ feeling of being needed and in strengthening their self-confidence. Because it positively affects individual motivation, supportive and communicative management creates more creativity in the team than management that simply controls. In order to foster a creative climate in an organization people involved need to develop mutual trust in each other’s needs and demands. This leads to the second challenge: the creation of mutual trust between design teams and management. When considering the demands of management, the need for control in design projects is obvious. At the same time, as explained above, control counteracts a creative climate and conveys a message to teams to use solution-based types of visualization. Because of the control issue, stage-gate models tend to rule the management of design projects, and they limit creative space. Among the companies involved in this study 26 out of 26 uses stage-gate process models for their projects.

The rugby approach towards new product development (NPD) suggested by Takeuchi and Nonaka (1986) envisions a process whose phases overlap, in contrast to the sequential process supported by a stage-gate model. Takeuchi and Nonaka emphasize that management needs to recognize that NPD is an iterative and dynamic process. However, project control is still an issue for management and is thus the third challenge that this study illuminates.

**Evaluation of results**

This study is based on interviews performed early in my education and reanalyzed using the theories developed by Schön (1991) as a natural step after developing knowledge regarding the importance of reflection-in-action at IDEO in Study A. However, this might bring up some questions regarding bias of the findings since the initial interviews was performed with another focus, the use of visualizations in the design process, this is considered as a minor risk since the focus in this study is more on connecting the current practice of these companies in relation to the reflective practice as it is described by Schön. The connection between practice and theory is also an issue to consider, in this case there is a great interest in enhancing knowledge in the early phases of innovation by theoretically reasoning about the current practice linking it to the reflective practice.

The selection of companies involved in this study is also an issue to consider since they are chosen based on availability. However, the companies involved represent a sample of companies in the region of Mälardalen and consisted of both large multinational companies as well as small and medium sized companies with their own product development department. This speaks for generalizability regarding the results in the study.
Conclusions about the research approach

We argue that the interplay between design team and management regarding the use of visualization can allow for management control and contribute to mutual trust in designing. To understand this depends, however, on an understanding of the reflective practice in design projects. Essentially, the reflective practice is the core management activity in design projects in a creative and innovative organization.

To begin with, management needs to understand the importance of the explorative part of designing as the way designers make sense of the situation at hand. Designers do this by using sketches and models in order to explore ideas and create new knowledge to bring into the project (as shown in Figure 3.2). Management also needs to develop an understanding of the different visualization types that can be used in design projects: their levels of abstraction and their possible resolutions. In this study, we define four visualization types, which underscores that there are different purposes for using visualization in a project. Understanding these purposes helps create deeper knowledge of the use of visualization in the reflective practice.

Visualization is commonly used in design for mainly two purposes. First, it is used as a way for designers to make sense of the situation at hand: using sketches and models, for example, to explore ideas. Second, it is used to provide output from the design process, the defined solution to the problem, often a high-quality rendering from a computer-aided design (CAD) tool or visualization software. The second use is very much dependent on the performance of the first. In order to present high-quality defined solutions as an output in the early phases of the design process, there is a need to be both efficient and effective (in other words, doing things right as well as doing the right things). This leads to implications regarding the understanding and control of design projects and the designers’ use of visualization in order to execute the design task.

The second use of visualization, the defined solution to the problem, is dependent on the performance of the first. Consequently, in order to present a high-quality defined solution as an output, the knowledge and competence on team and management levels are important. The use of visualization contributes to a mutual understanding of the status of the project and makes it unnecessary to use stage-gate models and written reports. Through this, visualization creates a communication platform that satisfies the management’s need for control.

Continuation

With this knowledge of the importance of the reflective practice in the early phases of innovation and the focus on the design challenge in order to understand the situation the aim with the research clarification is fore filled. And the focus for further research can be described.
The knowledge of design thinking and visual thinking and the insight in how much stories are used at IDEO in order to understand the situation, the descriptive study 1 will focus on narrative in the front-front end of innovation. In this explorative search for knowledge regarding how people relate to stories of an idea, on its way to become an innovation an exploration of the concept of Moon Message will follow. Further, the development of the idea of storyboarding, as a way to develop ideas but also as a tool to reflect upon performed projects, will be presented. This will develop deeper knowledge of narrative in the front-front end of innovation and also develop the method of storyboarding.

4.1.3 Reflection on research clarification

Regarding the different ways that management and teams use visualization, a deeper knowledge of the reflective practice needs to be established. This is necessary in order to put management in control of the situation and empower them to understand the designers’ reflective practice, while at the same time generating trust between teams and management in order to create confidence in the designerly way of knowing and doing.

When analysing the support that visualization can bring to the management of innovative development, a lack of knowledge about the effects of using visualization strategically and in a structured manner is highlighted. Today’s design management literature needs to focus attention on this. Finally, we argue that designers’ use of methods and tools in design projects can be understood in more depth by knowing the reflective practice of designers. This knowledge improves management’s overall coordination and control of design activities and improves the performance of design projects. This deeper knowledge about the reflective practice in design also contributes to innovativeness in organizations, since design and innovation are becoming more and more intertwined. The use of design to inspire innovation presents new possibilities for companies and organizations regarding the novelty of new ideas and concepts.

The value of performing your own study, regardless how well the issue or company is studied, was revealed for me in Study A. Being able to ask your own questions and “own” your own data is valuable since you control the interpretation of the data and are also able to return to the data in order to verify the findings. The use of open questions in an explorative study opened up for using earlier performed interviews in order to understand the use of visual thinking in 26 companies, Study B.

4.2 Descriptive study 1

Descriptive study 1 focused on exploration of storyboarding in understanding the situation to design for and as a reflection tool (Studies C and D). Study C focused on how we can make sense of innovation by following how people relate to stories of an idea; this ended up in enhanced knowledge regarding innovation from the perspective of innovation making and innovation telling. Study D using storyboard as
a tool to reflect on projects carried out does not have a direct connection with the objective unless you see the innovation process as a loop using lessons learned from previous projects as a starting point for new projects, which is something that I do. The outcome of this phase was a deeper knowledge of narratives and their connection with innovation as well as initial knowledge of the power of storyboarding in teams.

4.2.1 Study C, Understanding innovating

In this study the two concepts of innovation making and innovation telling, described earlier, make up the analytic frame to understand an innovation process that has been studied longitudinally by myself and docent Karin Berglund at Stockholm university. The innovation in this case is a service invented in the broad setting of the House on the Moon project that, in magazines and by powerful stakeholders, has been held forward as an outstanding example of innovativeness in contemporary society. This project was formalized by the non-profit association Friends of the Moon House and the company Luna Resort, but can above all be seen as an extensive network comprising numerous activities. Inspiration and the birth of the Moon House can be traced years back in time to the artist Mikael Genberg’s idea of creating a trilogy of housings. Next the Moon House will be described. After that the concepts of innovation making and innovation telling are further elaborated, before analysing the innovation process taking place in the Moon House setting.

Research approach

In 1999 artist Mikael Genberg got the idea to put a small red house on the surface on the moon. Since then a network has been created with various actors and organizations, which has been crucial to keep the project alive and on the move. Several cocktail parties have been arranged over the years that have come and gone, and many meetings and workshops have taken place in the 600 m2 art studio close to the ABB headquarters. Some of the key events taking place were a Castle Dinner with guests (such as energy business people and politicians) specially invited by the county governor in 2003, the inauguration by the Swedish astronaut Christer Fuglesang of two Moon House Hills at both highway entrances to Västerås, and the exhibition of a small red house on the top of the Globe, the spherical Swedish national sports arena in Stockholm. Moreover, the preliminary study made by the Swedish Space Corporation in 2004, in which it was stated that the project was not only technically possible, but also financially feasible, and the creation of the non-profit organization Friends of the Moon House in 2007 are highlighted as key ingredients in the process. While the project’s business and economic affairs have been administered by Luna Resort, a private limited company, many of the activities have been promoted by the Friends of the Moon House association.
An idea that came up during the process so far is to set up “the House on the Moon Foundation for Mankind” aiming to create conditions and initiatives for making the world a better place. Once the house is put on the moon this venture is predicted to become highly commercial, attracting new ideas and becoming a cash cow in itself. Since the utmost – and first – reason stated was the artist’s vision to provoke people’s minds and open up for rethinking how we can relate to mother earth in new ways, the idea of commercialism fits bad with the ideology of the artist. Hence, the foundation was created – and narrated – as an acknowledgement of the artist’s vision and an answer to a possible misinterpretation that the project is all about money. Even though the goal is not to bring in money, the realization of the project certainly needs considerable financing. Moon Message (MM) was seen as one of the ideas that could benefit from leveraging the venture capital of the whole moon house project.

In spring 2009 a workshop was initiated in order to develop the Moon Message (MM) idea. The idea was simple: messages could be sent – with the house to the moon – as a manifestation. This would be a way to send messages that would be left almost forever, like on runestones. People could send the messages by SMS and by doing so contribute to realizing the idea of putting the house on the moon. Further, the idea grew to start building “The House on the Moon Foundation for Mankind” by way of the income that MM would generate. Even if the idea of MM had been there for some years, it had not yet been implemented as a potential income generator. During a trip to NASA in San Francisco, the idea was, however, brought up again and further developed in the winter of 2009. The idea was thus to bring together the people involved in the moon house in order to make something substantial out of this idea.

The idea of the house on the moon has become a story told in many versions, as well as illustrated in many pictures and materialized by way of numerous activities (Berglund et al., 2007, Berglund and Gaddefors, 2010). By taking part in this ongoing project we got the opportunity to stage a workshop to promote the development of a promising idea that was born in the project. Innovating in the moon house project has thus not only been observed from a distance, but also enacted by both of us.

The Moon Message idea implied inviting people in general to be part of the moon house project by way of sending messages that could be sent with the house to the moon. This idea was from the moon house venture point of view seen as a promising fundraising initiative. In this section the focus is on the workshop that was staged in order to develop the MM idea, suggesting that this particular occasion together with the process that followed gave some insight into what goes on when innovating. The workshop uses storyboarding as a method to develop MM from an
innovative idea into a tangible product, understood in its widest sense. The method of the storyboard as it is used in this context combines the narrative with the reflection-in-action in the way the story is told and how the sketches drawn open up time for reflection in the entire group as well as for the person holding the pen. Schön (1991) describes drawing and talking as two parallel ways of designing and argues that drawing and talking make up the language of designing, so in this way the storyboard supports the narrative of telling stories and the reflective practice in drawing the sketches. The point of using a storyboard should be seen as a supportive tool in innovating and not as a completed artefact to be communicated. Furthermore, using the storyboard was meant as a shortcut to create a common understanding among diverse actors, yet emphasizing the diversity among the people who were invited to the workshop. Mapping action into visual appearance is a way of simplifying and bringing clarity to concepts, as well as of creating a common mental image of the idea so that the process moves from passive to active, from just being a great idea to inviting actors to take action. The method thus focused on taking care of the creativity of the whole group in molding and trying out different solutions for how MM could be turned into a product. As will be illustrated, several stories were tried out and various issues were raised.

When designing a workshop for a new concept like MM, we embark from how the reflective practice works in the development of new products or services, using naming – framing – moving – reflecting with an outcome to be communicated and told about. Figure 4.4 explains the phases of the workshop. The phases were studied from an innovation-telling and innovation-making perspective, following how the idea was developed using language and visual reasoning in the iterative process of opening and closing the idea for revision and negotiation.

![Figure 4.4. The different phases of the workshop.](image-url)
Phase 1: To create a warm, friendly, and creative atmosphere, the participants are told to write a greeting to someone on a large piece of paper at the entrance of the workshop area. Finger paints and clay are available. During this phase people will be able to say hello to other participants.

Phase 2: Three short presentations were planned in order to explain the idea of MM and give inspiration and information about the moon house project as a whole. People will be able to say hello to other participants.

Phase 3: The work started by individually answering questions on post-its; the questions (below) led to different scenarios about when MM is used. After this the participants were placed in groups so that four multidisciplinary teams were created. These teams all had one representative who was good at sketching.

In what situation do you send an MM? This answers where and why questions.

What do you send? Is it a special event or memory or experience that triggers you to send an MM?

When in life do you send an MM? What time in the day? Or in the year?

How do you use MM? Spontaneously or planned?

The questions create a foundation for the following steps in the workshop. The ideas that come out of this phase should be placed on posters on the wall so that everyone can see them.

Then there was a food break; a large table with chairs for everybody to sit around, and a buffet was served.

Phase 4: A competition between the five groups is planned. The aim of the competition should be seen as creating understanding of the MM idea and creating a concept of the Moon Message visualizing a scenario and a storyboard where the concept of the MM is further developed. The contest starts with the teams choosing notes from the previous phases, three notes from the “who” question and five notes from the “how” question. The remaining questions and post-its are used for inspiration for all the teams during the rest of the workshop. The task is to sketch scenarios of three ideas, quick and dirty sketches for about ten minutes for each scenario.

Phase 5: An evaluation process is planned where the groups make a choice of one scenario to continue work with for 30 minutes, creating a storyboard.

Phase 6: A visual tool has been prepared, with inspiration from Michanek and Breiler (2007), for the teams to conceptualize their work and concretize the storyboard (Figure 4.5). This leads to one scenario for each of the five groups.
Figure 4.5. Visual tool for concretization.

Results

The workshop took place in an old industrial building in the centre of Västerås, the hometown of Mikael Genberg, founder of Moon House. The participants started to drop in at five o’clock in the afternoon. 20 people were invited, of which 18 participated in the workshop. Those invited were selected in order to create a dynamic and multidisciplinary setting consisting of entrepreneurs, artists, people from marketing and advertising agencies, students from information design and engineering design, researchers, and engineers from the space field. On entering the studio, the participants found finger paint and clay at the tables as an incitement to play and work with their hands. This seemed to inspire some, while others were more reluctant to be part of the play, instead sitting down on one of the sofas having a chat with the people they already knew.

As a startup Mikael Genberg gave a background to the workshop and stated that the purpose of this particular workshop was to initiate a process that would take the Moon Message from an idea phase to realization. After that two students working with how the potential money could be invested for the common purpose of the whole project shared their view of what it meant to create the House on the Moon Foundation, since the foundation was seen as the receiver of the income generated by selling Moon Messages. Finally, another student working on her final examination presented her idea of an animation that would explain the core concept of the
moon house project and how it could make us reflect in new ways on the earth and our role as human beings on the globe. At this point we (as workshop organizers) handed out the first assignment, which was individual, involving brainstorming about the four questions (as outlined in the method section). This resulted in a wall covered by post-it notes with answers to the situation as well as sending a moon message (when someone makes me happy, as an advertisement, when divorcing, when in love, for the sense of community, when having spring fever, at a presidential election, and so forth). In total 71 suggestions were made on situations when one would send a moon message.

In the next assignment we divided the participants into five groups who were asked to choose three post-it notes from the “who” column and five from the “why” column in order to create a story from those notes. Vivid imagination and loud discussions (and laughter!) took place in the groups regarding possible stories to choose from. The discussions were less of a negotiation and more of an interplay with moments of surprise. To benefit the work of drawing the story, each group was assigned a student with artistic skills. A feeling of belonging now seemed to emerge in each of the groups, trying to make the best of their different post-it notes. After about half an hour the stories were presented as sketches on paper (see Phase 4 in Figure 4.6) illustrating how someone sends messages randomly to students that enjoy the surprise, or a girl in love who is dating a new boy by way of sending an MM, or a climber reaching the top of a mountain who sends an MM to his friends at base camp. In total 12 stories were created. All groups were now asked to present the stories to the other groups, which triggered enthusiastic exclamations, but also some friendly booing, trying to persuade the ‘public’ that their story was much better than the other presentations made.

The idea of MM thus took shape by way of the sketches during this phase. Before the dinner break, the sketches were placed on large posters on the wall so that everyone could see them. At this point some participants started to discuss their ideas with each other and also tried to convince persons from the other groups about their brilliant ideas. Others started to play with the clay that had been part of the introduction of the workshop, creating moon houses, moon house people, and space attributes and really started to play with the ideas with their hands.

After dinner an evaluation process took place where the groups made a choice of one scenario to continue to work with for about 30 minutes. A visual tool had then been prepared for the teams to conceptualize their work, which led to one scenario for each of the five groups. On the wall there were still lots of post-its that could be developed into new concepts that could help the MM to become real. Eventually, the workshop ended with choosing one of the stories with the help of the visual tool, resulting in a common story of the Moon Message idea that everyone at this stage agreed on.
To come up with this story however, the process fluctuated between making the story and telling the story. When the group was occupied at the beginning with answering the questions that were put on post-its, the members started to make a new story to tell about MM. The different stories were later formally presented by each group, which raised either a lot of booing (groups that emphasized that their story was the best) or enthusiasm (emphasizing that this was a story that the other groups liked or could relate to). This negotiation about which story to relate to also took part during the break, when the participants were eager to explain their ideas and tell their stories. Some, however, stayed silent and continued to work with their hands to form sculptures that were later important in the process of shaping a common and coherent storyboard.

During the evening several ideas were created and evaluated promoting understanding what the consumer experiences in the MM concept should be. The storyboard method highlighted opportunities as well as problems at a low cost and in a constructive way that prompted the group to come to an agreement on what concept to focus on in the next phase of development. The pictures drawn during the evening as well as the scenarios and the stories presented on the storyboards influenced the way we all viewed MM and facilitated making new interpretations. The point made is that focusing on a storyboard made it possible to narrate the MM
in new ways. Consequently, knowledge was gained about how stories are shaped interactively and how words and visualizations are used to delineate innovative features in organizational contexts.

The day after the workshop one of the participants felt enthusiastic about the idea and eager to take it further and made a couple of phone calls to Swedish communication companies. Would they be interested in participating to develop the idea of the Moon Message? One of the companies was very sympathetic to the idea and invited a group of moon house people to its head office. Three people from the communication company took part at the meeting, the CEO of marketing, a person responsible for CSR, and another marketing person at the company. From the moon house there were also three representatives. The idea of the Moon Message was presented on a large sheet of paper on the table; the story was told and simultaneously – pictures were drawn that explained the idea and how it was supposed to work. The communication company responded positively and made a commitment to supply the services necessary for sending a text message to the moon house database.

After this meeting a process that would take six months commenced with conferences with a web design company, an advertising agency, and again with the communication company. However, the process was still in the phase of an innovative idea and was not developed further, despite the keen interest and agreement to launch the Moon Message concept. This puzzled us – and other people involved in the initial phase – and gave rise to questions such as Why did this happen? Why was the idea not materialized? How come that a great idea that a lot of people believed in was not turned into an innovation, but remains an innovative idea? Of course we can find many answers to this. Our point is nevertheless that we can learn from this process that language – and the art of telling stories – is important in innovating, particularly when it comes to turning an idea into tangible reality that is distributed, taken up by people, used, and related to. This is what sifts the wheat from the chaff and is thus what separates a good idea from a successful innovation.

**Evaluation of results**

When following how people relate to stories of an idea, creating knowledge regarding narrative for innovation, the idea to follow and the people involved are important. In this case, the idea to follow is in the concept of a larger project within a non-profit organization. There where several other possible ideas to follow, but this project was interesting since it involved both art and technology, on a high level. This combination of different knowledge areas and culture are brought forward by Johansson (2004) as a way to create innovations. Also the people involved where interesting, we invited people to participate from different areas supporting diversity of the teams. This is not a grant for valid results, but the process became more interesting and controllable.
The layout of the workshop and the facilitation of the process of course guided the teams towards a solution. However, since the workshop is based on the theoretical framework of the reflective practitioner, the process became more as a guidance through a road they would go anyway, but in this case with timeframes, and methods and tools supporting the teams. So, regarding bias that comes from the process and facilitation of the workshop it is not likely that it have affected the knowledge developed regarding narrative for innovation.

**Conclusions about the research approach**

When focusing on innovating, knowledge can be discerned when it comes to how innovations are shaped interactively and how language and visual reasoning are used to delineate innovative features in organizational contexts. In innovation making, the plot lines and characters are not yet constructed; this creation of meaning, shaping reality, is constructed in a dialogue by joint efforts and interaction among people. This means that the innovation is sketched in order to be communicative. This sketching relates to reflection-in-action in the iterative process of creating new knowledge by defining and refining the innovation.

Narrative, reflection-in-action, and innovation is thus argued to be closely linked together and conclude that innovation could be traced by following the making of an innovation. The experience of surprise is one of the characteristics of reflection-in-action that could be linked to knowledge of innovating, the surprise being due to the fact that you get more knowledge out of the situation than you actually put in. If the reflection-in-action time frame is longer, this opens up the communication space between people and invites people to connect with the monologue of the innovation teller in order to open up the innovation for action and negotiation.

Hence, innovating is both about persuasion and about commitment and creative spirit. To put it differently, innovating rests on making up a story (from other stories), on putting this new story together, and on inspiring other people to catch on to it. This resembles the part of informing and persuading achieved by innovation telling, while language and visual reasoning in action resemble innovation making.

From the conceptualization of innovation making and innovation telling, knowledge can be discerned when it comes to how innovations are shaped interactively and how language is used to delineate innovative features in organizational contexts. Thus, the narrative approach in combination with reflection-in-action is closely connected with innovating, as it relates to how innovation is developed. And when using the narrative process as a way of learning as sensemaking (Weick, 1995), you bring new learning from the world of experience closer to the people involved in designing.
Continuation

This initial knowledge of narrative for innovation became a foundation for me to further build the concept of storyboarding. Through this study it is found that the layout and design of the workshop was part of the overall knowledge of design thinking, visual thinking and narrative, supporting reflection-in-action. This knowledge supported the phases to come and as you will see the layout of this specific workshop influenced the layout of the DoTank workshop presented in section 4.3.1. In order to develop deeper knowledge regarding storyboarding and its characteristics, storyboarding needed testing and evaluating.

The next step can be seen as somewhat not quite in line with the front-end of innovation since it deals with reflection on performed projects. However, the front-end of innovation must consider knowledge regarding “lessons learned” and storyboarding is a process tool developed in order to understand situations by telling stories about them. So, based on storyboarding as a process tool the next step was to create initial knowledge of storyboarding and deepen my knowledge about narrative in innovation.

4.2.2 Study D, Using visual narrative in reflection on practice

This study was conducted together with PhD students Jennie Schaeffer and Åsa Öberg and Professor Yvonne Eriksson in two multinational companies in the manufacturing and transportation industry, respectively. Participants represented the areas of product design, product management/integration, and R&D, and consisted of a majority of male engineers, both those with a long working experience (10-25 years) and some newly employed (1-2 years). Managers and non-managerial employees were mixed in the groups. The research consisted of two full-day workshops performed in November 2010 in the company premises with three researchers as facilitators. Each workshop included 10-15 participants that were divided into three groups.

One of the objectives of the overall research project (DeVIP) is to assist industry in developing strategies and methods to capture lessons learned in previous projects and use earlier experiences to avoid repeating mistakes. A common way to describe a project in the industrial context is using classical stage-gate models. The storyboard method is an alternative method for explaining flow in an organization.

The purpose is to discuss storyboarding as a method for capturing experience from finished product realization projects. The two main questions in this paper are:

Can storyboarding be used as a method for capturing experiences from earlier projects in the manufacturing industry?

If so, what does the method offer to the manufacturing industry?
The aim is to investigate both questions and analyse the results from a narrative theory perspective in relation to contemporary cognitive theories regarding how external representations (i.e., sketches) facilitate collaborative work; in this actual case, that work is a reconstruction of a product realization process. The narrative theory in this study has its origin in the term focalizer used by the Dutch scholar Bal (1995) in a visual communication context.

**Research approach**

The story that takes its form in storyboarding can be seen as communication, and in narrative theory, a narration can be defined as the way a story is told. This leads to the proposition that narrative theory also might be valuable when using storyboarding as a data collection method, both in terms of research and in collecting bits of data that can be valuable learning for upcoming projects. In this section the focus is on storyboarding as a tool to collect data, and no separation will be made regarding the two areas of communication and data collection. A narration belongs to a discourse in which the narrator plays a crucial role since she or he affects the story and, consequently, the episode that is told. Narrative theory is used in literature studies to interpret dramatic structures by differentiating the story and the narrative discourse. The focus of narrative theory is the narrator (the storyteller), the essence of a narration. The point of view of the subject is called a focalizer in narrative theory. The act of storyboarding is linked to narrative theory, and in order to make the concept operational for storyboarding, the following points of comparison are important:

- In a narrative discourse, focalization is the direct content of the linguistics. In visual art, it is the direct content of visual signifiers like lines, dots, lightness and darkness, and composition (Bal, 1995).

When storyboarding, it is the direct content of and comments on visual signifiers like arrows, lines, and different kinds of marks.

- In a narrative, there is an external focalizer, in principle identifiable with the narrator, from which it is distinguished in function, not in identity. This external focalizer can embed an internal focalizer. This embedding is crucial for the analysis of the narrative. For visual art, it is not easy to point out the external and the internal focalizers. The external focalizer (the artist) often creates an internal one, the one the spectator identifies her or himself with (Bal, 1995).

When storyboarding, the focalizer is identifiable with the narrator(s) in relation to the verbal narration. However, through the sketches artists create an internal focalizer that could be a third person’s position.
In a narrative, the fabula, the sequence of events, is considered to be mediated by the focalizer. In visual art, the use of the concept implies the claim that the event represented has the status of the focalized object produced by the focalizer (Bal, 1995).

When storyboarding, the narrator mediates what is crucial to an episode. As a consequence of this last point, the same object or event can be interpreted differently according to different focalizers. The ways in which these different interpretations are suggested to the reader are medium-bound. But the principle of meaning production is the same for verbal and visual art (Bal, 1995).

When storyboarding, it is possible for a focalizer to tell different stories in the text and the pictures. This could be explained by the fact that words and pictures belong to different symbol systems. It could also be explained by the fact that, for example, arrows, marks, and lines for emphasizing detail function as internal focalizers.

For the interpretation of the storyboards from the workshop, narrative theory is used from two aspects. First, to differentiate the story and the narration about the issues studied. Second, the focalizer is used in order to interpret the different levels in the narration. A focalizer is an agent of a story; in the actual workshops, the discussion is initiated by asking the groups to tell about several aspects of the actual product realization. In doing so, the facilitators in the workshops are external focalizers in relation to the choice of aspects and the focus of the narration. The individual participants contribute to the narration, some with verbal comments and others by sketches or verbal notations on the storyboard. The visual signifiers, such as cross-marks, lines, arrows, and other notations, must be interpreted as internal focalizers that guide the spectators through the narrations.

Figure 4.7 shows a layout of a workshop using storyboarding to collect data. The workshop starts with an introduction of the concept of storyboards and how to use the method together with examples of how the storyboard is used in film industry as well as examples of storyboards from data collection. Then the participants form small groups of three to five persons with one facilitator who explains the details of the session and hands out the material to use. The material has been prepared beforehand and consists of a storyboard template (A3 paper with 12 pre-printed yellow squares in total, four squares per row in three rows), post-its (to draw the sketches on in order to rearrange them easily) and four pencils with different colors (for different questions prepared beforehand). The role of the facilitator is to listen to the narrative, and by that also be responsible for throwing in supplementary remarks such as “interesting, tell me more” and “really, how do you mean?” in order to deepen the narrative and encourage reflection in the group. We found out that, besides those open explorative question above, a successful technique of the facilitator is mirroring, adopted from Engquist (1996). This means that a word mentioned in the group is repeated or slightly altered by the facilitator. That technique works
as a confirmation of the participant in the workshop and opens up for a deepened understanding of what is currently told. In the next step, the group is given four questions and told to draw and tell the narrative on post-its; the questions are all individually placed in an envelope and opened and answered one at a time. Examples of questions:

Can you tell me about the project, from the beginning until the end? (Use the black pen)

Can you tell me what people were important in different parts of the project? (Use the red pen)

Can you mention something that was crucial for the project (this can be anything of importance, internal or external to the project)? (Use the blue pen)

Can you mention some milieus that were important for the project? (Use the green pen)

The first question is paired with a black pen to indicate what is drawn on the storyboard when the content of the first question is discussed. The second question is paired with a red pen. The third question is paired with a blue pen and the fourth with a green pen. The session lasts for about 45-60 minutes and is preferably audio recorded. The first question is normally the most time-consuming question, taking approximately 30-40 minutes to complete. It is important not to rush through the first question; leave the group in charge of the narrative. In the end, the groups are left to organize a small presentation for all the participants in the workshop; here the use of post-its comes in handy because of the possibility to reorganize the storyboard. The groups present their stories for about 5 to 10 minutes while interacting with the rest of the participants. This session could also be recorded. All sessions should be transcribed before being analysed.

![Figure 4.7. The layout of the workshop.](image)

**Results**

The verbal and visual data collected from the storyboards show that when participants find it difficult to express something, they use different strategies. One is to explain the subject exclusively orally, for example an event or a situation. Another strategy when explaining something difficult is to use both oral and visual communication in the form of text. This reduces the content to words that communicate
parts of the significance but leave out other parts. A third strategy is to explain the subject through both oral and visual communication in the form of symbols, but with a comment regarding the difficulty of drawing it.

The facilitator of the workshop could be defined as an external focalizer when he or she asks a question that highlights a specific focus of the process. When the participants are confronted with questions, they are forced to react and start to communicate. The starting point of the project is the first discussion point accompanied by questions like how and/or what to draw to illustrate it.

As mentioned above, the storyboard has a structure with 12 pre-printed yellow squares in total, four squares per row in three rows. The reason for this is that it makes up a good structure that fits well onto an A3 size paper. It is clear that the pre-printed storyboards affect how the post-its are placed and how they are organized. The structure forces the group to focus on important steps in the story, but not just that, it also provides modularity. In a group interview, the verbal narration tells the story. In a group interview with a storyboard, the story is broken down into modules (= post-its); the modules are movable, and it is possible for the whole group to rearrange something said/sketched by another person and place it somewhere else. The same freedom is not available in a verbal narrative. In a verbal narration the story told exists in the group memory, and when a story is being changed, it has to be negotiated and it often takes a while before the revised story has been accepted by everyone. The refining of the story, the arranging and rearranging, lets the group form their version of the story from their understanding. They create a common understanding of the project. The revised story is externalized in the storyboard.

The story visually affects the group; the overview of the narration leads to insights. Insights come from seeing (Arnheim, 2004), and here the visual appearance of the story becomes a tool to visually structure thoughts of the participants, which leads to new insights. Here the storyboard acts as a cognitive tool supporting the human brain in information processing and memory organization.

The participants in the workshop are focalizers that act as agents for the narrative. Their different perspectives, views, and backgrounds in force when the story is being told, could initiate discussions about things that seem unclear, are understood differently, or are difficult to understand. By discussing these issues, the participants bring added value to the description of the issues.

The participants start reflecting when something is unclear, and this brings more information to the understanding of the issues. This discussion indicates a section where the participants might feel a lack of knowledge or have a different view of the event. This often occurs at the beginning of the story when explaining the start of the project. By being forced to draw a starting point, the participants start to discuss and share knowledge among themselves and with the facilitator. The sketches in the storyboard facilitate both individual thinking and interactive communication because they allow these processes to occur simultaneously, implying
that they become group-thinking tools. The sketches in the storyboard clearly inspire the group’s thinking and reflecting, which leads to new knowledge. The work around the sketches also creates a focus on the combination of internal and external information, giving new meaning to the issues. This occurs simultaneously throughout the process of creating the storyboard. First there is some talk. Then someone sketches while the others think and then the collective building of the sketch takes over. This iterative process could be compared to a creative process (Figure 4.8). This process is also compelling in terms of consensus about the narration, creating a common mental image about the issues.

Figure 4.8. The storyboarding process linked to the creative process.
Evaluation of results

The researcher has to limit the amount of information provided when organizing the workshop in order not to influence the black pen narrative. The developed structure of conversation technique (Figure 4.9) is regulated and the facilitator has to be controlled in what he or she expresses with words to avoid biasing the data collection, and therefore the use of mirroring is preferable. Second, on a meta level, the participants can ask themselves what to sketch and who are willing or allowed to sketch. The participants have different skills in sketching, and someone can take a more leading position by grabbing the pen and starting to draw. In doing so, he or she takes the position as an agent (focalizer) for the group. The sketches have an impact on the group process. In addition to creating a common understanding of a project, they may also contribute to creating new narratives because of the change in focus of, for example, the hierarchy in the group and who has the right to control the narration. The one holding the pen can take an initiative as well as the one that speaks. Nevertheless, since several groups of three to five participants are creating a story of the issues, the researcher gets access not only to several cases, but also to the benefit of different perspectives of every case. The narration is discussed, and different sources of information can bring out a pattern in the material validated by the group when developing and discussing the content of the storyboard.

Figure 4.9. The method of storyboarding with a focalizer and the relationship between the focalizers and the iteration when creating the storyboard.

As the storyboard is easy to create and access along with the breaking down of the issues into modules (=post-its), storyboarding is valid for research about how to collect data of workflow processes. Creating several storyboards on the same case but from different departments could generate a great deal of learning. It would
be interesting to interpret the different parts of the story, if and how they differ from one group to another, and what can be found in between the post-its in the storyboards. The areas not covered, the blanks, the spaces in between, or the grey areas are strong points for new questions. The blanks are arguments for further investigations! The storyboard does not completely cover how a case in an organization was dealt with, nor is it a simplified model of the workflow. It is a story, told by the participants, and it creates common understanding, formed by the participants when designing the storyboard.

In the storyboard, text, symbols of objects, graphs, lines, individuals, and metaphors work as focalizers for the narrative in the storyboards. On a post-it, an individual can have an inside position, since he or she refers to his or her own experience and creates an internal focalizer (by a sketch or mark, for example).

**Conclusions about the research approach**

To summarize, using storyboarding as a data collection method for understanding issues in projects carried out can add value to the understanding of the issues. The storyboard structure helps to focus on one aspect or problem at a time in the actual issue of interest. It is also valid to borrow the concept focalizer from the narrative theory since it helps us to interpret the range of focus in the storyboard in relation to different individuals and in relation to the questions asked by the facilitators. The focus of narrative theory is the narrator (the storyteller); the essence of a narration, the focalizer, is the agent for the narrative. The focus is to interpret the relationship between a story told by the group and one told by an individual in order to capture the experience from the workflow when evaluating the issues. In addition, in storyboards made by a group, one might leave out several agents, such as the individuals and the group as a whole. The questions asked by the facilitator can bring back new memories among the participants and that can lead to new aspects of the narrative, and sometimes the internal focalizer will change since new visual signifiers are added. The narrative becomes visible and thus concrete. The position of the focalizer at different stages can be identified, for both the group and the facilitators. Here the variety of colours when answering the questions in the storyboard is crucial; otherwise it would not be possible to identify the different positions (focalizers) the group takes in the answers.

The organization of the storyboard both limits and structures the work of the group. Through the externalization of the information, the group can reflect on, restructure, and refine the story. The modularization of using post-its supports this. Being able to see the result brings about new ideas, opening up for new insights into the issue of interest.

A sketch of the workflow or schedule supports involvement, and the participants involved get an overview of the whole process. The sketches are supposed to explain the idea and its context. It may be the roughness of the sketch that allows other participants and colleagues to add value to it by interpreting the sketch in their own
way, leaving drawn or written comments on it like a kind of opener to new associations and promoting a deeper understanding of the issue. Creating the information graphic, with sketches and text combined, facilitates individual thinking as well as interaction between participants and the facilitator. A participant or the facilitator can point at a frame in the storyboard to explore more about a certain issue in the narrative. The sketch communicates effectively and provides an understanding of the issue under consideration. The purpose of the storyboard is to create a common mental image of the issue and have the necessary information in one place. These sketches (modules) serve as building blocks in the development of knowledge through reflection on the issue.

Continuation

This study provided a lot of interesting findings, but also inspiration and ideas in how to proceed with deepening the knowledge about storyboarding. The facilitators role are important since it forces the team to frame and reframe the situation they are explaining, as help in this the team have the storyboard as a tool explaining the situation. The knowledge development regarding a situation seams to be facilitated by storyboarding. This needs to be understood in more detail. Also, the workshop needs to be developed further. Especially if it is to facilitate idea development in the front-front end of innovation and in this phase, storyboarding needs to be understood in depth.

4.2.3 Reflection on descriptive study 1

Theoretically, narrative theory is complemented by Schön (1991) theory of the reflective practitioner. While reflection-in-action emphasizes how professionals think in action, narratives illustrate how stories are shaped interactively and how words are used to delineate innovative features in organizational contexts. Together these theories lay the ground for introducing the concepts of innovation making and innovation telling. Both approaches highlight that innovating is a co-creation process that takes place between people as much as between people and the material world.

When making sense of innovation, one must consider the complexity of innovating and the fact that it involves many different areas of knowledge and theories. However, we have stated that innovation can benefit from the use of theories in the areas of design practice, visual thinking, and narrative. The persuasion of an idea is dependent on how people react and connect with the idea, here innovation telling is of importance; and the development of an idea is dependent on how people interact with the idea, this during innovation making. Thus narrative and reflection-in-action in innovation are shown to be important components in order to develop new knowledge about innovating. By borrowing terms from these areas we have unlocked some new ways to connect innovation management with design practice, visual thinking, and narrative, enhancing knowledge regarding the making of innovations.
While Schön (1991) stresses the dialogue between the person and the object of interest, the narrative approach emphasizes how this process can be understood in a social setting in which the object of interest sooner or later must be narrated. The action taking place in the conversation with the situation is therefore here seen as a process taking place in a social setting, rather than in a solely individual and cognitive perspective. Consequently, reflection-in-action gives an insight into how innovating is interacted and dialogued by framing and reframing the problem space, which becomes necessary by the (often silent) reflective conversation with the object of interest as much as the conversations with people taking part in the process. This standpoint implies viewing language as a performative tool that produces innovativeness in different disguises. This means that the story of an innovation is not seen as prefabricated, as a fact, or as an objective truth out there to be communicated, but as a story that is continuously shaped in social interaction.

When performing small explorative workshops new insights may be revealed. The workshops performed in Study C and D, with small groups of people cannot be generalizable, but they created knowledge about storyboarding otherwise hard to reach. By performing workshop you can discover interesting characteristics at the same time as being lean, preparing for a larger study in order to create generalizable findings.

However, to get even more data from workshops filming them could be an alternative, even though it affects people involved more than just voice recording. Filming can open up data regarding interaction and possibility to understand feelings and emotions in the team.

4.3 Prescriptive study 2

During Prescriptive study 1 (Studies E and F) a methodology was developed and an initial test was performed in order to understand how innovation management could benefit from using storyboards at the front-front end of innovation. Study E was performed in an explorative manner comprising 24 workshops with in total 54 teams. This study resulted in a deeper knowledge regarding storyboarding and how it affects the briefs. Study F was an explorative experiment to understand the difference between briefs created in a traditional way using written documentation and the brief using storyboarding. With these eight teams, four working with storyboarding and four writing a brief, the knowledge regarding storyboarding was developed and three hypotheses were formulated.

4.3.1 Study E, DoTank – exploring storyboarding

For the knowledge development regarding storyboarding, a methodology was developed, DoTank, which uses storyboarding as an information synthesis tool. Twenty-four workshops were staged with fifty-four teams developing concepts. The material was collected and interviews were held with the facilitators of the workshops. A master thesis was also written during this study.
Research approach

The DoTank methodology was developed from the theoretical foundation of design, visual thinking, and narrative (Figure 4.10). The methodology should support idea development in short workshops, 90 minutes, going from an area of interest to a concept description, where the concept highlights the framing of opportunities for innovation. Using the theory developed by Schön (1991), the activities were structured in a concrete way. Even though this theory springs from how professionals individually think in action and in this context teams with both novices and professionals participated.

![Diagram of the DoTank methodology visualized.](image)

Training facilitators

In order to see if the DoTank methodology could easily be taught to a group of facilitators without any deeper knowledge of the theories connected to the methodology, six students from Innovation Management, and Product and Process Development at Mälardalen University were asked to help facilitating the workshops. This training was done in three steps: first a presentation of the theories behind the methodology with a focus on the problem in framing opportunities, second a workshop using the methodology with the facilitators in groups, two of them being responsible for facilitating the workshop with the researcher as back office, and third a seminar reflecting on the workshop.

Organizing the workshops

The setup of the workshops was in the context of a large scale project called “Tipping point”, an exhibition at Kulturhuset, the cultural centre in downtown Stockholm. The objective of the exhibition was to open people’s eyes to the environmental hazards that threaten the earth and to make people aware of the consequences of human action to meet these threats. As a part of the exhibition, an innovation contest was arranged with the aim of generating ideas about climate-smart lunches, meaning lunches that are generally more sustainable than the alternatives existing today. Different themes were introduced in order to highlight the context of climate-smart lunches: commodities, packaging, transportation, cooking, recycling, and the whole meal as a concept. At the beginning of every workshop the facilitators introduced the specific theme and briefly explained the process. In this broad framework the DoTank methodology was used in order to take ideas to concepts.
The study is based on 24 workshops during a period of two months with in total 54 different teams participating in the contest and performing a DoTank workshop, each team consisting of three to five individuals.

Every step in the DoTank is supplemented by a visual tool shown in Figure 4.11. The first step for the teams to perform is an individual brainstorm (brainwriting) for about five minutes in order to clarify their individual beliefs and perceptions about the situation; this step is facilitated by a visual tool in which three questions about the future are posed. Who or what affects the area? Is there any uncertainty in the field and in general? What are the current trends, generally and specifically? These questions were posed in order to open up the mind for the specific theme and create the first frame of the situation. Since this is done individually, everybody in the team can make their voice heard in the next step, which is information sharing using brainstorming.

The brainstorming session starts by the team members sharing their thoughts and beliefs about the future. They are encouraged to build on each other’s information and add new thoughts and information that comes to mind during the brainstorm. Towards the end of this step, which lasts for about 20 minutes, the group is asked to focus on one situation or issue that they find most intriguing or interesting to continue working on.

When continuing to the next step the teams are instructed to draw and tell a story of the situation they have focused on using a storyboard. Towards the end of this step the teams are again asked to focus on one specific part of the story from which to develop their concept.

The last step creates conditions for others to understand the concept; it also makes the concept concrete and helps moving it forward.

Results

Using the framework of Schön (1991) and the findings of Hey et al. (2007) concerning the four phases of the framing cycle the characteristics of storyboarding in the context of pre-brief activities in idea development will be discussed.
We link back to the objective of this paper to explore the characteristics of storyboarding in team pre-brief activities in idea development and create a deeper knowledge regarding the challenges involved in framing the problem. A methodology (DoTank) was devised for idea development in 90-minute workshops focusing on the use of storyboarding as a bridge between naming and framing the situation of interest in order to understand the characteristics of storyboards. The analysed material was the visual tools used by the 54 groups during the 24 DoTank workshops. The analysis of the material was made by first going through every team’s material individually following the concept from the last step to the first step in order to understand when in the process the idea for the concept first came to mind and then a deeper analysis of the storyboard was made in order to understand the situation or issue described. Last a comparison between the material of all 54 teams was made in order to look for patterns and common characteristics of using storyboards in idea development. The findings are presented as a whole but focus on the different steps in the analysis; first the results regarding the teams’ concept development are presented, then the specific storyboard aspects and finally the patterns and common characteristics are presented.

**Team concept development and the use of storyboards**

In Figure 4.12 a story about a crop’s way to the customer is outlined. The story begins in a field and goes via transportation to processing in a factory. The story is split up by a big cross. The last two squares show how crops are cultivated on roofs. The first of these seems to be a villa and the second might be a store. The story is from the beginning a descriptive process, but when the team members reach the processing factory they suddenly deviate from this and start telling a new story.

![Storyboard](image-url)

*Figure 4.12. One example of idea generation using storyboarding.*
When following how the concept has been developed, understanding when the idea first came up, it becomes clear that storyboarding actually stimulates creativity and opens up for idea generation in addition to spotting the opportunity for innovation. One reason for this could be that the storyboard externalizes memory and reduces processing load by using external representations. This releases working memory capacity and stimulates creativity. It seems hard for the teams not to start creating ideas when drawing and telling the story of the situation. When the story is divided into frames (modularization), a transformation between the frames occurs and a gap is identified, indicated by the arrows in Figure 5. This gap in the story opens the plot for creativity and ideas are created closing the storytelling, and a new story begins to take place originating from new ideas that pop up in the gap between the frames in the storyboard. The story continuously describes the situation in focus but with a new direction not seen in the material from the earlier steps, resulting in a base for further development. This is described in the concept developed by the teams.

The idea generation performed by the teams during storyboarding is something not expected, but the fact that it occurs brings new light to storyboarding in this context. The idea generation could spring from an unexpected discovery in the story leading the team in a different direction and opening the plot to find a closure in the story. The search for a closure is inevitable and an important part of a narrative. It could also be an important part of creating a story in idea development. The opportunity for innovation occurs in the spaces in between the frames of the storyboard resulting in a new direction of the story (a surprise) leading the team towards idea development.

This also implies that storyboarding actually creates a fixation of the idea early in the process. This could leave ideas inadequately explored, which in the end could lead to ideas not corresponding directly to the opportunity spotted or ideas built on information not deeply rooted in the situation and/or needing to involve people. The early fixation of ideas presented in storyboarding is an important discovery and should be taken seriously depending on the risk of failing to spot opportunities for innovation further on in the process. The fixation could be conscious or unconscious and is often explained by the fact that what has been seen cannot be unseen, meaning that if a design solution comes up early in the process, it may dominate the entire process. The important thing here is to know that storyboarding can bring fixation into the process and that this fixation can be acknowledged.

The situation in the storyboard

In Figure 4.13 the story is about food shopping. The situation described is focused on ingredients needed to make a taco dinner and their packaging. The focus is not on shopping for just any food but shopping for one specific meal. The team later developed a deposit system for plastic and paper packaging. The opportunity can be seen in the third square in the storyboard, where the vegetables are put in plastic bags for transportation home.
When analysing the storyboard as such, two characteristic findings strike us. First the modularization of the story; when drawing and telling the story in a storyboard you are forced to divide the story into modules in order to fill in the blanks in the storyboard (as shown in Figure 6 above). The format of the storyboard supports the modularization of the story since the frames are printed on the storyboard tool. This modularization also supports the framing and the negotiation of the situation to create a common frame. This common frame is also supported by the focus that storyboarding brings to the process; since it forces you to pick a situation to tell a story about, it narrows the focus and supports the framing of a situation. The story is divided into modules that can have different resolutions. The resolution also gives information about the focus of the situation and the concreteness of the story told.

**Evaluation of results**

When analysing the data, a theoretical framework based on Schön (1991) and Hey et al. (2007) is used. We propose that storyboarding connects the two theories and can be a tool for teams to make conflicts apparent and negotiated. We suggest that the brainwriting and brainstorming parts of the workshop support the “pseudo frame setting” and the “individual frames made explicit”, and that storyboarding supports the “conflicts made salient” and the “common frame negotiated” steps (Hey et al., p. 94). And when connecting the reflective practice to the framing cycle, the characteristics of storyboarding brought into idea development concerning framing and reframing activities can be developed.

The methodology may invite questions about the generalizability and correctness of the findings due to the short time frame of 90 minutes of the workshop as well as regarding the participants of the workshops and their attitude to performing in the workshop. These two aspects actually support each other since the short time frame creates a more open mindset to perform in the workshop, not saying that this
is always the case. However, after the series of workshops a group interview with the facilitators was held in order to get their perceived feelings on the attitude of the participants and the overall atmosphere of the workshops. This interview gave the impression that most of the participants were focused on the topic.

Conclusions about the research approach

Using storyboarding in team pre-brief activities in idea development generates deeper knowledge regarding the challenges involved in framing a problem. Storyboarding shows a clear connection with the human-centred design approach since the stories told involve human interaction and are developed on a basis formed by activities and situations concerning human interaction with products, services, or systems. Storyboarding also helps in shifting the mindset from divergent to convergent and influences the clustering of information in a concrete way. Drawing and telling the story of interest clusters the information in a way that is easy to grasp and opens the plot for negotiation. In Figure 4.13 the packaging of all food is clustered and the sketches are used as both sources of information and negotiation of the opportunity.

The focus that comes with storyboarding could be a result of human centredness. Being forced to pick a story to tell storyboarding places you as narrator in the centre of the story at the same time as it puts the situation in focus (Figure 4.13).

Through this research we can see that creativity is stimulated, and idea generation during and after storyboarding becomes more focused when a common mental image of the situation is created. Storyboarding also supports the clustering of information since transformation of information into data takes place. Storyboarding can be a tool for transformation of data into a narrative format as well as exploring the ideas and thoughts through the sketches in the storyboard since it actually creates time for reflection in the team. With storyboarding a reflective conversation starts, both as a silent dialogue among individuals during the time of sketching and as an open dialogue between team members. This contributes to developing knowledge in the group as well as in individuals.

Continuation

Storyboarding is used as a tool to stimulate creativity to generate ideas and at the same time as a clustering object, negotiating the situation. This opens up for knowledge regarding storyboarding as a creative tool used for framing and reframing an opportunity for innovation in pre-brief activities with a human-centred approach. However, the difference between briefs developed through storyboarding compared to the traditional way of describing a brief, written documents, needs to be explored.
4.3.2 Study F, storyboarding vs. written

The first explorative study (Study E) resulted in knowledge regarding storyboarding in general; however, since briefing activities are traditionally carried out by writing the frame of the scope, an experiment testing both storyboarding and written briefs needed to be performed in order to establish the difference between storyboarding and written briefs. The result from this study was three hypotheses that needed testing.

This second step in developing knowledge regarding storyboarding as a tool in the front-front end of innovation will explore the difference between using storyboarding and writing documents in pre-brief activities.

Using the framework of Schön (1991) and the findings of Hey et al. (2007) concerning the four phases of the framing cycle, the characteristics of storyboarding in the context of pre-brief activities in idea development will be discussed. So will also the challenges involved in framing the problem or opportunity.

**Implications of storyboarding in pre-brief activities**

From previous studies knowledge regarding storyboarding has been developed as a method that enhances a designerly way of knowing and doing, which is seen as a central aspect of the innovation process. The reason for using storyboarding in the experiments was to tell stories in order to create an understanding of the culture in which the situation actually appears and so open up an understanding of where to create meaning in the situation. We view storyboarding as a shortcut to create a common understanding among diverse actors, yet emphasizing the diversity among the group of people. Mapping action into visual appearance is a way of simplifying and bringing clarity to situations as well as of creating a common mental image of the situation so that the process moves from just being a belief to inviting actors to take action and create a deeper shared understanding of the situation.

Through the development of a storyboard we can see that idea generation during and after storyboarding becomes more focused if we create a common mental image of the situation. Idea generation could also be important in regard to the clustering characteristic discovered. This is since a transformation of information to data along with an exploration of ideas and thoughts is necessary to build an understanding of the solution space. Storyboarding can be a tool for transformation of data into a narrative format as well as for exploring ideas and thoughts through the sketches in the storyboard. This is due to the fact that storyboarding actually creates time for reflection in the group.

It also becomes obvious that by doing a storyboard, a reflective conversation starts, both as a silent dialogue among individuals during the time of sketching and as an open dialogue between team members. This contributes to developing knowledge in the group as well as in the individuals.
Research approach

The experiment setup is to test how storyboarding is different from the common way of working when creating a design brief, i.e. writing documents, and to create a research agenda in order to explore this issue in depth. The experiment was performed in the context of a multidisciplinary concept development course with eight project teams with five to six students in each team at Mälardalen University. The participating students represented engineering, business, psychology, design, and art in the areas of product development, production and logistics, innovation management, and information design. The teams were divided into two groups, one of which created storyboards and the other wrote documents. The experiment as shown in Figure 4.14 is inspired by the reflective practice by Schön (1991) and divided into three phases, naming, framing, and moving – reflecting.

![Figure 4.14. Layout of the experiment.](image)

Every step in the DoTank is supplemented with a visual tool shown in Figure 4.15; however tool no. 2 was not used for the teams writing their briefs. The experiment starts with an introduction to the area of interest; in this case the area was inspired by “Good Ideas for Cities” and the open innovation challenge posed on http://www.maker.good.is accessed on 2012-09-10. The "area of interest" was:

“How are you positively affecting your community?”

With this area of interest the first step for the teams was to perform an individual brainstorming (brainwriting) for about five minutes in order to clarify their own beliefs and perceptions about the situation. This step is facilitated by a visual tool posing three questions about the future: Who or what affects the area? Is there any uncertainty in the field and in general? What are the current trends, generally and specifically? These questions open up the mind to the specific theme and create the first frame of the situation. Since this is done individually, everybody in the team can make their voice heard in the next step, which is information sharing using brainstorming.
The brainstorming session starts by the thoughts and beliefs about the future being shared among the team members. They are encouraged to build on each other’s information and add new thoughts and information that comes to mind during the brainstorm. Towards the end of this step, which lasts for about 20 minutes, the groups are asked to focus on one situation or issue that they find most intriguing or interesting to continue work on.

When continuing to the next step (framing), four teams are instructed to draw and tell a story of the situation they have focused on using a storyboard and four teams are instructed to write down the story of the situation. Towards the end of this step all the teams are again asked to focus on one specific part of the story from which to develop their concept.

The last step creates conditions for others to understand the concept, and it also makes the concept concrete and helps bringing the work forward.

The material from the experiment (scenarios, storyboards, and notes) was analysed with a focus on similarities and differences, using a hermeneutical approach searching for patterns and clustering the material. In the experiment we analysed four written briefs and four storyboard briefs. The results gave insight into three differences that can be of importance for innovation management regarding the early phases of framing opportunities for innovation.

Results

In order to understand the empirical material, the analysis is divided into separate parts to be put together again at the end of this section. First we analyse the written briefs and highlight the main findings, then we analyse the storyboard briefs and highlight the main findings from them, and as a summary a synthesis of these findings will be presented.

With a focus on the challenge posed to the teams, “How are you positively affecting your community?” we can see the following patterns when it comes to characteristics.
The written briefs

This is the brief formulated by team 1.

“The absence of Community

We do not throw waste in our own yard, not even at friends’ houses or places where you feel responsible or affiliated. Affiliation is variable, from your house, neighborhood to your community. We need to expand our sense of responsibility/affiliation/community on an individual level, in different environments both socially and geographically”.

When analysing the written briefs, the focus is on understanding the way the formulation can affect the concepts developed. However, since this is an experiment with a short time frame, the interest is also on understanding what the focus is when describing the situation of interest in order to compare with the situation described in the storyboard.

What can we see in the material?

The following patterns can be seen in the material. The results are presented on three levels, where the patterns concerning the brief are presented first. Then there is a short presentation of the concepts generated, which gives insights into the direction that the brief gives in the concept development. Finally some characteristics are summarized.

The following applies to the written brief:

• The situation or issue is broadly described. An example of this is that the description moves away from the “area of interest” where “you” are in focus and depicts situations that are generic.

• The description is understandable and formulated in an open way.

• The situation or issue is objectively described.

• The nature of the problem tends to be technically, not emotionally, described.

• The brief is communicable to others without support of an oral presentation.

Characteristics of the concepts of the written briefs:

• They are mainly written in text form even though team members are encouraged to make drawings.

• They are well connected with the brief.

• There is a low level of novelty in the concepts.

• One of four concepts agrees with the statement “you positively affect your community”
The written briefs have these characteristics:

- A broad description of the situation of interest is given, suggesting components that fit in other contexts outside the focus as well.
- The situation is technically described; the area of interest involves humans but the description is focused on the characteristics of the problem.
- The text is detailed in the description and guides you towards an understanding of a problem.

The storyboard briefs

This is the Storyboard brief from team 8 (Figure 4.16).

![Storyboard - berättar eller historier med bilder, används så många rutor ni vill](image)

Figure 4.16. The Storyboard of team 8.

When analysing the storyboards the focus is on develop knowledge in how storyboarding affects the concepts developed. However, since this is an experiment with a short time frame, it is also interesting to understand what the focus is when describing the situation in the storyboard in order to compare with the situation described in the written briefs.
What can we see in the material?

The following patterns can be seen in the material. The results are presented on three levels where the patterns concerning the briefs are presented first, and then a short presentation of the concepts generated is given. This gives insights into the direction that the brief gives to the development of the concept. At the end some characteristics are summarized.

The following applies to the storyboard brief:

- If it narrows down the situation or issue of interest. An example of this is Team 8, which focuses on one specific event where a lamp along the road is broken and a process to report this is described.
- The brief is hard to understand without text added.
- The situation or issue is described in more detail.
- The situation or issue is described in an emotional, not technical, way.
- It needs oral presentation in three out of four cases to be understood.

Characteristics of the concepts from the storyboard briefs:

- There is always a sketch attached to the written description.
- Three out of four concepts are well connected with the brief.
- There is novelty in the concepts even though the level is not very high.
- Three out of four concepts agree with the statement “you positively affect your community”.

Storyboarding has these influences:

- It narrows down the situation of interest.
- The description involves human interaction with the situation of interest; emotionally laden situations are easy to adapt to.
- The sketches and timeline in the storyboard guide you towards finding problems to solve.

What we can see in the data is some characteristics that could be worth studying in more depth. As a summary of the empirical findings we suggest three hypotheses that need testing in order to create new knowledge regarding storyboarding in pre-brief activities supporting management.

The development of storyboarding in pre-brief activities seems to promote an emotional understanding of the situation of interest. This indicates that storyboarding supports an empathic approach towards the situation. Empathy in understanding a situation or issue is seen as a key criterion when using a design-thinking approach.
Thinking when creating a brief is evidently dependent on the approach towards an understanding of the problem and the framing and reframing of the design brief. The designer’s use of abduction-2 reasoning is to some extent exposed in the use and development of a storyboard. This is best seen in the fact that storyboard briefs are focused on creating value in the situation while the written briefs are more focused on achieving results that can solve a problem. The written brief defines “what” is needed in the situation, and the “how” is the working principles of designing, e.g. following a stage-gate design process in order to achieve results. The reasoning activity employed in this is then more connected with deduction. How this affects the process could be seen in the observation of designers redefining structured problems into ill-structured problems in order to support the reasoning activities of abduction-2. This suggests that the making of a storyboard in framing and reframing a situation supports a kind of brief well adapted to the designer’s way of thinking.

**Evaluation of results**

When exploring how a support (in this case storyboarding) affects the things meant to be affected (the brief) a number of parameters are involved. In this case the people and the “area of interest” were the uncertainties with the most impact of the results. The people involved were highly motivated students in a course in concept development, the workshop was performed during their first session together and it was the first time a lot of them met. This speaks for good conditions regarding people’s performance and attitude to the workshop. When it comes to the “area of interest” a choice was made to be open and a bit ambiguous in order to open the solution space for the interpretation of the scope.

**Conclusions about the research approach**

The purpose of this research has been to understand storyboarding in framing and reframing a design brief. With reference to the findings presented we argue that storyboarding seems to be more promising when it comes to supporting innovation projects that have a narrow focus. However, in that area storyboarding is more open to freedom of interpretation and reframing of a problem at its roots. Written briefs seem more adapted to problem solving, in which projects are well defined but have more room (innovation space) for the search for a solution.

In order to understand the reasoning activities connected with the development of a storyboard in pre-brief activities, the following hypotheses have been formulated.

**Hypothesis 1: Type of innovation**

Meaning vs. function. As presented in previous research, the situation is explored with human centredness. Visual thinking focuses on exploration and externalizes thoughts and ideas so that they are accessible to other people involved in the process. A narrative forces the team to choose and explore a situation. Since stories often have an emotional connection, humans involved in these situations become central. Storyboarding answers questions focusing on meaning, where “why” re-
presents a problem-finding approach to the situation (storyboarding creates a focus on the context since there is a need to understand the context in order to develop the storyboard, both because of the narrative and the sketches), while the written brief is focused on function, where “how” or “what” represents a problem-solving approach to the situation or issue.

“Why” stands for ethnographic research and “what” stands for contextual inquiry.

**Hypothesis 2: Scope**

Broad vs. narrow (Figure 4.17). Storyboarding develops a narrow scope of the brief since stories force you to pick a case and then you finally focus on it. Stories demand concreteness, which leads to a specific situation around which to create the story. Storyboarding provides a timeline for the issue of interest as well, leading to a holistic understanding of the scope.

![Figure 4.17. The scope of the brief.](image)

**Hypothesis 3: Level of ambiguity**

Storyboard briefs are more ambiguous than written briefs. The timeline and sketches in the storyboard create openness to interpretation, while the text forces you to be more precise in your explanation, leading to less space for interpretation.

**Continuation**

The support that storyboarding can provide in pre-brief activities for innovation management needs more research and the hypotheses formulated need testing. The findings so far are promising in the sense that they promote enhanced knowledge regarding the characteristics of using storyboarding and the benefits and disadvantages involved. The aim is to create deep knowledge regarding the visual narrative role in framing opportunities for innovation and support management in the ambiguous activities involved in making innovations.
4.3.3 Reflection on prescriptive study

When developing support the goal is to create a change in a workflow or a process, this can be hard since it is dependent on people’s attitude about the way they work now and how the new support affects their role in the organization. Often support is developed without any evaluation in practice so their value is based on theoretical reasoning and assumptions. This prescriptive phase in the DRM is for developing support. However, the next step is about evaluating the support and is of most interest for the support to be implemented in an industrial context. What seems to be promising in this phase can be confirmed and useful in the evaluation of the support, but is could also be falsified and actually have negative effect regarding the situation.

When exploring new areas of knowledge you need to be open to opportunities and “listen” to the data previously gathered. In Study D an opportunity to develop a methodology (DoTank) and gather data in the context of a project called “tipping point” appeared. Even though time is never enough when pursuing opportunities, it is well worth the effort when the data is collected. In this study student assisted me in facilitating the workshops and collected the material from the workshops.

In order to understand how the methodology affected the people involved interviews with the facilitators was performed. Through their perception and stories of the workshops an over all view was developed, this created a holistic understanding of the situations of the workshops. The phase of developing the methodology should have been complemented with individual interviews and recorded discussions with the participants. Also to capture the workshop on film would contribute in understanding the methodology characteristics even deeper.

4.4 Descriptive study 2

In Descriptive study 2 the hypotheses were set up to be tested in a series of experiments with students (Study G). Four experiments were performed resulting in 17 briefs (nine storyboards and eight written documents). The total number of teams involved was 22, due to the fact that the experiment was different in setup. The results from this study constitute the main knowledge developed regarding the use of storyboarding at the front-front end of innovation and are of interest for support for innovation management regarding sketching and negotiation involved when storyboarding.

4.4.1 Study G, testing hypotheses

In order to test the hypotheses, an experiment was performed. The experiment was based on the theoretical foundation of design thinking, visual thinking, and narrative. The methodology (DoTank) supports idea development in 90 minutes workshops, going from an “area of interest” to a “concept description”, where the
concept highlights the framing of opportunities for innovation. Using the theory developed by Schön (1991), the authors are aware that this theory springs from how professionals individually think in action. In this context teams with both novices and professionals have participated, structuring the activities in a concrete way.

**Research approach**

To test the three hypotheses in specific, the experiment was designed and created to analyse how storyboarding can be used to formulate a brief in comparison with a written brief. In order to evaluate the difference between producing and using a storyboard and a written brief, a shift of teams took place at the beginning of the concept generation phase, but there was also an interest in following teams through the whole process of both producing and using storyboarding or written briefs. The experiment was divided into four separate experiments with a variation in design and the participants’ area of study. Each experiment consisted of three to six project teams with three to six students per team. The experiment had three phases, naming, framing, and moving-reflecting. The teams were assigned an area of interest as a starting point, after which they continued through the phases to conclude with a concept description.

**Area of interest:**

Many companies have recognized the potential of smart devices in vehicles to communicate with other smart devices. One of the companies wants you to develop this opportunity.

Every step in the experiment is supplemented by a visual tool shown in Figure 4.18. The first step for the teams to take is individual brainstorming (brainwriting) for about five minutes in order to clarify their individual beliefs and perceptions about the situation; this step is facilitated by a visual tool posing three questions about the future: Who or what affects the area? Is there any uncertainty in the field and in general? What are the current trends, generally and specifically? These questions are posed in order to open up the mind for the specific theme and create the first frame of the situation. Since this is done individually, everybody in the team can make their voice heard in the next step, which is information sharing using brainstorming.

![Visual tools supporting the different steps in the experiments.](image)
The brainstorming session starts by sharing the thoughts and beliefs about the future among the team members. They are encouraged to build on each other’s information and add new thoughts and information that comes to mind during the brainstorming. Towards the end of this step, which lasts for about 20 minutes, the team is asked to focus on one situation or issue that they find most intriguing or interesting to continue work on.

Moving on to the next step the teams are instructed to draw and tell a story about the situation they have focused on using a storyboard. Towards the end of this step the teams are again asked to focus on one specific part of the story from which to develop their concept.

In the last step (moving-reflecting) the teams are forced to create a concept out of the briefs. Depending on the setup of the experiment (there are two setups that are explained below), the time frame for this phase varies from 30 to 60 minutes. The challenge for the teams is to create a concept and conditions for others to understand their concept. This phase also makes the concept concrete and helps moving the concepts forward.

Experiment 1

The participants in this experiment were students of Product Development in their third and fourth years. In Figure 4.19 the experiment is visualized with the specific phases and where in the experiment the shift of teams from producer of the brief to user of the brief took place. In this setup a switch in teams was performed after the framing phase; this was to explore whether the interpretation of the brief was affected by the way it was developed.

Experiment 2

The participants in this experiment were students of Innovation Management in their second year and teachers of the subject, divided into three teams. This experiment was executed like Experiment 1, with the exception that each team completed all three phases (Figure 4.20). This implies that all teams were aware of the area of interest when developing the concept description. This also reduced the time of the moving-reflecting phase to 30 minutes; when shifting the teams before this phase, the time was 60 minutes.
Experiment 3 was executed like Experiment 1. The participants were second-year Information Design students, divided into eight teams.

Experiment 4 was executed in the same way as Experiment 2 but with six teams, three doing a storyboard and three producing a written document. This experiment was held at the National Taiwan University of Science and Technology in Taipei. The participants in this experiment were graphic design students and industrial design students. The reason for doing this fourth experiment in Taiwan was to give insights into the generalizability of the results in another culture and context.

Results
The four experiments resulted in 17 briefs, nine storyboard briefs and eight written briefs. The briefs were analysed individually and compared with the hypotheses. The results are summarized, presented, and discussed in the following sections. Two examples are presented below in order to clearly describe the difference between storyboarding and written documents.

Example 1.4, written document
A written brief from Team 3.4 in which they interpret the area of interest and develop a description where the situation is about lack of time in everyday life.

   Problem:
   Lack of time is a constant problem in everyday life.
   Need:
   Streamline everyday life, cultivate social and family relationships. Get the time to nurture social interaction.
   Opportunity:
   Smart devices help you not to have to think about mundane everyday problems such as shopping. They can support your memory and streamline your workday. Smart devices will give you time to care for your relations.
This brief has a clear topic, the issue of time in everyday life. There is no indication of function apart from using smart devices, which could be understood as some form of functionality, but we have not analysed this as functionality as in the briefs presented in the storyboards. This is not explicit in the brief but referring to something out there to solve the problem addressed. The focus is broadly described and does not give any direction regarding the aim or value to create. The area of interest has even expanded from the original one. The brief has put the area of interest into a new area of interest, using smart devices in order to create some kind of value in a social and family relation. There is a clear shift of focus in this specific brief, something that opens up for interpreting smart devices in a whole new area. This means that the transportation company (defining the original area of interest) is focusing on an area outside transportation.

Example 4.5, storyboarding

The following is a storyboard example from Team 4.5 (Figure 4.21). The storyboard describes a “Smart Parking Team” addressing the problem of finding a parking place in the city.

There is a clear meaning in this storyboard: creating value for the user with a smart and easy way to book a parking place in the city. However, there is also a clear function as well, using technology in the car to book, pay, and find your way to the reserved parking place. However, there are no clear technological descriptions of how this value should be achieved. It is also very clear that there is a narrow focus in the situation described; the area of interest was to explore the possibilities of using smart devices in vehicles. This storyboard focuses on one specific event, the parking of a car in a city. This is a really narrow area of interest and the framing of the situation is clear and convincing. Regarding the level of ambiguity there are some difficulties compared with the written briefs. The storyboard describes a clear value to achieve but is open for interpretation of how this value best can be obtained.

Hypothesis 1

Type of innovation: A storyboarding brief is focused on meaning while a written brief is focused on function.

The results from the experiments with respect to Hypothesis 1 vary. One thing that is interesting in Table 4.1 is the fact that the storyboard briefs include both meaning and function in five out of nine briefs, but the written briefs all distinguish between meaning and function. It also shows that there is a variation in focus (meaning or function) of the briefs regardless of whether they are done as storyboards or written documents.
Figure 4.21. The storyboard brief from team 4.5.
A brief focused on meaning describes a situation and why the situation occurs. It often involves humans and puts the user in focus. A brief focused on function has a problem-solving approach and describes desired functions.

The written briefs are distinct in either meaning or function. In the storyboard briefs on the other hand, it has been difficult to decide whether some of them are directed towards meaning or function since they include both. Some of the teams using storyboards started by formulating a problem scenario, i.e. meaning, and continued by finding solutions to the problem, i.e. function, which was not supposed to be a part of the framing phase. The storyboard tool itself contains a number of empty boxes encouraging the users to describe a problem or a situation along a timeline. The given number of boxes might also create a wish to complete the storyboard and not leave any blanks. This facilitates expressing meaning by telling a story but also encourages the users to continue the story by presenting desired functions and sometimes even solutions.

Hypothesis 1 claims that a storyboarding brief describes why a problem occurs, but observations and analyses from the experiment showed a tendency when using storyboarding to describe what is happening. This indicates a gap between meaning, i.e. why a problem occurs, and function, how the problem can be solved. The gap could be expressed as a situation, i.e. what is happening when the problem occurs. It is, however, an interesting finding that storyboarding more often includes both meaning and function, which might affect the concept generation in the next phase, either positively or negatively depending on the type of project. When a storyboard brief includes a great deal of text, it also seems to become more directed at function since the text might impose restrictions on the components that should be included in the concept. The result from the experiment shows that Hypothesis 1 cannot be confirmed. Hence, there is no direct evidence that shows a clear difference between storyboarding briefs and written briefs regarding the focus of the hypothesis. The indication from Study F was that there was a difference between storyboarding briefs and written briefs regarding the focus of meaning or function. What was found in this study was that there is a difference but not the expected one; the difference lies in the fact that storyboarding forces a focus on both meaning and function while written briefs focus on either meaning or function. This finding is interesting since it forces the team to focus on meaning when using storyboarding in the pre-brief activities. The other interesting thing here is that written briefs tend to focus on either meaning or function.

<table>
<thead>
<tr>
<th>Type</th>
<th>Storyboard brief</th>
<th>Written brief</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.1 1.3 2.1 2.3 3.1 3.3 4.1 4.3 4.5</td>
<td>1.2 1.4 2.2 3.2 3.4 4.2 4.4 4.6</td>
</tr>
<tr>
<td>Meaning</td>
<td>Y Y Y Y Y</td>
<td>Y</td>
</tr>
<tr>
<td>Function</td>
<td>Y Y Y Y</td>
<td>Y Y Y Y Y Y</td>
</tr>
</tbody>
</table>
Hypothesis 2

Type of scope: A storyboard brief is narrow in its scope while a written brief is broad.

The result from the experiments with respect to Hypothesis 2 is clear. As shown in Table 4.2 there is only one brief (3.2) deviating from the hypothesis. The reason for this could be found in an early fixation in the team on one specific part of the area of interest.

Table 4.2. Hypothesis 2. Y stands for confirmed, found in the briefs.

<table>
<thead>
<tr>
<th>Type</th>
<th>Storyboard brief</th>
<th>Written brief</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow</td>
<td>Y Y Y Y Y Y Y Y</td>
<td>Y Y Y Y Y Y Y</td>
</tr>
<tr>
<td>Broad</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results are also evaluated and visualized in Figures 7 and 8 below. The grey circle visualizes the given area of interest, the black ring visualizes the brief and the black dot shows the position of the concept description in relation to the area of interest and the brief. The size and position of the black ring shows the scope of the brief in relation to the area of interest.

In Figure 4.22 explaining the scope of the storyboarding briefs, it is clear that storyboarding is narrow and within the scope of the area of interest. Briefs 1.1 and 3.3 resulted in concept descriptions outside the boundaries of both the area of interest and the brief. In brief 4.1 the scope has deviated somewhat from the area of interest and the concept description is on the border of the area of interest.

Figure 4.22. Visualization of scope in the storyboard briefs in relation to the area of interest.

In Figure 4.23 explaining the scope of the written briefs, briefs 1.2, 2.2, and 3.4 are broader than the area of interest but lack important information, which allows for a solution outside the boundaries of the area of interest. Brief 1.4 is broad in its scope because it includes the original boundaries but has also additional information that opens up for solutions outside the area of interest. Brief 3.2 deviates from the hypothesis since it is very narrow in its scope.

Figure 4.23. Visualization of scope in the written briefs in relation to the area of interest.
A narrow brief is more delimited and specifies more details than the area of interest. A broad brief opens up for more opportunities and enables solutions outside the area of interest. The narrowness of storyboarding supports management in providing a strategic direction for the team; this also removes hidden fixations of the teams. When a broad brief is presented to a team there is always a risk that the team will end up with old solutions following fixations from past experience and not recognized as fixations. This could consequently be avoided by providing a narrow brief with clear directions for the team.

All storyboarding briefs are narrow in their scope while all written briefs except for one are broad. This written brief differs from the others by being extremely narrow. Observations during the experiments indicate that one participant in this team had a fixation that restrained the rest of the team. Fixation of an initial solution can be a barrier to innovative ideas, which can make the scope narrow. Regardless of the context and type of brief, a fixation can occur. Despite this deviation, Hypothesis 2 is considered confirmed.

The analysis showed that a written brief does not always describe a scenario. Instead, the written briefs focus on describing important events briefly in a short context. This allows for a broader scope of the brief since the root cause of the problem is undefined. A storyboarding brief is generally narrower than a written brief since the pictures in the storyboard usually describe one or more situations. A reason why storyboarding briefs are narrower could also be the complexity of describing a generic category with pictures only. In the experiment, a vehicle was pictured in the storyboards as a car or a truck, which made the brief narrower. In written text on the other hand, it is possible to choose generic categories to broaden the brief.

Hypothesis 3

Level of ambiguity. Storyboard briefs are more ambiguous than written briefs.

The timeline and sketches in the storyboard create openness for interpretation while the text forces you to be more precise in your explanation, leading to less space for interpretation.

When analysing the concept description in relation to the area of interest and the briefs, it was found that two of the concepts were outside the boundaries for both the challenge and the brief. Those briefs were storyboards, narrow in their scope and within the boundaries of the area of interest. This indicates that storyboarding briefs might have a higher level of ambiguity since a picture gives opportunity for divergent interpretations, while a written brief has a lower level of ambiguity since a text is traditionally used in more concrete and precise contexts. Besides, the participants might not be used to interpreting sketches in a context like this, which could make it difficult to identify important details, particularly when there are several sketches to interpret at the same time. All details might be there in the sketches but do not attract the participants since not enough weight is put on the importance of the details. The time limit set at the experiment might affect the ability
to understand the context of the sketches. A written brief gives a better overview of the important details since it allows the designer to check that the concept description is consistent with the brief.

Another indication of the ambiguity of the storyboarding brief is the results presented in Section 4.1 regarding meaning and function since the storyboard shows both, and a more ambiguous interpretation could be possible. However, this hypothesis needs more research in order to be understood. And, as formulated here it is not proven since it was more difficult to find ambiguity in these experiments than it was in Study F. However, the hypothesis needs to be reformulated, perhaps with a focus more on ill-defined problems instead of ambiguity.

**Evaluation of results**

There was a great variation in the design of the briefs, which indicated that some of the teams lacked knowledge of how to formulate a brief. Observations during the experiment showed that some teams spent time discussing what a brief is and how to create it. Hence, some of the final briefs did not include the basic context of a design brief, which should incorporate problem background and wishes or demands. The written instructions could have described the basic context of a brief and further clarified the focus on formulating a problem and not giving solutions. This might have affected the result of the experiment and should be considered when evaluating the credibility of the experiment.

Some of the written briefs lacked important information from the area of interest, which let the brief fall outside its mission. Based on observations, one reason could be a fixation on one part of the area of interest. Another reason could be that only one writer formulated the written brief, which may have discouraged the other participants to contribute. The storyboards on the other hand seemed to encourage all team members to contribute and take part in formulating the brief.

To be able to analyse the outcome and establish a result, we as observers had to set frames for how to evaluate the outcome. Since the two concepts in Hypothesis 1, meaning and function, are not opposites of each other, it was difficult to set clear frames for the evaluation. The outcome clearly showed that a brief could include both meaning and function, which made it difficult to analyse the outcome based on the given hypothesis. Hypothesis 2 on the other hand concerned scope, where narrow and broad are opposites of each other. The area of interest was a reference for the evaluation and made it easier to decide the scope of the brief. In Hypothesis 3 the results appeared in the analysis of the other hypotheses; these findings would have been hard to confirm without the other parts and might be more complex than those of the other hypotheses.

It should be mentioned that Experiments 2 and 4 were evaluated in the same way as Experiments 1 and 3, even though there was a difference in the design of the experiments. To get even more reliable results, it might be necessary to perform additional experiments, also formulated differently. It could be interesting to investigate how different teams would interpret the same brief.
Conclusions about the research approach

This experiment involved two different methods to frame a problem, storyboarding brief and written brief. The methods were compared in an experiment where three hypotheses were tested with two different setups, one with teams doing the whole workshop and one with a switch of teams after the naming phase in order to evaluate the interpretation of the briefs. Hypothesis 1, regarding meaning and function, is not confirmed since some of the briefs included both meaning and function and no distinct result could be determined. It is an interesting finding, however, that storyboarding briefs often include both meaning, i.e. why a problem occurs, and function, i.e. how the problem can be solved. This could be expressed as a situation, i.e. what is happening when the problem occurs. This allows for different possibilities and outcomes of the next phases in the design process. This fact actually forces a focus on meaning when framing a situation using storyboarding. Hypothesis 2, regarding narrow and broad, is considered confirmed since all storyboarding briefs were narrow in their scope while all the written briefs except for one were broad. Storyboarding briefs are in general narrower than written briefs since the sketches in storyboarding usually describe situations, while the focus of a written brief is on describing important events briefly in a short context. This allows for a broader scope since the root cause of the problem is undefined. Hypothesis 3, regarding the ambiguity of the storyboard, needs more research, but some indications of the ambiguous level of storyboards are presented, however not enough to make a statement about the hypothesis.

Continuation

Since this is the last step in this research the continuation is presented in future research in section 6.5.

4.4.2 Reflection on descriptive study 2

The evaluation phase is where the value of the research is created. In order to create a controlled environment for the experiments graduate students assisted the experiments. This opened up for performing several teams at the same time that lead to more data in less time. Also the opportunity to gather data from another university was a great experience, the set-up was easier than expected and the effort well worth.

Time is always an issue to consider, in this study a lot of material was collected and the experiments was filmed. However, interviews with the participants after the experiments might have been useful to develop even more knowledge regarding their perception of storyboarding. This was not prioritized but when reflecting it might have been useful. The knowledge regarding storyboarding needs to be complemented with experiments in “real” settings, performed by managers and designers developing a brief.
The objective is to increase the knowledge of how storyboarding can support innovation management in the front-front end of innovation.
5 Discussion

In this research storyboarding has been pointed out as a possible way to support innovation management in pre-brief activities. This positioning was based on the initially performed studies regarding enhanced knowledge in the field of design thinking, visual thinking and narrative. There was also an academic need to connect the discourse of designerly thinking with the more management based discourse of design thinking (Johansson-Sköldberg et al., 2013). This was then put into the context of the important early phases of innovation, namely in what is called the “front end” (David et al., 1994, Cooper and Kleinschmidt, 1995, Khurana and Rosenthal, 1998, MacCormack et al., 2001, Verganti, 1999). The phase of the front end is of great importance for the success of innovation; it does not matter how well the process is managed or the design realized if they are based on a wrong assumption regarding the problem (Cooper, 1988). The objective of the research is to

“increase the knowledge of how storyboarding can support innovation management in the front-end of innovation”.

This objective has been explored through several studies in order to develop new knowledge about the front-end of innovation and about storyboarding. In the following discussion I will go from knowledge regarding storyboarding towards a holistic understanding of innovation processes and the connection between designerly thinking and design thinking.

The studies in this research started out in a broad exploration of the early phases of innovation and what effects design thinking, visual thinking and narrative have, and ended up searching to understand storyboarding in pre-brief activities. In this discussion the opposite approach will be used, going from the specific, knowledge regarding storyboarding in pre-brief activities, to a discussion on how this knowledge support a processual understanding of innovation.

5.1 Understanding storyboarding in pre-brief activities

This research presents findings regarding the use of storyboarding in pre-brief activities in the front-end of innovation. Storyboarding is presented as a method that may enable reflection on both meaning and function when creating a brief, this brings a human-centred approach to pre-brief activities and therefore how humans create meaning of things. Also, storyboarding frames a narrow area within the “area of interest”, this supports management when a clear statement about a strategic direction is sought. Storyboarding is explained as a visual narrative method when describing a situation of interest. The combination of visual (sketches) and narrative (stories) is not new; however, in activities aimed at creating a design brief, storyboarding is new. Especially when considering storyboarding as a process tool, that is a tool in order to support thinking when creating a brief and not as a visualization presenting the finished brief.
When enhancing knowledge regarding storyboarding in team pre-brief activities, a number of characteristics connected are of importance. The four phases of “the framing cycle” (Hey et al., 2007) is used when discussing the role of storyboarding as a tool to support innovation management since they:

“highlighted the role that concrete user data, effectively shared, played in the formation of a shared frame” (p. 95).

The following will explain the four different phases in “the framing cycle” and discuss each phase in relation to storyboarding. In Table 5.1 the connection between the theory of Hey et al. (2007), and Schön (1991) the DoTank methodology is presented along with the study in which it has been established.

<table>
<thead>
<tr>
<th>Hey et al</th>
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Table. 5.1. Connecting the “frame cycle” to the DoTank methodology.

"Pseudo-frame setting” is an initial step to understand the “design situation, the goals, important features, boundaries and evaluation criteria” (Hey et al., 2007, p. 93). This is handled within the naming phase (Schön, 1991). In the DoTank methodology this takes place in “Brainwriting & brainstorming”. The brainwriting part starts this when you individually answer questions by writing down information or perception about the situation. This is done in order to prepare the sharing of your understanding of the situation with the other team members in the “brainstorming”.

"Individual frames made explicit” is the next step performed, this step is done in order to collect data from users and break down the designers pre-understanding of the situation. In the DoTank methodology this is done by “brainstorming”, share understanding and build a common view of the situation. It is also in this phase that you make decisions about directions to follow. As Hey et al. (2007, p. 94) argues:

“The consequent sharing of expectations through team interaction makes each member’s implicit frames more explicit, common frames can begin to be negotiated”.

So, the DoTank methodologies first step “naming” (Brainwriting & brainstorming) support this consequent sharing and builds a first negotiable understanding of the situation. This since the tools enables individuals to express their thought and pre-understanding of the situation, first while silently writing down on papers and secondly sharing this with the other team members. This means that past experience and personal opinions that are shared plays an important part and con-
nect the study where storyboarding is used to capture “lessons learned” (study D) to the front-front end. Since storyboarding enables a reflection on both meaning and function, using storyboarding to capture “lessons learned” provide knowledge about the emotional parts of the performed project to bring into the “mind’s eye” (Ferguson, 1992).

This first step of the DoTank methodology support both individual reflection and group negotiation, using visual and narrative. In study C, about the moon message, an idea was followed in order to understand how people relate to stories of it. In this, language is used to create meaning in the situation and to “sketch” the innovation in order to negotiate the understanding. The iterative process of innovation telling and innovation making is here connected to the “framing cycle” (Hey et al., 2007), using language to create a common shared frame.

The use of storyboarding supports the process of "conflicts made salient" and "common frame negotiation" in the way that it forces the team to pick a situation to describe, this provides a narrow scope of the situation as described in Study F. By this decision making the team is labeling and prioritizing needs discovered in the situation. The frames in the storyboard support modularization of the situation (as shown in Study D), dividing the story in parts where a transition is made between the frames. This modularization is supported by the structure of the storyboard with its pre-printed frames. This has been observed trigger the narrator in us, why this happens could be found in narrative where the search for a closure of the narrative is sought (Abbott, 2008). This is something that happens whether you want it or not, and is triggered by a surprise. This surprise can in storyboarding occur when the team discusses a transition between frames. This is observed in many of the teams where a different direction is taken in the story, but difficult to show in the storyboards. Storyboarding also enables reflection-in-action, connecting to the theory developed by Schön (1991) regarding how professionals think in action. This is since a space in time is provided by someone sketching and the others unconsciously reflect on what is being sketched and connects this to the sketches already drawn. This reflection-in-action makes the situation based on reflected beliefs, as individual frames and also reflected beliefs in the team since the storyboarding supports negotiation and shared frames. The storyboarding externalizes the narrative in both visual and verbal form, open the space for interpretation and negotiation.

When connecting this to the way IDEO works the initial understanding of the situation is important and almost always made through an ethnographical approach, involving peoples understanding and emotions of the situation. Referring to Hey et al. (2007), the inspiration and information gathering at IDEO is done in order to 1) set a frame, 2) make implicit frames more explicit, 3) make conflicts more salient, and 4) negotiate a common frame. The way this is done is mainly by using visual thinking and narrative. At IDEO stories are used as a tool to make understanding of the situation and repeatedly share information about the situation as it is under-
stood at the specific moment. This means that stories change over time since a new frame is developed and shared, and they perform multiple iterations of the framing cycle early in the process.

This shows that storyboarding can assist teams in organizing and discussing the situation of interest as a method providing space for reflection and negotiation. New tools within this phase is needed (Hey et al., 2007).

5.2 Bringing design thinking to the front-front end using storyboarding

As described by Dorst (2011) designer’s frame creation can benefit organizations and practitioners in other fields. The framing, or frame creation, is seen as a core activity in design practice and with the unique reasoning patterns behind designing new knowledge regarding a situation of interest can be achieved.

In the introduction I refer to Nielsen (2009) list of five important points that connects the design perspective to the front-front end of innovation. Can storyboarding be a method to bring design-thinking to the front-front end of innovation, applying a human centred approach to pre-brief activities, below is a discussion on the points that Nielsen makes.

Designers tackle wicked problems and approach all problems as if they were ill-defined.

We have seen differences in written briefs compared with storyboarding regarding what we initially defined as ambiguity. This ambiguity could not be proven in the experiments as presented in Section 6.3. However, storyboarding might transform well-defined problems into ill-defined problems since it offers several possible interpretations developed by several sketches that build up a whole. This has not been the focus in this research and needs more research to be understood.

Designers are human-centred and have a myriad of tools and methods to approach the user (or the network of stakeholders).

Storyboarding offers a new method to enable human centredness into a brief; this is shown in many of the storyboards in the DoTank workshops. More interesting are the results from the experiments comparing the written briefs with storyboarding briefs, where we can see that regardless of whether you start your storyboarding with function or meaning, the teams highlight both dimensions. This is not seen in the written briefs, where the teams stay within the dimension chosen from the beginning. This indicates that if you tend to have a function-related problem, the use of storyboarding can bring meaning to the problem and highlight that dimension with a human-centred approach to the problem.

Designers co-develop the understanding of the problem along with the creation of the solution.

When storyboarding, the narrative format supports the endeavour to close the story; this endeavour opens up for a surprise in the story where a search for a solu-
tion starts. This could also be seen as a result of the modularization of the story that the storyboard sustains. The modularization creates gaps in the story where transformation occurs. So storyboarding can support this co-development of the problem along with the creation of an understanding of the solution and what the solution might look like.

Designers use abductive reasoning and strive for a solution.

Among others, Tversky (1999) shows that sketches facilitate memory. This affects the way storyboarding can support abductive reasoning activities since abstract sketches connect to memories from the past and imagination of the future. Also the focus in storyboarding is on describing a situation as it is, the gaps and the narrative format open up for surprises, as described earlier, and stimulates new ideas. You need to make sense of the situation in order to formulate the problem, and this process is supported by using storyboarding.

Designers engage in a reflective conversation with the situation.

The teams’ work in storyboarding, describing the situation of interest using sketches and storytelling, rests on reflective practice and is the teams’ way of being part of a reflective conversation with the situation. The negotiation of the situation of interest creates time for reflection in the making and supports reflection actively. This is observed in most of the teams doing storyboards with moments of silence while someone is sketching followed by discussions regarding what is described in the sketch in that specific frame and how it is connected to the ones before. The teams’ reflective conversation is closely connected with the four phases of the framing cycle presented by Hey et al. (2007), and was also seen in team meetings at IDEO.

This connection of storyboarding in pre-brief activities and the attributes connected with a designerly way of thinking and doing highlights the support that storyboarding brings to the process of creating a brief. Storyboarding brings a design-thinking approach to the pre-brief activities and supports management in a human centredness of the brief. As Cross (2000, 2008) explains, the basic context of the brief is the background of the problem including a wish or a demand, not a solution. The aim of the activities involved in creating a brief is to frame and reframe a problem so that an actual and shared view of the problem can be created. Storyboarding supports framing a narrow area of interest but at the same time it opens up for a reframing of the problem in accordance with the modularization of the story, this since there are different ways in interpreting the gaps provided by the modularization, and an endeavour to close the story. This role of storyboarding can create value in problems where a narrow but still open brief is needed. As described earlier, storyboarding enables reflection on both meaning and function when creating a brief. This reflection on meaning could be valuable when focusing on radical innovation with new meaning (Verganti, 2009).
And as Krippendorff (2006) argue “design is a sense creating activity”, acknowledging designers making sense of things when describing what designing is all about. In order to bring designerly thinking into design-thinking the approach needs to be supported by methods, stimulating the mindset needed. And by using storyboarding, the team connect the two different tracks of perception and conversation with others described by Nielsen (2009) in figure 3.1. Going from sense to meaning using perception, interpreting the sketches and the storyboard as a whole, and in conversation with others you negotiate the situation in order to create a common frame.

As an illustration of frame creation Dorst (2011) describes a situation of an entertainment quarter in a metropolis with issues regarding drunkenness, fights, petty theft, drugs dealing and sporadic violence. The initial frame was described (by local council) as law-and-order problem, needing law-and-order solutions. When the designer approached the situation they used a broader “area of interest” (as I call it) and looked at the people involved in the situation and understanding their needs and behavior. They framed the situation quite differently and proposed to look at the entertainment quarter as a music festival. And by this new and narrow frame (a music festival is in my opinion narrow in its scope since it describes a concrete situation while a law-and-order situation only gives an overview of a problem) they could look at the situation with new eyes and propose solutions inside the frame but with a completely new meaning. When using storyboarding in a situation like this it could much likely be the situation described above. Starting with a broad scan of inspiration and information, picking a situation to describe, young people go out to have fun in entertainment quarters in a metropolis (much like a situation on music festival an idea of an analogy could be seen as a surprise in storyboarding) and by describing this situation using storyboarding similarities can be made of a music festival. And since storyboarding enables reflection on both meaning and function, solutions generated would most probably have embraced the experience of the “night out”. Of course this is just a speculation, but it gives an indication of what I have experienced using storyboarding in team pre-brief activities.

As proposed earlier, storyboarding is connected with the step between naming and framing, indicating that Storyboarding supports the understanding of the situation of interest and forces the team to bring meaning to the situation with a focus on the end user in the situation. Even though storyboarding brings a narrow focus, a holistic view of the situation is created through the sketches and the narrative, because the narrative is based on specific events and not on general statements.

5.3 The front-front end connected to the reflective practice
The discussion above connects storyboarding with a number of attributes characterized in designing, and since there is an interest in using design methodologies in innovation management, this link is important. As described earlier there are several challenges connected with the front-front end of innovation. The most important of these challenges must be to know what problem to solve; this understan-
故事板的开发需要在预准备活动中给予更多的关注。故事板的发展将重点放在理解背景之前定义的简要上。然而，故事板和反思实践之间的联系也是重要的，因为反思实践是专业设计工作以及设计思维的基础。图5.1所示的模型（Schön, 1991）由Wikström和Jackson（2012）开发。该模型有助于理解设计的迭代过程。以下是对不同阶段的描述，涉及反思-in-action。

用于解释和可视化，如草图，是设计师的重要工具。它在解释专业人士如何与当前情况互动中是中心的（Schön, 1991）。直观也打开了对别人的评论，如果行动-现在时间框架更长。因此，可视化实际上是一种使发展工作受益的技术。此外，使用问题解决方法论和心态与涉及反思-in-action的一系列决策链有关。问题解决的重点在于命名和框架阶段，其中项目的目标和目的被确定。设计过程是对设计师的认知和行为方式的表征。然而，尽管过程通常被描述为线性的（以便进行交流），但它实际上是一个迭代过程，在关系到识别的框架（framing）和命名（naming）的上下文中移动和反思并测试想法。

图5.1。Schön (1991)的反思实践

该模型有助于理解迭代设计过程。以下是对不同阶段的描述，涉及反思-in-action。

用于解释和可视化，如草图，是设计师的重要工具。它在解释专业人士如何与当前情况互动中是中心的（Schön, 1991）。直观也打开了对别人的评论，如果行动-现在时间框架更长。因此，可视化实际上是一种使发展工作受益的技术。此外，使用问题解决方法论和心态与涉及反思-in-action的一系列决策链有关。问题解决的重点在于命名和框架阶段，其中项目的目标和目的被确定。设计过程是对设计师的认知和行为方式的表征。然而，尽管过程通常被描述为线性的（以便进行交流），但它实际上是一个迭代过程，在关系到识别的框架（framing）和命名（naming）的上下文中移动和反思并测试想法。

图5.1。Schön (1991)的反思实践

The model helps to understand the iterative process of designing. Below is a description of the different phases involved in the reflection-in/on-action.

Means for interpretation and visualization, such as sketches, are important tools for designers. It is also central in explanation of how professionals interact with the situation at hand (Schön, 1991). Being visual also opens up for comments from others if the action-present time frame is longer. Thus, visualization is actually an enabling technology supporting development work. Also, using problem-solving methodologies and mindsets is related to a chain of decisions described that involve reflection-in/on-action. The focus of problem solving is in the naming and framing phases, where the objectives and goal of the project are identified. The design process is a conceptualization of the designerly ways of knowing and doing. However, although the process is often described in a linear way (in order to be communicative), it is in fact more of an iterative process of moving and reflecting and testing the ideas in relation to the frame identified (framing) and the context named (naming).
Understanding the situation and describing the core of interest and key questions regarding the design challenge are related to naming and framing. When understanding the interaction between the situation and the user in question, the designer needs to understand what the relevant questions are for the people involved. This is one of the activities in naming. When framing the area of interest, the designers need to describe the core of the project and what the relevant questions are with regard to the situation. This is very dependent on having an end-user perspective and focus, as well as having a holistic view of the product.

Creativity is needed when the designer makes his or her moves towards a solution or creates an idea of the solution. These moves often trigger an intuitive response to the situation that demands creativity. Using opportunity-finding methodologies and mindsets is central when making moves towards a solution. The act of surprise is central, and the difficulty lies in being able to relate to those surprises and create new knowledge from them. Further, in order to achieve a creative climate, management also needs to support creativity in the teams (Thacker, 1997). An external representation can carry multiple interpretations of understanding, in terms of creating a common mental image in the project. Communicating this mental image by moving and reflecting between different parts in a development process is difficult. It demands a dialogue that does not flinch at analogies and metaphors and that the receiver interprets from his or her experiences.

This section will end the discussion and focus on how the knowledge developed support a processual understanding of innovation.

When focusing on innovating, knowledge can be discerned when it comes to how innovations are shaped interactively and how language and visual reasoning are used to delineate innovative features in organizational contexts. In innovation making, the plot lines and characters are not yet constructed; this creation of meaning, shaping reality, is constructed in a dialogue by joint efforts and interaction among people. This means that the innovation is sketched in order to be communicative. This sketching relates to reflection-in-action in the iterative process of creating new knowledge by defining and refining the innovation.

However, innovation telling is also an important part of innovating. The innovation must be communicated to different stakeholders and sold so that it gains acceptance in the context of use (market, organizational setting, and so forth). As Tom Kelley at IDEO (Kelley and Littman, 2005) puts it,

"Stories persuade in a way that facts, reports and market trends seldom do, because stories make an emotional connection". (p. 242)

In his account of how stories are important in developing new ideas and innovations, stories become the glue that ties people and things together. Storytelling starts processes that stimulate reflection, a mirror reflecting reality.

I thus argue that design thinking, visual thinking and narrative are closely connected to innovation. The experience of surprise is one of the characteristics of
reflection-in-action as well as narrative and could be linked to understanding innovating, the surprise being due to the fact that you get more knowledge out of the situation than you actually put in (Schön, 1991). If the reflection-in-action time frame is longer, this opens up the communication space between people and invites people to connect with the monologue of the innovation teller in order to open up the innovation for action and negotiation.

Hence, innovating is both about persuasion and about commitment and creative spirit. To put it differently, innovating rests on making up a story (from other stories), on putting this new story together, and on inspiring other people to catch on to it. This resembles the part of informing and persuading achieved by innovation telling, while language and visual reasoning in action resemble innovation making.

From the conceptualization of innovation making and innovation telling, knowledge can be discerned when it comes to how innovations are shaped interactively and how language is used to delineate innovative features in organizational contexts. Thus, the narrative approach in combination with reflection-in-action is closely connected with innovating, as it relates to how innovation is developed. And when using the narrative process as a way of learning as sensemaking (Weick, 1995), you bring new learning from the world of experience closer to the people involved in designing.

Theoretically, narrative theory is complemented by design thinking and visual thinking. Where design thinking relates to the reflective practice and emphasize how professionals think in action, and visual thinking is considered to be “the very flesh and blood of thinking itself”(Arnheim, 2004)(p.134), and narrative illustrate how stories are shaped interactively and how words are used to delineate innovative features in organizational contexts. Together these theories lay the ground for enhanced knowledge regarding the process of innovation. These theories highlight that innovating is a co-creation process that takes place between people as much as between people and the material world.

When making sense of innovation, one must consider the complexity of innovating and the fact that it involves many different areas of knowledge and theories. However, I state that innovation can benefit from the use of theories in the areas of design thinking, visual thinking, and narrative. The persuasion of an idea is dependent on how people react and connect with the idea, here innovation telling is of importance since language is used as a tool persuading and informing people about the idea, and the development of an idea is dependent on how people interact with the idea, this during innovation making. Thus, design thinking, visual thinking and narrative are shown to be important components in order to develop new knowledge about innovating. By borrowing terms from these areas we have unlocked some new ways to connect innovation management with design thinking, visual thinking, and narrative, and by that get one step further to understand the making of innovations.
While Schön (1991) stresses the dialogue between the person and the object of interest, the narrative approach emphasizes how this process can be understood in a social setting in which the object of interest sooner or later must be narrated. The action taking place in the conversation with the situation is therefore here seen as a process taking place in a social setting, rather than in a solely individual and cognitive perspective. Consequently, reflection-in-action gives an insight into how innovating is interacted and dialogued by framing and reframing the problem space, which becomes necessary by the (often silent) reflective conversation with the object of interest as much as the conversations with people taking part in the process. This standpoint implies viewing language as a performative tool that produces innovativeness in different disguises. This means that the story of an innovation is not seen as prefabricated, as a fact, or as an objective truth out there to be communicated, but as a story that is continuously shaped in social interaction.

Using the reflective practice developed by Schön (1991) for analyzing the data collected at IDEO, a bridge between designerly thinking and design thinking is established, answering the call from Johansson-Sköldberg et al. (2013) to “acquire a scholarly base that relates more to designerly thinking” (p. 131). I have shown that the way IDEO works is closely related to the reflective practice, and when discussing directly with designers at IDEO about these results, using the model in Figure 5.1 a validation of the results was also established.
6 Conclusion

This chapter will present conclusions of the research and show how the research questions have been answered. Even though the answers to some extent already have been reviewed, this chapter aims at connecting the answers directly to the questions. The main questions have been divided into sub-questions in order to be fully explored and give guidance to the studies performed.

6.1 General discussion

The front-front end of innovation is defined as the phase of finding opportunities and defining a brief. When answering the research questions, the focus is on developing knowledge related to innovation management and to create enhanced knowledge regarding the processes involved in making innovations.

The research questions posed in Chapter 1 were:

RQ1: How does design thinking, visual thinking and narrative affect the front-front end of innovation?

RQ1.1: How does design thinking affect the specific activities involved in innovating?

RQ1.2: How does visual thinking affect the front-front end of innovation?

RQ1.3: How does narrative affect the front-front end of innovation?

RQ2: How can innovation management benefit from using storyboarding at the front-front end of innovation processes?

RQ2.1: What is the role of storyboarding at the front-front end of innovation?

RQ2.2: What is the difference between using storyboarding and written briefs?

The sub-questions will be answered first, mainly to build up the argumentation and create a holistic view of the area to be answered in the main questions.

To answer RQ1.1, a study was performed at IDEO in order to understand best practice of design thinking for innovation. First of all there was a need to understand what is in the term “design thinking” in order to understand how it affects the activities involved in innovating; there is not one proper definition of design thinking but several interpretations. The reflective practice and abductive reasoning activities are, however, central in several of these interpretations and used as a foundation for analysing design thinking at IDEO. The front-front end of innovation at IDEO is characterized by visual thinking and stories, stories to be told, to be interpreted, and to be communicated but also to be retold. With a working principle (from the abductive-2 reasoning) of sharing stories by using visualizations they develop an
understanding of the situation they design for. Through this storytelling they create a frame to be used as a goal for the value creation. By being visual in all of this they develop a visual story of the process so that management can easily access and grasp the situation but also follow the process so far. The IDEO way is to follow the information where it goes; there is no standardized way of being innovative, and the search for and sharing of information to create understanding is what affects all activities involved in design thinking at IDEO.

RQ1.2 studies how visual thinking affects the front-front end of innovation through a descriptive multiple-case study in order to develop knowledge about current practice and implications for management. Two different purposes of using visualizations are defined. One focuses on management use of visualization as something that comes out of the design process, an outcome to use in communication. The other is the designers’ use of visualizations, better known as visual thinking, as a tool for exploration and for making sense of a situation. These different purposes highlight implications of visual thinking and in a sense also the reflective practice of designing. The use of visual thinking at the front-front end of innovation is influenced by the management way of using visualizations since they employ their way of thinking and use visualizations as a means to create solutions beforehand. When employing a visual thinking mindset at the front-front end of innovation, you put a designerly way of thinking, doing and learning about the situation in focus since it brings the reflective practice to this phase. The “products” of visual thinking, visualizations, become group thinking tools and support a common mental image of the situation at hand.

In RQ1.3 a search to understand how a narrative affects the front-front end of innovation was initiated. And as already presented, stories are an important part in the way IDEO works. However, language is here seen as a tool to create a common understanding of the situation. The understanding is shaped interactively by a constant negotiation between the parts involved; language is used as a way of sketching the reality in order to be communicative. The narrative at the front-front end of innovation rests on making up a story from reality, putting this story together in its context, and on inspiring other people to catch on to it or reframe it. This was shown to be important in study C concerning the “moon message” and how that idea was developed in constant interaction within the team in the workshop. When connecting this with the reflective-practice narrative, another medium is used to make moves towards a solution, in line with the different media exemplified by Schön (1991) describing how professionals perform in reflective practice.
Also the second research question RQ2 is divided into sub-questions that will be answered first in order to develop a foundation for the main question.

RQ2: How can innovation management benefit from using storyboarding at the front-front end of innovation processes?

RQ2.1: What is the role of storyboarding at the front-front end of innovation?

RQ2.2: What is the difference between using storyboarding and written briefs?

Defining the role of storyboarding at the front-front end of innovation, RQ2.1, is based on an explorative study using the DoTank workshop format. However, RQ1 is also a basis for this exploration. As presented in Section 4.3, some common roles about storyboarding in pre-brief activities are revealed. The essence of this can be explained in the following way: the structure of the storyboard supports modularization of the story in smaller parts, which opens spaces in between the frames, where opportunities for innovation can be found. This supports briefing in the sense that situations are described enabling opportunities to be revealed. These gaps together with the endeavour to close a story also stimulate idea generation and creativity by inspiring the narrator in us. This helps in framing the area of interest, highlighting the context of the situation as well as focusing on ideas related to details in the situation. However, storyboarding also creates fixation early in the process that could depend on the use of sketches. This fixation needs to be resolved. Storyboarding focuses on the situation since it forces you to pick a situation to describe; the story about the situation becomes an object for negotiation but it also provides support to the clustering of ideas and thoughts that create a frame to bring to the brief.

In order to understand the difference between storyboarding and written briefs, RQ2.2, an explanatory study was performed, resulting in three hypotheses that needed testing. There are two main conclusions that can be drawn; first, storyboarding may enable reflection on both meaning and function in the situation while written documents do not explain both parts. However, the starting point is not affected by the different ways to explore the situation; both storyboarding and written briefs could have a starting point of either meaning or function. The difference is that when writing a brief you tend to stay within the area where you started (Figure 6.1) while storyboarding may enable an exploration of both meaning and function (Figure 6.2).
Figure 6.1. The written briefs and the exploration space.

Figure 6.2. The storyboarding briefs and the exploration space.
Second, written documents tend to be broad in their framing and also frame areas outside the area of interest (Figure 6.3) while storyboarding frames a narrow area within the area of interest (Figure 6.4). This affects the space for reframing in the sense that reframing in storyboarding can be within the area of interest while written documents open up for reframing outside the area of interest.

The difference between storyboarding and written briefs regarding scope provides some benefits, i.e. strategic direction and fixations, for innovation managers in their pre-brief activities. In order to use this in best way, a strategy is needed early in the process in order to take advantage of this new knowledge., but these findings can also be limitations in storyboarding and a strategy to is needed in order to use storyboarding when it is suitable.

Figure 6.3. The scope in the written briefs.
6.2 Conclusion

**RQ1**

Discussing the sub-questions above paves the way for the answer to the main question. Exploring how design thinking, visual thinking and narrative affect the front-end of innovation I have developed knowledge that design thinking, visual thinking and narrative support reflection-in-action since they are used as different ways of sketching how to understand a situation. The reflection-in-action is argued to be an important part of the front-end of innovation since it frames how professionals think in action. As discussed earlier, the situation is explored with a human centredness that brings meaning; visual thinking focuses on exploration and externalizes thoughts and ideas so that they are accessible to other people involved in the process, and the narrative forces the team to pick and explore a situation, and since stories are often emotional, humans involved in these situations become central.

**RQ2**

First we conclude that storyboarding may enable a reflection on both meaning and function in framing the problem. This could be useful since most briefs have a focus on function and support a problem-solving approach even though there is a
need for an approach more aimed at problem finding (design thinking), bringing a human-centred design into the brief, and therefore how humans give meaning to things.

Second, when a clear statement about a strategic direction is sought, storyboarding can be helpful since it frames a narrow area within the area of interest. This allows for reframing the situation and still having a focus within the area of interest. This supports innovation managers in their leadership by providing space for reframing but still a clear pathway to follow. A written brief describing a broad area may cause the team to pursue paths that are fixations from earlier experience or knowledge. Instead, using storyboarding with a narrow focus guides the team in a direction where hidden fixations are not attained.

Third, if management needs creativity and idea generation in order to stimulate new ideas or thought that can lead to new directions in the brief, storyboarding supports this by modularizing the situation and opening up gaps in the story. Such gaps activate the narrator in us and start a process searching to close the story. This search triggers surprises in the reflection of a situation and are deeply connected with the reflective practice.

6.3 Academic and industrial contribution

The understanding of storyboarding as a process tool in pre-brief activities supporting innovation management is new and knowledge have been developed regarding the use and characteristics of storyboarding in comparison to the traditional way of working in this phase, writing documents. The pre-brief activities in innovation processes are a topic hidden in “the fuzzy front end”. Since these activities traditionally are developed using written documents the comparison brings knowledge about hidden issues when executed in a traditional way. A brief developed writing document contains hidden fixations.

The academic contribution also consists of the bridge between designerly thinking and design thinking. Where enhanced knowledge regarding design thinking at the company IDEO are explained through the reflective practice (Schön, 1991). This bridge enables scholars in the discourse of designerly thinking to reflect and discuss the discourse of design thinking as part of the designerly thinking discourse and in this way contribute in both discourses.

The need for innovation management to understand the reflective practice as part of the early phases of innovation processes has been shown. By providing a model of the reflective practice a discussion about the process and outcomes of each step can be achieved between design teams and innovation management.

The industrial contribution can be found in the development and explanation of storyboarding as a process tool used in the pre-brief activities. Companies today need to find the right problem to solve, this demands an understanding of the whole context in which an opportunity can be found. There is a need for new methods in order to facilitate this work and storyboarding can support innovation managers
in their work. What happens with ideas when they are submitted to “idea boxes” or “intranet solutions” is in many companies quite obscure, by using the DoTank methodology these ideas can be developed into briefs creating a deeper understanding of the situation and by this exploration develops insights about the value of the idea. This may lead to support internal communication about idea stream, as well as the most important take decision to develop ideas worth developing.

6.4 Limitations

In order to fulfill the objective two research questions were posed and answered. However, the chosen research method and the research design have influenced the conclusions drawn from this research. Below are limitations revealed and discussed.

The experiments have been performed with students and this might have affected the outcome since students are not used to the situation of defining a brief. However, the briefs defined contained the information needed and was considered to fulfill the basic elements of a brief, even though most of the briefs were complying with all these elements. When looking how briefs are defined in industry some could definitely be questionable as well. This is of course not an argument in it self, but when briefs in industry are doubtable defined the validity of this research could be said match what is performed in industry today.

There could also have been different understandings among the students regarding what a brief contains and how it should be formulated. The written instructions given to the students during the experiments should deal with this issue, but students can occasionally suffer from performance anxiety and by this get stuck in the process. This was handled within the experiments by instructing the teams to go back to the written instructions.

Another issue regarding the use of students is that they could have common shared characteristics, resulting in a common shared understanding with no discussions or negotiation needed. The students involved in the different experiments consisted of a diversity of individuals, male and female, students from different courses/disciplines, cultures and parts of the world. Also one specific experiment was held in Taiwan with students from different background performing in the same team in order to deal with this issue. However, there is a risk that this might have affected the results.

Students are also limited in their contextual understanding of the “area of interest”. This is something that might be different within a industrial context where the employees are well familiar with the company scope and the products or services offered by the company. The “area of interest” also may have affected the outcome of this research. What would be helpful is to replicate this research with “real” managers.
6.5 Future research

Since storyboarding in the front-front end of innovation was discovered late in the process and the data collected is rich some parts have not been used in this thesis. This leads to suggesting that the data might add new knowledge to areas outside the scope of this research. The data, however, is still available for further analysis and may even bring new knowledge to areas connected to storyboarding in the front-front end of innovation.

One such area is something that has been observed during the experiments comparing storyboarding and written documents. There seems to be much more interaction in the teams that work with storyboarding than in the teams working with written briefs. It is not only the fact that all team members seem to be involved in the interaction; the level of interaction and playfulness seems to be higher. This could easily be analyzed since all of these experiments were filmed; what is needed is time to analyse the material.

Another part that is really interesting is the ambiguity of storyboarding, which is mentioned in the discussion as a space for reframing. The fact that storyboarding could bring space for reframing in the pre-brief activities could bring new knowledge both to storyboarding and to the activities involved in making a brief today. The setup of this kind of research could be done using experiments with teams of managers and designers using storyboarding in an area of interest in order to create a brief.

The experiments presented in study G can be further analyzed comparing differences and similarities between the material collected and the background of the students. Each experiment consisted of students from different programs except from experiment 4 which contained students with different disciplinary background in all the teams.
References


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VAN DER LELIE, C. 2006. The value of storyboards in the product design process. Personal and Ubiquitous Computing, 10(2-3), 159-162.


Appended papers


