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Is all balance created equal?

An analysis of how balance in the innovation process affects innovation success in Norwegian industrial firms

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Task text

This thesis tries to answer to what extent balance in the innovation process of firms affect innovation success. It builds on Rao & Weintraub's framework on innovation culture, and data from Norwegian industrial firms is collected with their survey through the SISVI project.

Preface

This master thesis on innovation process balance is written in cooperation with the project group Sustainable Innovation and Shared Value Creation in Norwegian Industry (SISVI) at the Norwegian University of Science and Technology (NTNU). It concludes five years of study to achieve a master of science in Industrial Economy and Technology Management with a specialization in Strategy and International Business Development.

The thesis is written in the period from January to June 2015, with data collection in February through April. Information is gathered from various sources and referenced in the text in addition to a full reference list at the end of the document. The thesis is structured with an introductory literature review, followed by methodology, a findings section and a discussion of these before making our final conclusions. Additional information is collected in appendices and referenced in the text where appropriate.

The conclusions drawn in this paper are fully and wholly tributed to the authors and NTNU are not responsible for any of the statements or results presented in this thesis.

The study has been conducted with the invaluable help of our mentor Alf Steinar Sætre, and the doctoral students Marta Morais-Storz and Nhien Nguyen. We would like to thank them for professional guidance and for giving thorough and honest feedback on our work. We would also like to thank all of the participating companies for their time to answer the survey, making our master thesis possible.

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Abstract

The business environment has evolved into a dynamic and fast-paced world where companies rely on innovation to grow and sustain profitability. As innovation has become a collective effort in the company, fostering a culture for innovation has never been more important. Rao and Weintraub (2013) propose six fundamental building blocks of innovation culture: Resources, processes, values, behavior, climate and success. The factors within the processes building block are representative for the different stages in the innovation process, and this thesis seeks to understand the relationship between the balance in that process and innovation success. Using a cross-sectional design and survey data from several Norwegian industrial firms connected to the SISVI-project (Sustainable Innovation and Value Creation in Norwegian firms), we use statistical analysis to identify relationships using a quantitative approach. Theory led us to three separate perspectives based on different assumptions regarding how the balance in the innovation process affects innovation success. This thesis is the first attempt to empirically test these assumptions made in previous literature, and uncover what is most important in the innovation process to achieve superior innovation success. Our findings challenge the perspectives arguing that a specific part of the innovation process is more important than others and that the balance in the process affects the results in a significant way. In addition, our research found significant support for the impact the average of the innovation process parts has on innovation success. Managers are therefore advised to take all parts of the innovation process into consideration to achieve superior innovation success.

Sammendrag

Dagens forretningsmiljø har utviklet seg til en dynamisk verden med høyt tempo der bedrifter er avhengige av innovasjon for å vokse og opprettholde lønnsomheten. Ettersom innovasjon har blitt et kollektivt ansvar innad i bedriftene, vil det å fremme en innovasjonskultur være viktigere enn noensinne. Rao og Weintraub (2013) deler inn innovasjonskulturen i seks byggestener: resursser, prosesser, verdier, atferd, klima og suksess. Faktorene som bygger opp prosesser representerer de ulike stegene i innovasjonsprosessen, og denne oppgaven forsøker å avdekke forholdet mellom balanse i denne prosessen og innovasjonssuksess. Ved å gjennomføre en tverrsnittstudie og bruke data samlet inn ved hjelp av en spørreundersøkelse sendt ut til flere norske idustribedrifer knyttet til SISVI-prosjektet (Sustainable Innovation and Value Creation in Norwegian firms), vil vi bruke statistisk analyse for å identifisere sammenhenger gjennom en kvantitativ tilnærming. Teorien ledet oss til tre forskjellige perspektiver vedrørende hvordan balansen i innovasjonsprosessen påvirker innovasjonssuksessen. Denne oppgaven er det første empiriske forsøket på å teste antagelsene i tidligere litteratur og samtidig avdekke hva som er mest viktig i innovasjonsprosessen for å oppnå overlegen innovasjonssuksess. Funnene våre utfordrerde perspektivene som impliserer at en en spesifikk del av innovasjonsprossessen er viktigere enn andre, eller at balansen i prosessen påvirker suksessen på en signifikant måte. I tillegg avdekket undersøkelsene våre signifikant støtte for påvirkningen innovasjonsprosesser har på innovasjonsuksess som følge av snittscoren av de ulike delene. Vi anbefaler derfor ledere å ta alle delene av innovasjonsprosessen i betraktning for å oppnå overlegen innovasjonssuksess.

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Introduction

To be able to grow and sustain profitability, companies rely heavily on their ability to introduce new products, services and process innovations. The business environment has evolved into a dynamic, ambiguous and fast paced world where companies are forced to innovate or die.

After a new product or service is introduced to the market, the innovator can earn Schumpeterian rents until competitors imitate it (Collis, Montgomery, & Montgomery, 1997). Continuous innovation is therefore imperative for sustained growth and financial performance. Whereas special departments or groups within the organization, e.g. the designer, engineers or scientists, handled innovation before, it has now become a responsibility of the entire organization (J. Birkinshaw, Bouquet, & Barsoux, 2011).

As innovation now is more of a collective effort, the foundation on which an organization bases their innovation initiatives becomes increasingly more important. To serve as such a foundation, Birkinshaw, Bouquet and Barsoux (2011) notes that creating a culture that supports innovation is crucial for creating sustained innovation performance. To support this argument, Tellis, Prabhu and Chandy (2009) find that corporate culture is a much more important driver for radical innovation than labor, capital, government or national culture. For the organization to be able to build such an innovative culture, knowledge of which factors that affects the innovation culture and how they interact with each other is vital for identifying where to concentrate their efforts. Rao and Weintraub (2013) provide a framework for understanding the innovation culture in an organization. This framework is made up of six building blocks that together comprise an organization's culture for innovation.

One of the six blocks, *processes*, relates to the way the organization structures its innovation efforts. The *processes* building block of Rao & Weintraub's framework is further divided into the three factors, *ideate*, *shape* and *capture*, which can be viewed as the three main steps of the innovation process. The factors are further divided into three elements each. In total, nine elements are identified, where the sum of them describe a company's innovation process.

It has been argued that the innovation process is fuzzy and ambiguous (Brun, Saetre, & Gjelsvik, 2009) and that the uncertainty involved is too great to be managed. Others argue that effective innovation, to a certain extent, implies controlling this ambiguity and that innovation is an organizational process that can be managed (Robert G Cooper, 1990). Jaruzelski & Dehoff (2010) found that a common factor shared among successful innovators is a rigorous innovation management process, further emphasizing the importance of a deliberate innovation process. Several other researchers have found relationships between innovation performance and innovation processes (R. G. Cooper & Edgett, 2012; Robert G Cooper & Mills, 2005; D. a. B. Jaruzelski, 2005), but nevertheless, little is said about what part(s) of the innovation process contribute the most to innovation success or how one should balance ones efforts. In their paper "The Innovation Value Chain", Hansen and Birkinshaw (2007) argue that the innovation process should be regarded as a three step innovation value chain (IVC), and that a weak link in the chain can inhibit the success that could be created by the strong parts of the value chain. According to them, the innovation performance is thus highly dependent on the weakest link. By improving their weakest link, companies can more effectively achieve innovation success. This is closely related to bringing the innovation process into balance, where the company is equally good at all three parts of the process. The R&W framework, and in particular the *processes* block, can in that regard be used to measure and compare each part of the process. Other researchers focus on the importance of a proper ideation phase and strengthening of the so-called fuzzy front-end (Boeddrich, 2004; Reid & De Brentani, 2004; Zhang & Doll, 2001). The focus on one part of the innovation process implies that this is more important than the others, and that a balanced approach not necessarily will yield superior results.

There have been made few attempts to empirically determine how companies should distribute their efforts to improve the different parts of the innovation process. The literature is inconsistent and portrays different views of what managers should focus on when developing their innovation efforts. We wish to challenge these assumptions, and uncover the answer to:

How does the balance in the innovation process affect innovation success?

We aim to uncover what has the most impact on innovation success. Is it one of the individual parts of the innovation process, the weakest link or the balance among them? This information would provide a good foundation for managers to determine how to best utilize their resources to achieve superior innovation success. With this valuable information and a formal review of how each part of the innovation process is developed, managers can avoid developing activities that are already working well, and therefore will not contribute further to innovation success. They will also be able to identify what parts of the innovation process that will contribute most to innovation success with the least amount of time and money invested. This thesis will provide a new way of looking at the relationship between innovation processes and innovation success, providing empirical data to evaluate the validity of existing theory.

Definitions and Frameworks

In this section we explain and elaborate on the terminology and the assumptions we have made. We will further describe in detail the frameworks we will use to operationalize the innovation process in the thesis.

Innovation performance and success

Innovation performance and innovation success are concepts that are often used interchangeably to represent the results or outcomes of the innovative activities an organization conducts. We, on the other hand, will treat innovation performance and innovation success as two separate and different concepts with important distinctions.

Innovation performance

In our paper, we will use innovation performance as an *objective* metric of how good the innovation outcome of an organization is according to predefined criteria, which can be compared to other organizations.

Innovation success

Innovation success is used in our paper as a *subjective* measure of how the organization perceives to have success in its innovation efforts. The innovation success of an organization can arise from many different sources, including financial profit from new products, how much the organization learns through the initiatives or how successful individuals feel personally based on their own innovation contributions. This means that financial profit in this context affects the individual's perception of innovation success, and in such becomes a subjective part of the innovation success. What defines innovation success in total will depend on how the organizations weigh the different criteria and will vary across organizations.

Whether or not the organization considers their innovations a success or failure is what will determine the performance feedback and reinforce innovation culture and behavior, regardless of actual innovation performance. One company may focus on learning through innovation projects, and subsequently consider them a success or failure depending on the learning outcome, while other companies may focus solely on commercialization and return on investment. In some cases where the organization seeks only financial gain from their innovation efforts, innovation success will be aligned with innovation performance.

The difference between the two concepts is small but important. The main distinction is the objectivity of innovation performance, compared to the subjective nature of innovation success. In addition, the acknowledgment of non-financial aspects is unique to the definition innovation success.

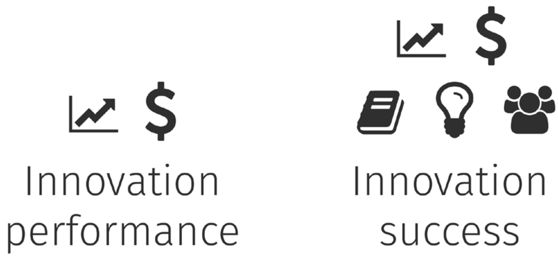

Figure 1. The difference between measures of innovation performance and innovation success.

Assumptions

The thesis builds on some assumptions that were made to more efficiently analyze the collected data. The survey we have used to collect data have been answered by employees in Norwegian industrial firms. Throughout the paper, we will treat the respondent's answers regarding the innovation process as an approximation to their company's actual innovation process performance. We see this as the most effective way of measuring the level of the different parts of the innovation process, as objective metrics is hard to obtain, and each approach has limitations as well. Alternative approaches to using self-assessment from employees would be e.g. observations or obtaining metrics describing how different innovation activities are executed. The first approach would require significant time with each company, and in addition that observers are objective and affect the company's activities at a minimum. This approach was not feasible for our master thesis. Obtaining objective measures such as e.g. evaluating the time companies used to terminate poor performing projects would be both difficult, time consuming and demand subjective measures from the researchers on what time frame that is reasonable. This makes such an approach more demanding as well, and we will therefore use self-assessment as other approaches does not provide substantial benefits to offset its higher research costs. Throughout the paper we will also use the respondent's perceived level of company success as an actual measure of the company's innovation success. Measuring innovativeness is inherently difficult and according to Smith (2005 p. 149)

"An immediate problem is that innovation is, by definition, novelty. It is the creation of something qualitatively new, via processes of learning and knowledge building. It involves changing competences and capabilities, and producing qualitatively new performance outcomes."

The alternative to self-reporting measures would be to obtain financial and sales data to derive objective measures, but this information is not readily available and would demand more time. Self-reporting measures are commonly used in social sciences, but there are limitations connected to the data gathered through such surveys. This will be elaborated on in our limitations section.

Frameworks

This thesis will be based on the innovation culture framework by Rao & Weintraub (2013) as well as the IVC, a model of how innovation projects flow through the organization, proposed by Hansen & Birkinshaw (2007). We used Rao & Weintraub's questionnaire for mapping the innovation culture and collecting data, but we will evaluate the results using both of the aforementioned models, as they are very similar when it comes to the innovation process. Nevertheless, they are also different, providing distinct perspectives and ideas connected to evaluating the innovation process. Both Rao & Weintraub's framework and Hansen and Birkinshaw's model divide the innovation process into three distinct phases that are very similar in content. This makes it easy for us to use both frameworks for evaluating the innovation process, and discussing how the innovation process and its parts affect innovation success. A more detailed description is necessary to understand how they classify and view the corporate innovation culture and the innovation value chain. We will present the Innovation Culture Framework and IVC below, before we point out similarities and differences, making an argument for their relevance towards our research question.

The innovation culture framework by Rao and Weintraub

Rao and Weintraub (2013) provides a framework for measuring the innovation culture based on six building blocks which they see as essential for how an organization's ability to innovate is facilitated. Each building block consists of three factors, which themselves is divided into three elements. A total of 18 factors and 54 elements build up what Rao and Weintraub defines as the innovation culture. The framework is accompanied by a survey meant to identify an organization's innovation quotient, and assess which building blocks are relatively stronger or weaker than the other. Rao and Weintraub (2013) associate each element with a statement scored on a scale from 1 to 5. Each of the statements are posed in a manner such that a higher score contributes positively to the innovation quotient, and in their view, to a culture better suited to facilitate innovation.

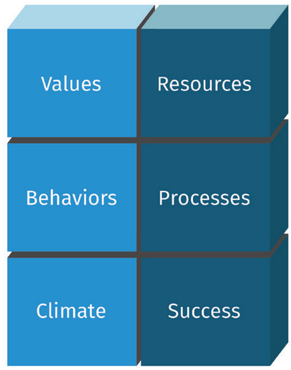

Figure 2. The six building blocks of innovation culture (Rao and Weintraub, 2013).

Resources

The resources building block is the first of the three tools-oriented building blocks and concentrates on the resources an organization can draw upon to facilitate innovation. The resources consist of both tangible assets such as people, systems and intangible assets such as networks, projects and knowledge. The people factor includes innovation champions, which promote new ideas and are critical for innovation facilitation. Experts and talent provide the knowledge to generate and transform ideas into successful products. Systems are also a significant part of resources. Systems include the organizations supporting structures for hiring and innovation, in addition to facilitating communication and an ecosystem for collaborating with suppliers and vendors. The last factor is projects, which includes how the organization provides time, money and space to pursue new opportunities.

Processes

This building block is the second of the three tools-oriented building blocks. There exists a vast amount of literature on how to adapt an organization's processes to facilitate innovation. The processes building block focuses on the path innovations take from inception to scaling of the new product development (NPD) initiatives after launch. The first factor, *ideate*, comprises the elements generate, filter and prioritize. This factor of the processes building block concerns the inception and choice part of the innovation process. In this stage the organization develops routines for generation of new ideas, how to filter the good ones from the bad ones and prioritize the ideas based on risk and opportunity. Afterward the ideas enter the *shape* phase. Shaping includes how an organization prototype, how they interact with customers through iterations with feedback and how they fail-smart, by providing predefined criteria to stop projects. When the product is developed, the organization needs to capture the value. This is facilitated by having flexible processes, launching the products quickly when they show potential and scaling the efforts connected to the products that perform well.

Success

Success is the last of the three tools-oriented building blocks and address how success is captured at three levels in the organization: External, enterprise and individual. Success can serve to reinforce the innovation culture, and can affect financial performance and growth. The external factor measures the external recognition the organization gets for its innovation efforts, the performance or output of the efforts and the financial profits of innovation. Together, the score of this factor can be considered a self-reporting score of the organization's overall innovation performance. The enterprise factor covers the organization's innovation strategy and if they are able to develop new capabilities from their innovation initiatives. This factor will measure how deliberate and disciplined the respondents innovation strategy is. The last factor, individual, covers how the employees in the organization are involved, rewarded and able to develop their competencies through innovation, which can be important for motivation and future success.

Values

Values give direction to the organization and managers and found a basis for priorities and decisions. The values building block is divided into three factors: Entrepreneurial, creativity and learning. The values of the organization can be reflected in a curiousness and desire to explore new opportunities, or it can relate to the type of people that work there. To be entrepreneurial it is also important to be able to turn the ideas into reality by having an action-oriented attitude. Valuing and fostering creativity, encouraging wild ideas and looking at the problem from different angles can result in original and innovative results. To foster creativity can also be important not to take oneself too seriously and have the time and freedom to be able to pursue new ideas. Lastly, daring to experiment and spend time and resources even if the results are unknown can lead to new opportunities, and if the experiment fails, it can be an important learning experience.

Behaviors

The second people-oriented building block is behaviors, and this focus on how leaders inspire, challenge and facilitate for innovation. Management should not only be involved in the organization's innovation efforts, but also be in the forefront and be ambassadors for innovation. The behaviors of leaders can be divided into three factors: Energize, engage and enable. Leaders need to be role models for the rest of the organization and at the same time challenge and inspire employees to be entrepreneurs. Leaders need not only inspire, but also engage and make sure that the employees get supervision and support in their innovation efforts. Leaders need to take time to give feedback and be mentors, and at the same time take initiative for new projects. To facilitate innovation, the employees need to be able to overcome organizational obstacles. Leaders also have to be able to change course when needed and adapt to the environment, but at the same time have persistence in exploring existing possibilities.

Climate

The climate building block for innovation culture is the last of the three people-oriented building blocks and focuses on the internal ambiance for innovation. A climate fostering engagement, enthusiasm, risk taking and continuous learning will often result in above average innovation output and results. Such a climate can be achieved through a focus on strong collaboration, a factor based on a community that speaks the same language about innovation. The internal collaboration can also be strengthened by taking advantage of the diversity of the individuals in teamwork settings. Safety, as a second factor of climate, relies on mutual trust and integrity. Openness for unconventional or controversial ideas can also enhance the internal safety and thus the climate for innovation. The third factor, simplicity, focuses on the danger of bureaucracy hampering the innovation climate. To build an organizational climate capable of innovation there should be a balanced set of rules and rigidity not to hamper the enthusiasm and drive necessary for innovation. There should also be acknowledged steps that employees can follow to take their innovation from idea to realized product or service.

Innovation Value Chain

The building blocks described by Rao & Weintraub are all important for harvesting the organization's innovation potential, but in addition to the internal culture for innovation, every company should have a view of the actual steps included in their innovation process. The innovation challenges faced by different companies are often unique, so implementing an innovation practice based on other's experience could be more harmful than helpful. Hansen and Birkinshaw (2007) recommends looking at the innovation process as a value chain, comprised of three sequential phases:

Idea generation, conversion and diffusion. Most managers understand the importance of generating ideas as an initial step in the innovation process. Understanding where and how to source these ideas is more difficult. The first step in the IVC described by Hansen and Birkinshaw is named idea generation and contains three interlinking tasks a manager can focus on when initializing an innovation process: Internal, external and cross-unit collaboration.

The next step in the IVC is the conversion of ideas. To be able to further develop the most promising innovation ideas, an organization needs efficient screening and funding mechanisms. Some companies lack the funding capabilities and the commercials skills for high-risk projects, making it difficult for the innovators to move forward with their idea. This again affects the internal climate for idea generation. Other organizations do not apply any screening at all, making all the different internal projects a burden for further development. In the final step of the conversion phase the initial idea has to be developed into a product or process that can generate value for the organization.

Idea diffusion is defined as the final link in the IVC. After the innovation has been sourced, screened, funded and developed, it needs buy-in both from the customers and the rest of the organization to be able to spread in an efficient manner. If this step is not implemented effectively, the company will never be able to monetize on the ideas it generates, making the whole IVC worthless.

Using the IVC framework, managers can evaluate the IVC of their company, making it possible to pinpoint and improve the weakest link. Hansen and Birkinshaw's approach of looking at the innovation process as clearly defined steps is not unique, therefore we will review other frameworks like the Stage-Gate model and the innovation management life cycle later in the paper to further discuss this strict view on innovation processes.

As a part of our frame of reference, we have in this section described our assumptions regarding how we interpret innovation performance and innovation success, and what distinguishes them from each other. Our reference frame encompasses both Rao and Weintraub's building blocks of innovation culture, and the IVC framework introduced by Hansen and Birkinshaw. We have based the following literature review on this frame of reference, and will focus on the subjects that have a connection to our research interests.

Figure 3. The three phases of the innovation value chain (Hansen and Birkinshaw, 2007)

Literature Review

Innovation and the innovation process is a topic that has received a lot of attention from researchers. In this section, we will summarize the most relevant literature from an extensive literature review. We will start by summarizing literature on the different stages of the innovation process, before we turn our attention to the importance of balance in the process.

How can a company enhance its innovativeness? Can innovation be controlled, or is it something best left ad-hoc? These are questions that managers want answers to, but the theory on innovation and its process is, as we will show, divided in its view on the fuzzy concept of innovation. Our research aims to uncover if a balanced, formal innovation process is associated with higher innovation success, but before we cover the limited literature related to that subject, we have to take a step back and look at the innovation process itself. What is an innovation process? Is a controlled and formal process possible when it comes to innovation, or is the causes and precursors to innovation too ambiguous to be distilled into formal models? By using the frameworks presented in the above section, we will, based on our pre-thesis, first present the current literature on each building block of the innovation process as modeled by Rao & Weintraub.

Our approach to this literature review will be presented as an introduction to this part, to provide transparency of our methods. Second we will present the relevant literature connected to formal innovation frameworks, and make an argument for why such formal processes make sense. This will be presented in the context of the IVC, presenting what different literature says about each phase in the IVC. These summaries will provide an overview of what the innovation process consists of, what frameworks that exists and the differing views on what are the best practices for facilitating innovation performance.

This literature review will also provide a good foundation for the discussion of why an innovation process is important, why a formal process could be effective for improving the innovation success, and in extension whether all phases should contribute equally or if some phases are more important than others. To conclude this section, we will present the limited theory related directly to the balancing of contributions from the different phases of the innovation process. We will also make an argument for why the topic of a balanced IVC is relevant.

Approach to literature review

To identify relevant literature for the building blocks in Rao & Weintraub's framework we used two approaches. The first approach was to use the reference chapter of the article "How innovative is your company culture?"' by Rao & Weintraub as a starting point to get an overview of relevant knowledge sources. In addition we drew upon knowledge from experienced researchers in the field to identify core articles that were essential for Rao and Weintraub's framework. We branched out from the citations and references in these articles to find relevant literature, which again provided us more references to draw upon. In addition we used the "recommended articles" and "others also had an interest in these articles" functions of SCOPUS and the different databases that contained the article. The decision to read the abstract and possibly include it in the project was also made subjectively by assessing the title's relevance.

The second approach was to conduct keyword searches in relevant databases to identify articles covering the individual elements within the building blocks. In our literature searches we mainly used the tool SCOPUS, which covers a vast amount of different articles and the main journals on management we found relevant. As in the first approach, we branched out from the citations and references in these articles to find relevant literature, which again provided us more references to draw upon. As the area covering innovation culture is vast, we used informal Google Scholar searches initially to build our own knowledge of relevant keywords and terminology. The choice of Google Scholar over SCOPUS for this activity was familiarity with Google searches. At the later stage, such searches were also used to faster find specific articles we needed. Google searches also provide a counterweight towards SCOPUS as they rank and choose articles differently than SCOPUS. We used keywords and phrases to find articles in Google Scholar and continued our search more formally in SCOPUS when we found keywords and/or articles that were relevant. This was mainly done in connection with the building block "success".

As there are several different words referring to the same concept, we used a number of keywords and phrases to search for literature connected to each of the elements in our building blocks. For our searches in SCOPUS, we used Boolean operators to search for different combinations of these keywords and phrases. For example we searched for "innovation processes", "generate" and "ideas" for finding articles relevant for the element "Generate". The terms "new product development" or "NPD" was also used interchangeably with "innovation process" and "innovation". We required the terms to be included in the abstract of the article, and used a combination of the article title and the contents of the abstract to assess the relevance of the article subjectively.

We searched mainly for articles from the six top journals relevant to our field: International journal of Innovation and Technology Management, Administrative Science Quarterly, Organization Science, Academy of Management Journal (AMJ), Academy of Management Review (AMR), Strategic Management Journal (SMJ) and Management Science. This was done by a Boolean OR function. In the cases where the field of study was less developed and the number of articles were low, we included all other journals covered by SCOPUS, and filtered more based on titles and keywords. In the cases where we did more general searches with a large amount of results, the articles were first sorted by relevance, and then by citations. We continued assessing articles until the titles clearly showed no relevance to our project, based on a subjective assessment. In addition we limited our search to papers written in English.

For the subjective assessment of relevance, we used the statements in the survey connected to Rao and Weintraub as a guideline. If the title seemed relevant, the abstract was read before a final decision on the article's relevance and the possibility of including them in the project. We also noted the publisher year of the article and assessed how relevant it is today, but without formal rules or restrictions on the age of the document. A summary of the findings from this literature review that is relevant to our master's thesis will be presented in the next sections.

The innovation process

The literature on innovation processes is vast and has received a lot of attention from researchers. Processes for facilitating innovation and NPD in organizations are easier to identify and comprehend than the more soft, people-oriented building blocks. Cooper and Edgett (2012) highlights the importance of having "a proper idea-to-launch system", or an explicit innovation process, as one of the important characteristics of firms that stand out in terms of NPD. Other studies support their conclusions (Robert G Cooper & Mills, 2005; D. a. B. Jaruzelski, 2005). By looking at best-practices among several superior performing firms, Jaruzelski, Dehoff, and Bordia (2005) finds that superior results come from good processes rather than uncritical spending

"[...] it's the process, not the pocketbook. Superior results, in most cases, seem to be a function of the quality of an organization's innovation process—the bets it makes and how it pursues them—rather than the magnitude of its innovation spending". (D. a. B. Jaruzelski, 2005, p. 2)

The first characteristic of best-practicing innovative firms is, as mentioned, simply to have a process. Cooper and Edgett (2012) also identifies several other key characteristics: The processes are visible and documented at an operational level, they are really used, they enable teams to access the resources they need to succeed, they incorporate compliance checks to ensure the process is followed, as well as being adaptable and scalable.

We find that these characteristics are included in Rao and Weintraub's framework, providing credibility to their theory through empirical observations from best-practicing firms. Elements such as filtering and prioritizing are connected to choosing the "right bets", while fail-smart, flexibility and scale address the need for follow up, adapting and scaling of different initiatives. Aspects of Cooper's

(1990) Stage-Gate model are also frequently associated with best practicing firms, providing explicit targets to keep track of the innovation initiatives progress. To provide further insights into how the innovation process of a company drives the innovation performance, we need to study the specific elements and stages of the innovation process in detail. We will highlight the different factors and sub-elements of the innovation process in Rao and Weintraub's framework in the next sections, providing an overview of the most relevant research and literature on each of the elements. This is highly relevant to our research question, providing insight into how contributions from different parts of the innovation process influence innovation success in the company.

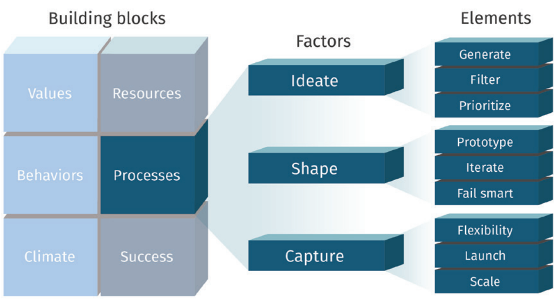

Figure 4. Rao and Weintraub's (2013) factors and elements in the innovation process.

Ideate - Idea creation, filtering and selection

Every innovation has its inception as an idea. According to Rao and Weintraub (2013) the ideation phase does not only consist of the generation of ideas, but also how ideas are filtered and prioritized to be able to select and put the best opportunities into the development phase. To be able to conduct this selection process, an organization needs to have a sufficient pool of ideas to choose from, something that might explain why companies focus so much on the idea generation step of the innovation process.

Ernst (2002) conducted a literature review on the success factors of NPD, and concluded that processes are important for the innovation performance, and that the majority of the literature focuses on how assessment of the market in the initial phase of NPD drives innovation performance. We will in this section present an overview of what the literature says about how different elements of the ideation stage affect innovation performance, and in extension innovation success. This includes idea generation (generate), the filtering stage (filter), where only some of the ideas are chosen for further assessment, ending with the selection (prioritize) where ideas are to enter the development stage (shape) of the innovation process.

Generate - Idea generation

To be able to innovate, an organization needs ideas that can be developed into innovations and new products. Cooper et.al. (2002) find that the best performing companies harvests ideas by adding a discovery stage to their innovation processes, and thereby explicitly source ideas before making judgments on which ones to select for further development.

Several capabilities and characteristics of both the business environment and the organization are important for the ability to create ideas, which could lead to innovations and increased innovation performance. In this regard, Sætre and Brun (2013) argue that the organization needs to be able to handle ambiguity in order to identify opportunities by recognizing the potential value in available information. They conclude that the management of this ambiguity in the innovation process is done through "…cycles of expansive (explorative) activity where ambiguity increases, and constrictive (exploitative) activities, where ambiguity decreases." (Sætre & Brun, 2013, p. 1) The balancing of creativity in the exploration phase and constraint during exploitation is according to Sætre and Brun important for generating ideas through an organization's absorptive capacity, and a high tolerance for ambiguity is considered a minimum requirement. In addition, Amabile (1996) points to the need for creativity to foster innovation and explicates that creativity is built up by the three components: Expertise, creative thinking and intrinsic task motivation. Improving these will affect the ability to innovate.

As information is more readily available today, Chesbrough (2003) argues that open innovation makes ideas more accessible to firms, and partly removes the boundary between the firm and the outside. This makes it possible for firms to take advantage of false negatives from other organizations, where they failed to see a potential value (Henry William Chesbrough, 2003) through their absorptive capacity. Cohen and Levinthal (1990) define absorptive capacity as "..the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (W. M. Cohen & Levinthal, 1990, p. 128).

One way to build its absorptive capacity is to conduct R&D. This will give the organization the ability and foundation within different areas to exploit spillovers from other organizations R&D and avoid lockout in a specific field. Lockout occurs when the organization does not have sufficient absorptive capacity within a certain field, meaning they will not recognize useful information and thereby not be able to generate ideas from the available information. In such, the potential for creating innovation suffers due to a reduced pool of ideas.

In his paper, Boeddrich (2004) highlights some essential characteristics of how an organization should facilitate the internal idea generation. He argues that an organization must be able to realize the ideas and get them out of the individuals head, evaluate them several times, for example during creative loops, and acknowledge that ideas are not polished upon inception. In addition, providing an IT-system for contributing ideas and understanding that the ideas are the intellectual property of the employees and should be respected is also important to create an environment facilitating generation of good ideas.

The ability an organization has to gather knowledge through its absorptive capacity, and provide systems and facilitate for contribution of ideas are at the core of the initial phase of the innovation process. Looking at the total idea generation phase, the literature emphasizes the importance of absorptive capacity and facilitating systems for generating a sufficiently large pool of ideas. To ensure that these ideas can lead to innovations, it is important to ensure that processes are creative and provides a sufficient ability to handle ambiguity in the exploration phases. As a sufficient amount of ideas is generated, the organization can proceed to the next step in the innovation process, namely to filter out ideas for further elaboration.

Filter - Selection of ideas for elaboration
After generating ideas from various sources, an organization can choose to discard some ideas to focus their resources usage on a smaller subset of ideas. The goal of the filtering part of the process is to choose the best ideas to move forward with, based on constraints set by the organization.

According to Ernst (2002), the quality of the planning in NPD before entering the development phase is of specific importance for the success of new products. Several studies mentioned in Ernst (2002) points to evaluation of ideas, execution of technical and market-directed feasibility studies and commercial evaluation as key activities in this regard. Stockstrom, Verworen and Nagahira (2005) found that the best practices among Japanese companies have a systematic approach to filtering and assessing the ideas. Filtering is also promoted by Chesbrough (2003) as open innovation changes the landscape of idea generation. Earlier, the focus of the filtering process was to remove false positives and only provide funding to the most promising opportunities. Chesbrough adds to this by posing that companies must “play poker as well as chess” (H. Chesbrough, 2004, p. 25) to be able to exploit new information and track progress and interest in terminated projects. By filtering one could license and spin-off ideas one do not wish to pursue internally, and thereby reap additional value from false negatives.

Another important reason for filtering the ideas are made by Hansen and Birkinshaw (2007). Developing too many ideas may clog the IVC and do more harm than good, providing a rationale for not over developing some parts of the organization’s innovation process. The use of a formalized gate could provide clarity on which ideas to filter.

To be able to efficiently filter ideas, and not be subject to choosing the ideas that at first glance look most promising, the organization needs to provide specific routines for the filtering process. This will enable managers to choose ideas without using “questionable tactics”. Planning the filtering, and performing various analysis to guide the decision is essential to make the best choices and evaluate which ideas should be developed in-house. Filtering is also needed to keep the IVC from clogging, and thereby decreasing the innovation performance. Nevertheless, filtering ideas is not just about choosing some ideas over others. It can also be a matter of what set of ideas to choose in a development portfolio.

Prioritize- Choosing ideas for development
Prioritizing the ideas hinges mainly on the task of evaluating risk and choosing the right ideas for a development portfolio according to Rao and Weintraub. The importance of having clear routines on how to select the set of

projects to fund, and what the idea portfolio should contain, is vital for the organization to be able to innovate and capture the value.

The idea portfolio could consist of several ideas that the organization wants to develop further. The types and amount of ideas provide the input of the development process, and can be composed in different ways. Kanter (2006) concludes that it is important not to filter out all the small, incremental ideas on behalf of the big ones. It is important to choose a portfolio with different types of ideas. Such an approach is coined an "innovation pyramid", consisting of: Several big bets at the top that get most of the funding; more promising midrange ideas still in testing; and a broad base of smaller and incremental innovations. In this manner, traditional rules for portfolio management can be used to reduce risk associated with NPD.

To help prioritizing different projects in "the fuzzy front end" and understand ambiguity, Brun et.al (2009) develops a model for classifying ambiguity in NPD along two axes, namely subjects and sources of ambiguity. An important point is that innovation may suffer if ambiguity is minimized constantly. Information about what the actual source of the ambiguity is and on what subject it works can help in handling it, and prioritizing which projects to fund. Research done by Nagji and Tuff (2012) also provides a more specific suggestion for resource allocation. An allocation of 70% resources to core initiatives, 20% to adjacent initiatives and 10% to transformational initiatives outperformed others. This balances short-term gains with the predictable growth and earnings from long-term bets. The value extracted from this allocation is approximately the inverse, 10-20-70%. As we can see there is a clear relationship between risk and reward with engaging in transformational activities.

As with the process of filtering ideas, the stage of prioritizing which idea's to include in the portfolio could be judged by a set of rules, especially if one implements a Stage-Gate approach, which is commonly used by best-practice companies (R. G. Cooper & Edgett, 2012; Robert G Cooper et al., 2002). One should nevertheless not implement such an approach blindly just because it is associated with best-practicing companies. Doing that without regard to the type of initiative is according to Nagji and Tuff (2012) dangerous. Using Stage-Gate, and other formalized approaches in the prioritization stage, should never be applied in vacuum but take into consideration the variety of different initiatives.

Prioritizing ideas focuses mainly on choosing ideas that balance the risk an organization is willing to take against the expected innovation performance. Customizing the approach and not falling prey to a "one-size-fits-all" system is emphasized, although certain approaches provide better results in a given situation. Prioritizing which ideas to include in an idea portfolio is the last step before entering the development phase of the innovation process, where the idea is shaped, and prepared for the last phase of the process.

Summary of the ideate factor

In summary, the ideation phase has clear linkages to the innovation performance of an organization. The ability to absorb information and create and capture creative ideas provides the foundations for innovation. If no ideas are generated, innovation performance will obviously be absent. Managing the ambiguity associated with the generated ideas and filtering out the best ones according to a customized approach will also contribute to higher performance, as they will fit the customer better and not force the organization to develop all ideas, good or bad, depleting their resources. In addition, by having a deliberate approach towards which set of ideas are to be selected for development, the organization is able to trade off risk for innovation performance.

The vast amount of research connected to the ideate factor indicate that this is an important aspect of the innovation process and thereby highly relevant for our research question. But to succeed with innovation, ideation alone is not enough. At the end of the initial phase of the innovation process, the selected ideas enter the development phase, where they are shaped and prepared for launch.

Shape - transforming ideas into products

As the initial part of the innovation process is finished, the organization will have a set of projects that should be managed and shaped into innovations. The chosen ideas are potential innovations, but innovation success is not guaranteed without a proper system for developing the ideas into products or services. According to Rao and Weintraub, transforming the ideas into products or services requires the organization to focus on the ability to prototype products rapidly, how to involve customers in the development and how to terminate projects that are not progressing according to plan. As an overarching concept, Cooper, Edgett and Kleinschmidt (2002, 2012) finds that the best-performing companies use some form of phase-gate system to monitor this progression according to a preestablished set of rules. Although such a system is formal, it does not mean it can be copied from one organization to another without customizing it.

Prototype - Developing ideas first hand

The ability to prototype products, or even services, influences the transformation of ideas into products. Rao and Weintraub argue that the ability to prototype opportunities rapidly adds to an innovation culture, and in extension the innovation performance of a company. Kelley (2001) agrees that prototyping is important as it increases the ability of the organization to rapidly have a physical implementation of its products and creates an early opportunity for the customer to deliver feedback. As the business environment is more dynamic and rapidly changing than ever, the emphasis on speed, and in this regard the ability to rapidly prototype, becomes even more important. The evolution within helping aids, and especially thanks to CAD software, makes Rothwell (1994) agree with this conclusion and he lists “use of fast prototyping techniques” and “use of simulation modeling in place of prototypes”, as important for successful innovation.

In general, the literature on the element of prototyping and its direct impact on the innovation performance is limited. This is especially the case for assessing how the speed of prototyping influences the innovation process, and what is regarded as best practices. Nevertheless, Mishra et al. (1996) finds that in-house prototype testing is a driver of innovation success, and that prototyping is a valuable tool for interacting with customers. Much of the value from prototyping comes as it facilitates dialogue with the customer.

Iterate - The voice of the customer

Rao and Weintraub (2013) argue that effective feedback loops between the customer and the organization contributes to a good innovation culture, and helps shape the ideas into final products. When the decision has been made to include customers in the process, these initiatives need to consider several aspects. According to Ernst (2002), considering the utility of the customer and the market segment is important in NPD, but it is important to distinguish between being market-oriented and involving the customer directly in the development process. Gruner and Homburg (1999) specifies that involvement of customers in early and late phases has a positive impact on performance, but at the same time that the customers involved exhibit some key characteristics. These customers tend to have high economic attractiveness, lead-user characteristics (Von Hippel, 1986) and a certain scope of business relationship with the customer. Choosing any customer randomly might not yield the results that were intended with the initiative.

Direct customer feedback and involvement in the development comes at a cost as it significantly increases the time-to-market for new products (Feng, Sun, Zhu, & Sohal, 2012), at least in the IT-industry. To be able to create efficient feedback loops and process the information extracted from the organization's customers, the organization needs an appropriate system to support it. Foss, Laursen and Pedersen (2011) argues for this standpoint and suggests that organizations establishes intensive vertical and lateral communication internally, rewarding employee sharing and knowledge acquirement, in addition to delegating decision rights. They find that the effect of customer knowledge on innovation is completely mediated by the practices implemented in the organization. If the organization does not possess the practices to absorb the feedback, the potential ability to innovate through customer interactions will not be fully exploited. This is supported by several studies mentioned in Greer and Lei (2012), for example the importance of the organization's absorptive capacity (Tsai, 2009). On the other hand, the more the firm engages in internal communication and the more it uses incentives for increasing the knowledge base, the higher the innovation performance will be.

There exists a large collection of literature on the subject of customer involvement, and Greer and Lei (2012) finds that much of the literature assumes net positive benefits from such initiatives. Some of the reasons for these beneficial effects are according to Leonard Barton (1992) and Bond and Houston (2003) because of the concepts, core rigidities and cognitive inertia. These pitfalls may come as a result from exclusively in-house development. By accessing external sources, such as customers, these dangers can be mitigated. Atuahene-Gima (1995) and Souder et al. (1997) finds that knowledge of and the use of market information, in addition to being market-oriented, is a driver for innovation success. Mishra et al. (1996) and Parry and Song (1994), gets similar results and emphasizes the awareness of customer needs, wants and other relevant characteristics as important. The benefits of customer involvement do nevertheless vary negatively with the age of the technology area according to Chatterji and Fabrizio (2013), and are most beneficial to the development of radical innovations. The latter is supported by Pittaway, Robertson, Munir, Denyer, & Neely (2004). Greer and Lei (2012) also points to relevant literature where customer involvement is described as inhibiting. Kang and Kang (2009) provides evidence for an U-shaped relationship with innovation performance, leading at some point to declining returns, and some studies question the overall effectiveness and the cost level of customer involvement initiatives. Especially will the cost and strategic dimensions be of importance as they pose important trade-offs for budgeting and issues relating to principal-agent theory and pose a risk of exposing the company's intellectual property.

Summarizing, the literature and experience from customer interaction varies from study to study, and factors such as industry, organizational set-up and time and resource usage dictates the results from such initiatives. In addition, the type of customers which one co-operates with also affects the success of the collaboration. Nevertheless, most of the literature tends to agree the net effects are positive as long as the system and resources usage are at an appropriate level.

Fail smart - Termination of projects

Interaction with customers evolves and shapes the idea or innovation, but some ideas do not turn out the way they were planned. An organization needs to assess how each innovation project is progressing, and the element "Fail Smart" in Rao and Weintraub (2013) is explicated as "We quickly stop projects based on predefined failure criteria".

Daly, Sætre and Brun (2012) concludes that ideas are harder to kill the longer they get to prosper, and that managers often do not appreciate the human side of innovation enough. Killing the wrong ideas, that in fact could be profitable, can have significant consequences, but not stopping those that will not evolve into a satisfying product can have the same effect, if not worse. Termination of some projects affect results just as stimulating others do. Ernst (2002) argues that continuous assessment of a NPD project during all phases is important for the innovation success of an organization. Terminating products that show less potential than others frees resources, which can be committed to more promising opportunities. Cooper and Kleinschmidt (1995) identify the timely and consequent termination of unprofitable NPD projects as an important success factor. In such, applying defined and clear criteria for the termination process and using them in practice may lead to success for the firm.

Summary of the shape factor

All things considered, the part of the innovation process where the idea is shaped into an innovative product, service or process, has various ways of affecting innovation performance. Prototyping affects innovation performance through impacting the development speed and its effect on resource usage. Prototyping is also associated with innovation success, and work as boundary objects facilitating discussions and interactions with customers, which is also essential for innovation performance.

Most of the literature is positive on the effects customer interaction has on innovation performance and innovation generally. The conclusions are nevertheless dependent on customization for each organization and type of idea or project. In fact, even the type of users involved affect to what degree customer interaction is effective. This seems to be an overarching theme for almost all elements contributing to innovation performance. No solution must be applied without regard to the environment it will be deployed in. From the theory we have reviewed, it is clear that firms should have a deliberate approach for shaping their ideas into new product and service innovations. With our research, we aim to uncover how important the shape factors is compared to the two other stages of the innovation process.

Capture - Profiting from innovations

The final part of the innovation process concerns the value capturing from the generated ideas. Rao and Weintraub (2013) find that the flexibility of organizations processes, and to what degree organizations launch and scale their NPD projects is important for the innovation process. Chesbrough and Appleyard (2007) discusses the problem of capturing value in the era of open innovation and proposes an "open strategy" which learns from traditional strategy. One has to be able to balance value capturing and value creation to promote stable initiatives. Flexibility is important, but to be able to capture the value, the process needs to have some sort of strategy and system in place to keep it from becoming uncontrollable.

Flexibility - Adapting to change

The business environment today is increasingly uncertain and dynamic, requiring organizations to better handle ambiguity and uncertainty. This enables them to adapt to changing conditions, and to the acquisition of new knowledge and technology. MacCormack et.al. (2001) propose a more flexible approach to product development. This counters a lot of the literature that poses explicit phase-gate processes for innovation, such as the Stage-Gate process posed by e.g. Cooper 1990 and Ulrich and Eppinger 1995. These types of process works better for more stable and mature environments where there are fewer changes (Robert G Cooper & Kleinschmidt, 1996).

Flexibility can also affect innovation through strategy. To be able to provide an environment for innovation while maintaining some form of structure, Kelley (2009) advises managers to balance the wish to provide strategic clarity with an environment facilitating creativity and exploration. Sætre and Brun (2013) describes the balancing of exploitation and exploration, which highlights the importance of the need to get more clarity as the project evolves through oscillating stages of exploration and exploitation. To be able to do this, one needs some sort of flexibility in the processes, but at the same time clear strategies provide direction in the innovation efforts. Kanter (2006) suggests that firms are flexible in their planning and control efforts as well, e.g. by reserving funds for unexpected opportunities.

Balancing the need for clarity with flexibility to cope with changes and ambiguity is essential to provide an environment for innovation. With too rigid structures, one cannot adapt and facilitate creativity and thus innovation, while too flexible solutions will not give the direction needed to earn profits on the innovations. Nevertheless, some amount of flexibility, both in work processes, financing activities and on the strategic level seem to provide a better foundation for innovation based on the reviewed literature.

Launch - bringing the products to the market

The process of launching new products resulting from NPD is an important milestone. The business environment is becoming more and more intensive, and the time-based competition (Stalk, 1988) is increasing and thereby enhancing the importance of minimizing the time-to-market. This is in agreement with Rao and Weintraub's focus on launch speed. Nevertheless, speed is not the only factor an organization has to take into account when launching their new products.

One can launch new products in a number of ways. Not only does the organization need to choose how fast to launch, but also many marketing decisions like which marketing channels to use, pricing and type of distribution. Thölke et. al. (2001) characterizes the strategies and decisions connected to launching new products as an "under-researched area". According to them, the strategy of how to launch a new product has six feature launch decisions: Position in life cycle, core technology, focus on feature or product, differentiation practices, feature diffusion in the product line and the make-or-buy decision. This shows that speed is not the only factor important during launch for the success of NPD. The question of speed is nevertheless an important decision to make for organizations when launching a product.

The launch part of the process occurs towards the end of the NPD project and the innovators must make a trade-off between performance and reducing the cycle time of the NPD projects (Calantone & Di Benedetto, 2000; M. A. Cohen, Eliasberg, & Ho, 1996). Chen, Reilly and Lynn (2005) conducted a study where they investigated the relationship between speed-to-market and new product success (NPS). Generally, they did find that speed-to-market contributed positively to NPS, but also noted that different conditions of market uncertainty moderated the effect. The literature on the subject of speed and performance generally supports the findings of Chen, Reilly and Lynn (2005) according to their own literature review. Cooper and Kleinschmidt (1994) also support the notion of the supremacy of speed when it comes to innovation and notes “speed is king” (Robert G Cooper & Kleinschmidt, 1994, p. 381) with some caveats.

This section provides us with an understanding of the impact of the launch decision on performance. For innovations, the speed-to-market is the most important part of the launch decision, deciding whether it is most important to be first or have a mature product. It seems as if the literature favors speed over excessive development when it comes to innovative products. To which degree rapid launch is beneficial depends highly on the business environment, product and organizational characteristics, implying the need for not making this decision in vacuum.

Scale

After launching the products to the market, an organization needs to assess the performance of the product in the marketplace. The innovation process does not end upon launch, as products must evolve into the offerings the customers want to buy. Rao and Weintraub (2013) focuses on whether a company can associate themselves with the statement: “We rapidly allocate resources to scale initiatives that show market promise”, to assess how well they do this last phase of the innovation process.

The literature connected to this specific topic is scarce, and the articles covering resource allocation mostly discusses how to allocate scarce resources to projects before they enter development, and at least before they hit the market. The most relevant findings were from Klingebiel and Rammer (2014). They find that innovation performance can improve by funding a breadth of projects initially, especially for those who, at a later stage, funds projects selectively. The scaling of promising projects can therefore improve by having a larger set of initially funded projects which will be scaled accordingly as they show promising results.

Summary of the capture factor

The last phase of the innovation process involves how to capture the value connected to the idea. Being able to balance flexibility towards the need for clarity is essential to capture value from innovations that need flexible processes to be efficient. Innovation performance comes as a result of flexibility and thus increased ability to handle ambiguity, but for the organization to reap value from the innovations they also need to launch the products in the best way. A rapid launch, decreasing time-to-launch is reported to work best for innovative products, but how this effect innovation performance is not clear. This is also the case for scaling the different initiatives, as the literature on this subject is very scarce. As one is dependent on implementing the innovations to reap the benefits and create innovation success, the capture phase is also highly relevant for our research question. As we aim to find how the innovation process as a whole affects innovation success, capturing is a vital part, even though little research is done on the subject.

Summary of the innovation process review

As the organization finishes the last phase of the innovation process, the idea finishes its journey from inception, through evaluation, shaping and finally ending up as a complete product, service or a newly implemented process improvement. If done right, the idea has become an innovation.

The literature review on the process part of the innovation culture has contributed to some overarching knowledge. The first being that all of the different parts and elements feed back into the innovation culture and affects it in different ways depending on environmental factors, the organization itself and the people inhabiting the organization. This leads to an often-reported conclusion, namely, that it is important to not apply any approach in vacuum without taking the specific organization, people or environment into consideration. One solution may be positive for organization A while being damaging to organization B. An example would be that stage-gate processes often provide a good fit in stable environments, but how well they fit fast paced environments are more uncertain. Therefore, choosing which elements to improve and allocate resources to must be a result of a will to customizing the approach.

The second contribution we can draw from the review is that the elements that build up the innovation process, poses trade-offs for the organization. Different researchers find both positive and negative effects of focusing on a single element, and often different conclusions are reached. For example, flexibility might contribute to better facilitation of creative processes, but too much flexibility might make it harder to capture value from the projects. It also affects exploration and exploitation independently. Thus, an appropriate level of how well the elements are developed is essential to secure the best possible innovation performance.

The last contribution is that the literature focuses on the initial phases of the IVC. As we gradually move towards the end of the innovation process, the literature gets increasingly limited. Our impression is that there has been a lot of research on how to facilitate idea generation, and the filtering of these ideas, but less research on how to stop non-performing projects, how to capture the value from them upon launch and especially what to do with the initiatives after they are launched. The literature in general shows that all phases affect the innovation performance of the organization. A lot of research has been done on individual elements, but very few have compared different initiatives to each other to find a basis for resource allocation. Best practicing firms tend to use a formal process, but the most important characteristic shared by best practicing firm within innovation is to have an innovation process in the first place.

In the next section we will present arguments for why a formal innovation process is important and present what different formal innovation process frameworks says about each phase of the innovation process as described by the IVC-framework by Hansen and Birkinshaw.

Innovation frameworks for formal innovation processes

The literature describes the innovation process as fuzzy and ambiguous (Brun et al., 2009) involving considerable amounts of uncertainty for the players involved. To innovate efficiently therefore implies controlling this ambiguity to a certain extent, without imposing too much rigidity to kill of the entrepreneurial climate necessary for innovation. Cooper (1990) argues that innovation is an organizational process and that this process, like any other, can be managed. To achieve this, his Stage-Gate model applies formal process management methodologies to the innovation process, starting by dividing it into a predetermined set of stages.

According to Van De Ven (1986), an important strategic problem for leaders is creating an infrastructure that is conducive to innovation and organizational learning, further emphasizing the need for formality in the innovation process. This should on the other hand not interfere with the uncertainty and diversity within the organizational environment because “necessity is the mother of invention” (Van de Ven, 1986, p. 605). Hansen and Birkinshaw (2007) argue that all firms have an existing innovation process and that the formal IVC framework will help them pinpoint their weakest link. The goal is to discourage managers from importing innovation practices that may address only a part of the chain, but not necessarily the one the company needs to improve. They see a company fostering a balanced IVC, which take idea generation, conversion and diffusion into account, as superior to a company who masters a single phase. We will get back to this and other contradicting views later in the thesis.

If a company only dedicates effort and time into idea generation and not the further conversion of this idea, employees could see their innovative ideas lost without the proper attention and follow-up necessary for success. This could hamper the entrepreneurial climate and the willingness to generate ideas, reducing the effectiveness of the phase the company has put the most effort into. Thereof comes the need for a formal and structured review of the complete innovation process.

In their paper on innovation management frameworks, Bassiti and Ajhoun (2013) presents their idea management life-cycle based on their belief that a well-structured processes must be used to achieve high innovation performance, even if some researchers treat the early stages of innovation as “fuzzy” and unmanageable. Booz Allen Hamilton (B. Jaruzelski, Dehoff, & Bordia, 2006) supports this further and find that a common factor between successful innovators is “a rigorous process for managing innovation, including a disciplined, stage-by-stage approval process combined with regular measurement of every critical factor, ranging from time and money spent to the success of new products in the market." (as referenced in du Preez, Louw, & Essmann, 2009, p. 1). Adding to this, Cooper and Kleinschmidt (1986) found that the completeness of the process significantly relates to the project success, and that the more steps or activities left out, the higher the likelihood of failure. Cooper (1990) further argues that such a formal process of innovation, like the Stage-Gate model, will allow for a quality focus often missing in organizations innovation programs. Lack of market orientation is described as a major reason for innovation failure, and by allocating more time, money and resources to the process, the Stage-Gate model is argued to provide a stronger market orientation in new product development, thus enhancing the likelihood of innovation success. The author further emphasizes the importance of the steps preceding the actual product development, arguing that a Stage-Gate model for innovation will encourage a more thorough preparation for the predevelopment activities that define and ensures the quality of the project. With the Stage-Gate model implemented, Cooper (1990) also argues that companies will be able to handle parallel innovation process, conduct better project evaluation and set up a visible roadmap to support the team and project leader in the innovation process.

The reviewed literature points towards the need for structure and formality in the innovation process, and its positive effect on innovation performance. Hence, the occurrence of different frameworks designed to analyze this value creating process. These findings support that looking at the innovation process holistically, as more than the sum of its parts, can be beneficial and increase the innovation success. However, will balanced contributions from the different parts of the innovation process further enhance innovation success, or are some parts of the innovation process more important and value creating than others? Before we get into this topic, the essence of our research interest, we will begin by dividing the innovation process into three parts, inspired by the IVC, and look at each step in the light of different models and frameworks described in the literature.

In contrast to the earlier section where we summed up the literature connected to the elements in Rao & Weintraub's innovation process framework, we will now look specifically at formal innovation process frameworks and what they emphasize as important in each link of the IVC proposed by Hansen & Birkinshaw. The similarities between the *processes* building block from Rao & Weintraub's innovation culture framework, and the IVC by Hansen & Birkinshaw are many. Both partition the innovation process into three parts, which mainly concerns the same innovation activities. They differ in the sense that "the innovation culture framework" includes the prioritizing and filtering of ideas in the first phase (ideate), while the IVC claims this screening is a part of the second phase (conversion). The last step in "the innovation culture framework" includes the scaling of initiatives, while the IVC mainly revolves around how to diffuse the "finished" innovation both internally and externally.

As the innovation culture framework is more comprehensive and in depth, it is suitable for reviewing the literature on innovation processes. The innovation process framework could be considered as taxonomy of all the relevant elements of the innovation culture, where the innovation process is one of several parts. This enables us to fragment and specify our search, making sure we include a comprehensive part of the literature as done in the previous section. As they both include mainly the same aspects, which makes them comparable, and as the IVC focus exclusively on the innovation process, we find the IVC more suitable to use as a framework for reviewing other innovation process frameworks. A comparison of the two is presented in figure 5 below.

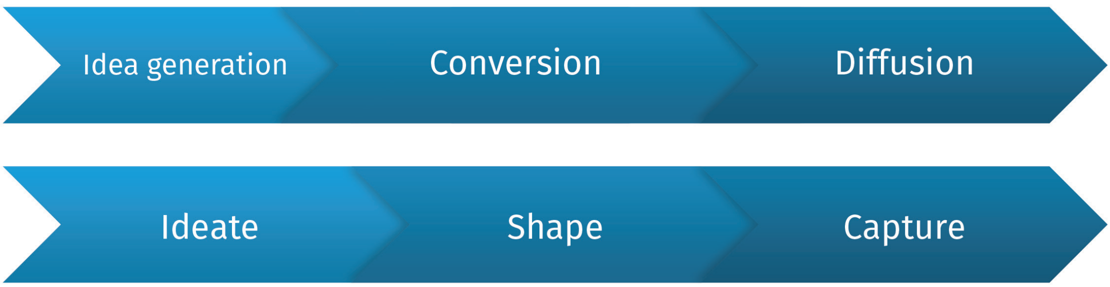

Figure 5. Comparison between the innovation value chain (Hansen and Birkinshaw, 2007) and the three stages (factors) of the innovation process (Rao and Weintraub, 2013).

We will now proceed with the review of the formal innovation process frameworks in the context of the IVC.

Idea Generation

It is argued that all innovation begins with creative ideas (Amabile et al, 1996). The question managers have to ask before initializing the innovation process is thus, from what source should the organization gather these ideas? Hansen and Birkinshaw (2007) point towards internal, external and cross-unit collaboration as the three main catalysts for idea generation. They argue that many companies miss important opportunities because they overlook possible sources for ideas outside the firm and even outside the industry. The organization should tap into the insight and knowledge of the customers, competitors, investors and scientists to harvest the best ideas. Roper, Du and Love (2008) found that knowledge sourcing is strongly complementary between horizontal, forwards, backwards, public and internal knowledge sourcing activities. This means that companies that collect knowledge from one source, e.g. customer feedback, is more likely to collect knowledge from other sources as well. Papers from Genotakis and Love (2012) and Roper and Arvanitis (2012) support these complementarities. In addition, all sources of knowledge have a positive impact on both product and process innovation. They also found that in-house R&D will boost the likelihood of the company engaging in innovation projects, but will not increase the likelihood of success.

Bassiti and Ajhoun (2013) also emphasize the importance of knowledge sourcing in the idea generation phase. They argue that the systematic development of new knowledge produces innovations, and that the continuous interaction of knowledge and ideas will define the organization's capacity to innovate. In concurrence to Hansen and Birkinshaw, they also draw lines between innovation, idea generation and collaboration because they see managing innovation as largely a process of managing people and the way they utilize different knowledge. They go on to introduce their "idea management life cycle", emphasizing that without good ideas, the chances are low of having an innovation that drives the growth of the company. The life cycle presented in their paper starts with a creativity step, whose objective is to provide a set of thoughts on focus areas of innovation from both internal and external sources. These initial innovation thoughts are then refined in several iterations before a final innovation idea is presented at the validation stage. The innovation idea is also the first step in the Stage-Gate system, introduced by Cooper in 1990, but his system does not elaborate on the origin of this idea. Cooper's first gate is the screening of ideas, leaving idea sourcing out of the formal innovation process.

The reviewed literature concludes that efficient idea generation based on different knowledge sources will positively affect the innovation performance. The first question that arises is whether these ideas should be generated in a structured stage of an IVC or left to processes that are more informal. The advantage of the first approach is that companies continuously seek knowledge and feedback from different sources, on which they can base their idea. This could on the other hand lead to a company not able to see the potential in a disruptive innovation idea, if this would arrive through unfamiliar knowledge channels. The second question is whether strong idea generation alone will drive innovation performance, or to what extent it relies on conversion and diffusion to create value for the company. Before we can answer these questions we have to extend our knowledge on the next phase, idea screening, usually described as the first part of the conversion phase of the innovation process, whose main objective is to develop the idea into a more tangible innovation ready for internal or external diffusion.

Conversion

Once the initial innovation idea is in place, conversion or development is usually the next step in the different models described by the literature. Hansen and Birkinshaw argue that these ideas will not prosper without strong screening and funding mechanisms, and that potential innovation projects that are not followed up on will create headaches across the organization. Their conversion step in the IVC consists of selection, divided into screening and funding, and development, which entails turning the idea into a viable product, service or process innovation. Hansen and Birkinshaw argue that the main challenge new ideas face is internal bureaucracy and delays caused by lack of interest from the administration, emphasizing the need for multi-channel funding to avoid premature canceling of innovation projects. Cooper´s Stage-Gate system largely focuses on this part of the innovation process, describing four stages of idea refinement. His biggest contribution to the literature on innovation processes is not these stages, rather the gates that separate them. The project leader must for every stage prepare a set of deliverables for each gate that will be evaluated before the project can move on to the next stage. This iterative process of development and idea review keeps track of the quality and value potential the innovation carries. The output from each gate is an action plan the project is to pursue, making it ready for the next set of criteria at the next gate. Coopers stages include a preliminary assessment, definition, development, validation and commercialization, where each stage can be skipped or customized to fit the unique innovation challenge faced by the organization.

Bassiti and Ajhoun (2013) implement similar gates in their Innovation management life cycle, an extension of the idea life cycle described earlier. Every gate gives a go/no-go decision based on clearly defined criteria, and enables a retroaction loop if a project does not pass. Similar feedback loops and learning engines are presented in other frameworks to enable learning from every project, success or failure. The conversion phase of Bassiti and Ajhoun's (2013) idea management life cycle focus on the iterative process of refining the initial idea, interlinking the idea into the strategic roadmap of the organization, improving the idea through a range of collaborative activities and validating the idea before implementation. Their complete innovation management life cycle adds implementation and exploitation, which covers the conversion and diffusion steps of the IVC. Most companies have no shortage of formal systems for managing ideas (Hansen & Birkinshaw, 2007), the challenge thereafter is an efficient transition into the conversion phase where the ideas can be developed into an actual product, service or process innovation. To handle this challenge, all the presented frameworks to a large extent implement an iterative idea improvement process in the conversion phase. This underlines the importance of tight project follow-up after idea generation, to ensure future innovation success and performance. Birkinshaw, Bouquet and Barsoux (2012) also acknowledge the importance of the conversion phase in their paper on “the 5 myths of innovation”, arguing that companies are sufficiently good at generating ideas and that the bottleneck in the innovation process occurs further down the pipeline.

Related to our research interest, the literature underlines the importance of the conversion phase and a holistic approach to the innovation process. Many companies have developed their ideation capability far more than their ability to convert good ideas, a mistake that for many have led to inferior innovation performance. No part of the innovation process should be left unattended, but could some part actually contribute more to success than other? Some argue that you only need one good idea to convert, while others argue that many different ideas are necessary to find the right one. All agree that no idea is a true innovation before it is diffused either internally in the company or externally to customers to generate value, so before we can discuss what aspect of the value chain is most important we have to present the last part of the process.

Diffusion

The last part of the described frameworks usually entails the diffusion of the innovation internally, for process or production innovations, or externally for product or service innovation. Bassiti and Ajhoun (2013) argue that without the implementation and exploitation phase, organizations cannot draw benefits from their innovations and a competitive edge is not created, emphasizing the importance of this final step in innovation process. They see innovation as the successful exploitation of new ideas, whereas an invention is only an idea for an improved service or product. The diffusion phase in their innovation management life cycle involves an implementation stage and an exploitation stage, where the last consists of turning the invention into the desired innovation. Roper, Du and Love (2008) also describe the importance of the exploitation phase, arguing that both product and process innovations that succeed here contribute to company growth. Hansen and Birkinshaw (2007) focus on disseminating the innovation across the organization as the main difficulty arising in the diffusion step. Organizations that don't have the ability to gain traction for new products, services or process improvements internally, will struggle with the external buy-in necessary for monetary exploitation of the idea. Cooper highlights the importance of successful idea diffusion in the final gate, where every project leader has to present a satisfying market plan containing financial projections before the commercialization can begin. His paper, introducing the Stage-Gate model, does not cover specific steps in the diffusion process, but emphasizes the value of a "post-implementation review".

Based on the reviewed literature we can conclude that the diffusion of innovation is critical for companies who seek to harvest a competitive advantage from their investments in idea generation and conversion. We can also infer that a strong implementation of this phase in a company contributes positively to innovation performance, but if the preceding phases are not developed, then this would not be enough to create sustained competitive advantage on its own. Should the diffusion fail, the literature still points towards possible benefits for an organization with a structured approach to innovation in the form of learning. This learning, generated through failure and formal assessments of the innovation process, can later prove valuable when developing new ideas through generation, conversion and diffusion. To be able to absorb knowledge and learn from previous mistakes and experiences, the reviewed literature emphasizes the importance of formal "learning engines" (El Bassiti & Ajhoun, 2013, p. 7) that collects and distributes learning and knowledge, and that this part of the IVC also should be accentuated when implementing a balanced innovation process.

Summary of innovation frameworks

As the above review of formal frameworks in the IVC points out, it is vital to have resources and routines for handling the journey of an idea from inception to realization. The frameworks and theory argue for the positive impact formal innovation processes has on innovation performance. Especially the IVC focus on the need to view the different phases of the innovation process as interlinked, where failure to develop one of them could affect the overall innovation performance. That is why this thesis presents several frameworks and solutions as to how one should attend to, and aid the development of each of the phases in the innovation process. Formality in the innovation process will help organizations pinpoint where to use their resources, and provide clarity for managers as to what is important to achieve higher innovation performance which again reinforces innovation success.

In the next section we will take a closer look at research connected to how each part of the innovation process should be developed compared to the others, namely how the innovation process should be balanced, and where resources should be used to provide the best innovation performance in the organization.

The need for balance

Several papers we have reviewed imply that a balanced innovation process positively affects innovation success. Other research implies that one part of the innovation process is more pivotal when seeking superior innovation performance (Berg et al., 2009; Robert G Cooper, 1990; El Bassiti & Ajhoun, 2013; Ernst, 2002; Govindarajan & Trimble, 2010; Herstatt et al., 2006). A summary of research in favor of the different opinions is presented in figure ??. What represents reality best, and what focus should managers have when developing their innovation process? If indeed balance is the most important aspect of the innovation process, is innovation process balance equally important to maintain no matter how good or bad the innovation process is? With the above review of the innovation process and a thorough understanding of its components, we turn our focus towards the internal balance of the process.

We aim to discover what balance of the different factors in the innovation process managers should strive to achieve superior innovation success. Intuitively, no part of the IVC can be left unattended, but could there be one link that drives performance more than others? While Hansen & Birkinshaw (2007) points towards the weakest link, forcing managers to seek a balancing of the IVC, Rao & Weintraub favors improving the strongest link and thus not aim for balance. Rao & Weintraub (2013) does not go into detail on why companies should focus on their strengths and not weaknesses, but it is an interesting standpoint nonetheless. Even though we base our research on the Rao & Weintraub framework for innovation culture, we will not put a stronger emphasis on their standpoint compared to other literature.

This section will, based on the literature covering formal innovation processes, present different perspectives on what part of the innovation process managers should focus on improving, or if there is a specific internal distribution of resources, a balance, that will provide a higher innovation success than others.

Our literature review has uncovered little to no research on the subject of balance and the importance of different phases in the innovation process. The relevant research often just assumes that a balanced innovation process yields superior innovation success, but we have not found any empirical studies that confirm this assumption. The logic behind this assumption might be intuitive, and improving the weakest link seem like an effective way to improve the performance of the process, but we still want to test the assumption with real data to see if a balanced innovation process actually yields superior innovation success.

Despite the lack of literature directly connected to balance in the innovation process, we will continue with an overview of what we found on the subject that relates to our research question. Based on the findings in our literature review we find it natural to define three separate perspectives on how balance affects innovation success. The next section will elaborate on the first perspective, namely that one part of the innovation process could prove more important. We will then elaborate on the second and third perspective, which advocate for a weakest link focus and a balanced average respectively. This division will also be used as a basis for our research propositions that will conclude this part of the thesis.

The pivotal part perspective

In his 1990 paper, Cooper argues that “The most pivotal activities, those in which the difference between success and failures were the greatest, were the early activities in the new product process”. This implies that the ideation stage of the innovation process is the most important when innovating. Related to our research question, this further implies that a balanced innovation process does not necessarily yield additional innovation performance. Managers should therefore develop their ability to generate ideas, regardless of the current state of the other two parts of the process. This perspective is shared by many authors within the field of “fuzzy-front-end”, among them Berg et al (2009, p. 1) who argue that “Recent studies indicate that these early front-end activities represent the most troublesome phase of the innovation process, and at the same time one of the greatest opportunities to improve the overall innovation capability of a company”. This further builds on the idea that managers should focus their attention on the first stage of the innovation process to achieve superior innovation success, hence that some part of the innovation process is more important and stronger correlated with success than others. Last, Bassiti and Ajhoun (2013) also underline the importance of the early stage of innovation, and argue that this will have the most impact on the ultimate success of innovation activities. Preez & Louw (2008) to some extent agree on the notion that some part of the process might be more important than others, but do not agree with ideation being the most important part: "The problem does not lie in the invention part or the generation of innovative ideas, but more in the successful management of the innovation process from an idea to a successful product in the market" (du Preez et al., 2009, p. 1) This would imply that *shape* and *capture* phases of the IVC are where the most innovation value is generated. A company only needs one good idea to develop and diffuse to create a profitable innovation. A less developed ideation phase combined with strong *shape* and *capture* phase in the innovation process could therefore be sufficient for innovation success. This is also supported by Govindarajan and Trimble (2010) which in their book "The other side of innovation: Solving the execution challenge" state that companies focus far too much on ideation:

"Companies can't survive without innovating. But most put far more emphasis on generating Big Ideas than on executing them – turning ideas into actual breakthrough products, services, and process improvements. That's because " ideating" is energizing and glamorous. By contrast, execution seems like humdrum, behind-the-scenes dirty work. But without execution, Big Ideas go nowhere." (Book description, Govindarajan & Trimble, 2010)

Even though some researchers point towards parts of the innovation process as more important than others, research covering the complete innovation process often see the weakest link in the process as the most important for managers to focus on. Next, we will look closer at this perspective.

The weakest link and the balance perspective

Our initial division of innovation management into three perspectives separated between those who argue that one factor is the most pivotal, the weakest link approach and a balanced approach to value chain revision. The literature proved difficult to be presented in the same manner. The ones advocating for a balanced IVC in most cases use some sort of weakest link analysis as a mean to pinpoint the area of focus and achieve the desired balance. As a result, both the weakest link and the balance perspective will be covered together in this section. In the rest of the thesis these will be treated separately, as we regard the distinction as important even though few articles support only one of the perspectives.

The weakest link and the balance perspective is supported by Hansen & Birkinshaw (2007) who argue strongly for a balanced IVC: "Any weak link can break your innovation efforts, so focus on pinpointing and strengthening your deficiencies." (M. T. H. a. J. Birkinshaw, 2007, p. 2). They further emphasize that a company's capacity to innovate is no better than the weakest link in the IVC. Related to our research question, it is clear that Hansen & Birkinshaw believe that a balanced innovation process yields better innovation performance. Managers should, according to them, formally review their innovation process and focus their time and efforts to improve the weakest link, no matter the cost of doing so. This is contrary to Cooper (1990) and Berg et al (2009) who favor the ideation stage, and Preez & Louw (2008) who points to the importance of the later phases. Dervitsiotis (2011), who review the quality of the complete innovation process, sides with Hansen & Birkinshaw and emphasize that "The essential need for balance dictates that the idea generation stage, the project selection stage and the development stage must be properly synchronized to achieve the best overall effectiveness." (Dervitsiotis, 2011, p. 10)

Literature covering the complete innovation process often implies that the balance is most important and that managers should focus on improving their weakest link. Literature covering specific parts of the process, like the "fuzzy front-end", naturally see their research topic as most important and influential for innovation success. Birkinshaw, Barquet & Barsoux (2011) conclude that smart companies to a larger extent know what the weakest link in their IVC is, and invest more time in correcting those weaknesses rather than continuing to reinforce their strengths. Even though they advocate for balance in the innovation process they also acknowledge that most companies are sufficiently good at the idea generation phase, and that the "bottleneck" actually occurs further down the innovation pipeline. They still imply that the weakest link should be the focus of attention, but that this might often be one of the later links in the value chain.

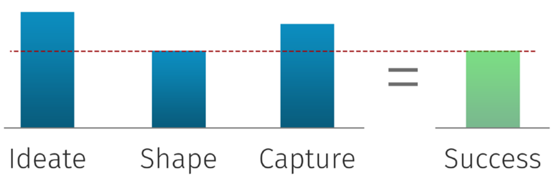

Figure 6. A weakest link relationship between the innovation process and innovation success.

A pure weakest link approach to innovation management should in every sense be implemented with caution. Researchers often suggest that the best approach to improve your innovation success is to improve your weakest link (Hansen & Birkinshaw, 2007), but does not necessarily agree that the weakest link is the sole determinant of innovation success. So if innovation success is *not* limited by the weakest link, other approaches might prove more effective.

Even though the weakest link is the least developed and will impact innovation success the most per improvement in score, it might be costly to improve this factor for some reason. In this case, improving another factor of the innovation process might give more utility per cost, as it demands fewer resources to improve the innovation success by the same amount. This could lead to higher innovation success for less money. As an example, consider a company which needs $10000 to improve the score of their weakest link with 0,1 point, and that the 0,1 point increase in score leads to an increase in innovation success with 1 point. To improve another link of the innovation process, the company needs only 1000$ to improve the score by 0,1 point, but this 0,1 point improvement only leads to a 0,12 increase in innovation success. Even though improving the weakest link improves innovation success significantly more per improvement in the link, the cost of doing so is proportionally higher. A rational actor who maximizes their utility based on the improvement in innovation success per cost would not choose to improve its weakest link. By improving the other part one would have an increase in innovation success by 1,2 with the same investment of 10000 $ in the weakest link, which yields only a 1,0, increase in innovation success. With this approach, managers should aim to improve the phase with the highest cost/benefit-ratio, even though the weakest link is the most effective per improvement.

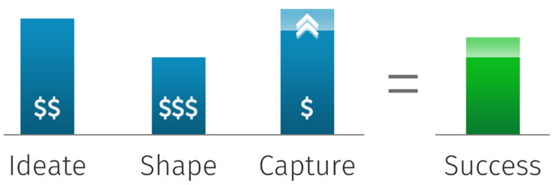

Figure 7. In this illustration, the capture factor has the highest cost/benefit-ratio.

In the most extreme case it might even be beneficial for innovation success to tone down some of the phases to improve innovation success. If the benefit/cost ratio is low for improving all phases, and innovation success is improved by having a balanced innovation process, it might be most cost-effective to use fewer resources on one overdeveloped phase, and thereby increase balance. One could imagine such a case for a company that produce to many ideas to evaluate and screen everyone properly, thereby "clogging" the innovation value chain. If the large amount of ideas are not properly handled by later phases, the company's ability to properly develop and filter the good ideas from the bad ones could be weakened (M. T. H. a. J. Birkinshaw, 2007). This is an aspect not researched by the covered literature connected directly to innovation processes, and could in that regard be an interesting topic for further research.

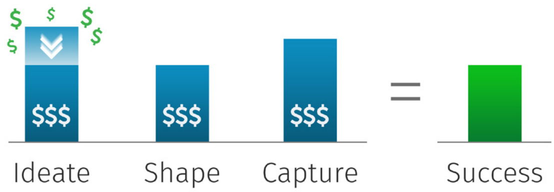

Figure 8. An example where reducing the investment in ideation does not affect success.

Based on the above presentation of the existing literature and the organizing into several perspectives connected to how one should balance the innovation process to get most innovation success, we find that the topic of innovation process balance have interesting and unanswered questions. Moving forward, we find it both relevant and of practical interest to explore the following research question:

How does the balance in the innovation process affect innovation success?

With this literature and research interest as a basis, we will continue by presenting our research propositions. They are presented in the context of the three perspectives elaborated on in this section. In total we present five research propositions, where the first is used as a foundation for our article, the second, third and fourth are connected to the presented perspectives, while proposition five goes in depth of the balance perspective and is directly related to our research question based on our hunch.

Propositions

A logical claim concerning a company's innovation activities and its success with innovation would be that the better they perform the various innovation activities in the innovation process, the more success would they have with innovation. Before presenting the propositions connected to the three innovation process balance perspectives, we will propose a relationship that is seen as a prerequisite and foundation of innovation process theory. Common sense would dictate that if we were to rate the level in which a company performed different innovation process activities, a higher average level would lead to more innovation success. This is also extensively explored by Cooper and Kleinschmidt (1995). They find and suggest that an innovation process is one of nine constructs that drive innovation performance.

The covered literature either states explicitly that an innovation process is important (Cooper and Kleinschmidt, 1995; Cooper and Edgett, 2012; Ernst, 2002), or imply it by exploring some part of the process and present findings that support its impact on innovation performance (e.g. Kanter, 2006; Nagji and Tuff, 2012; Rothwell, 1994; Kang and Kang, 2009). Nevertheless, few papers explore the relationship between the innovation process as a whole and innovation success empirically and quantitatively.

To lay the foundations of our thesis we first want to assure whether there indeed exists a relationship between the innovation process and the innovation success of a company. Based on our theoretical background and logical reasoning we therefore propose that:

P1: *A high average of the various parts in a company's innovation process will lead to greater innovation success.*

This will serve as a basis for our thesis, and our following perspectives will assume that this proposition finds support in our data.

The pivotal part perspective

Earlier we provided three separate perspectives on the innovation process balance and what influences innovation success the most. The advocates for some part of the innovation process being more important than others implies that individuals should rate some part of the process higher than others while simultaneously reporting that innovation success is higher. This leads us to the following proposition on the relationship between the balance in the innovation process and innovation success:

P2: *One part of the innovation process is more important in achieving innovation success.*

This proposition implies that some parts of the innovation process could affect innovation success to a large degree, while other parts might determine the innovation success to a smaller degree or maybe not at all. We will not speculate a priori on which factors that could be most important for innovation success, but try to find evidence that could support the above proposition through evaluation of relationships between parts of the innovation process and innovation success. This will give relevant insight into whether some part of the innovation process affects innovation success more than others. This would in extension imply that a perfectly balanced process does not necessarily yield the best innovation success.

The weakest link perspective

This perspective advocates for a relationship between the innovation process and how successful the innovation in a company is based on Porter's value chain theory (Porter, 1985). In this perspective, innovation success is determined by the weakest link in the company's innovation efforts, the part which they are poorest at. This distinguishes the weakest link perspective from the pivotal part perspective and the balance perspective that argue for, respectively, that one part contributes the most and that a balanced focus is more important to achieve success with innovation. The weakest link will constrain the success of the innovation efforts by making the organization unable to reap benefits from improvements in other links of their innovation efforts. In such a case, the success of the innovation in a company will depend on what they perform least good, and not be affected by how well they do other activities connected to innovation. The following proposition is connected to this standpoint:

P3: *Irrespective of all other parts of a company's innovation process, it is the weakest part that will determine innovation success.*

The above proposition suggests that the level of the weakest link will move more in tandem with innovation success and better determine innovation success than the other parts of the process.

The balance perspective

The last perspective argues that balance in the innovation process is an important determinant for innovation success. Individuals should in this case report more success with innovation while at the same time reporting that they execute the different parts of their innovation activities equally good. The following proposition would be associated with this perspective:

P4: *A company that is equally good at all parts of the innovation process would have higher innovation success than a company where some parts are more or less developed.*

This proposition would argue against P2 that implies the existence of some part of the innovation process that is more important than others. In this case one would have more innovation success by focusing on this vital part, and at the same time reducing the balance of focus on the entire innovation process. Therefore, P2 and P3 argue differently for which aspects that are most important to achieve superior success with its innovation activities.

Hunch perspective

In addition to the above perspectives and accompanying propositions, we would like to explore an additional proposition based on our own logic, which is in line with our research interest. This proposition extends the balance perspective and also incorporates P1. The following proposition explores our main research interest and was the inspiration for the title of this thesis: “Is all balance created equal”.

Based on the literature supporting a balanced IVC, we wanted to test whether this was the case no matter how well a company on average performed the various parts of their innovation efforts. Put another way, given that a company score their average efforts below par to 1,7 out of 5, would a balancing of efforts on different innovation activities affect their innovation success equally much as a company with an average score of 3,9? Or does the balance matter only when a company reaches a certain average level in their innovation efforts? Our reasoning here is that if you are relatively bad at the entire innovation process, it does not positively affect success that you are *equally* bad at all the various parts. A poor innovation process would not benefit from being balanced. A good innovation process, on the other hand, might benefit from focusing on balancing their efforts on different innovation activities. As a company’s innovation process gets better, the benefit of improving the activities might shrink, and other aspects, such as the balancing of efforts, might be gradually more important to increase the success they have with innovating. This logic is not explored and tested in existing theory, and our thesis will be the first attempt to evaluate how this relationship could be described.

The study of this possible relationship is considered as an important contribution to the innovation process literature. The following proposition captures these ideas:

P5: *The better a company performs its innovation activities, the more its innovation success is affected by how well it balances its efforts among different innovation activities.*

The five propositions mentioned above provides us with a starting point for the analysis of how balance in the innovation process affects the success connected to innovation. Our propositions are not necessarily mutually exclusive, and most of them can be true at the same time. It is also plausible to believe that we will find varying support for the differing propositions and that reality will reflect a mixture of the above perspectives e.g. that the weakest link might be more important than other parts but *not* that it determines success irrespective of other parts. Due to this fact, we aim to uncover which perspectives and propositions could be grounded in actual data to provide indications on what approach to innovation management managers should adopt to achieve superior innovation success. Before we present our empirical findings and try to indicate what is the superior approach to innovation management, the details of our methodology will be elaborated on in the next section.

Research Method

In this section we will outline our research strategy and research design, and describe how we will collect data for analysis. We further operationalize our research, by defining the variables, statistical methods and hypotheses we will use in our analysis.

Pre-thesis

We laid a foundation for our master thesis through a pre-thesis where we conducted a thorough literature review on the different parts of the innovation process, innovation success and the IVC. The literature review from our pre-thesis was further complemented by a study of literature on the role of balance in the innovation process and the relationships between the different parts of the IVC. The relevant theory has been summarized in the literature review in the theory section of this paper. In addition, we also presented our approach and relevant methods in connection with the review.

Research strategy

Starting out with the theory from the literature studied in our pre-thesis, we will take a deductive approach to our research. We will start by defining and operationalizing our variables, before translating our propositions into hypotheses. We will proceed with data collection to attempt to confirm or reject these hypotheses. If our results are found to be significant and noteworthy, they can be a contribution to the existing theory on innovation processes.

Epistemology

As social researchers, we have to consider our epistemological standpoint, or what to accept as true knowledge in our research. We take the scientific approach of positivism, where we view social science as being subject to the same methods applied to the traditional natural sciences. Positivism entails elements of both deductive and inductive principles, and it is possible that we will discuss interesting findings from our data even though they are not directly related to our research question at the end of this thesis. Positivism calls for objective research, and we will strive to collect objective data and confirm our research after the principles of validity and reliability. When analyzing our data and discussing our findings, we will try to look at the data and interpret it beyond the numbers. In contrast to positivism, this hermeneutic approach to our discussion can be considered to be elements from interpretivism. In interpretivism, subjects in social science, i.e. people, are viewed to be different and more complex than subjects in natural science, and believed to require researchers to not only study the facts and data, but try to grasp the subjective meaning of social actions (Bryman, 2012).

Ontology

We also have to take ontological considerations. Our ontological standpoint determines whether we consider social entities as objective entities existing externally to the people it contains, or if we view the entities as social constructs built by people that interact with it (Bryman, 2012). Can the innovation process in an organization be studied as a separate entity, or should we instead study the people within the organization that created the innovation culture? To be able to operationalize and study the innovation process we will take an objectivistic ontological approach to our research, meaning we consider social entities as existing externally to the people it contains. This way we can use the constructs that have already been established by theory to support our research and we will be able to quantify our results within an established model of the innovation process. Nevertheless, the constructs are adapting and we acknowledge that it is hard to ignore the notion that the social constructs change based on the actors interacting with them. One limitation of using an already established construct for innovation culture and innovation process, is that we run the risk of overlooking parts of the process and mediating factors that are not a part of the theoretical construct.

Quantitative and qualitative research

Research methods are often categorized as either quantitative or qualitative methods, even though all research methods could be used either for quantitative or qualitative analysis. A quantitative approach could be used to test hypotheses, while a qualitative approach is more about inducing hypotheses on background of collected data. In a quantitative approach, empirical data is collected and analyzed with the help of statistics. The data can be collected from many sources, including surveys, experiments or public databases (Field, 2013). One of the advantages of using a quantitative method is that if the sample is random, statistically valid and large enough, the findings can be generalized to the entire population. Empirical data can often be more easily analyzed through mathematical methods compared to data collected through qualitative methods, as the data generally is more structured and comparable. In qualitative research methods, data is often collected through interviews or discussions in focus groups. Qualitative data is often more in depth and detailed than quantitative data, but not as easily quantified. Qualitative data needs to be interpreted in some way by the researchers, which means it can be subject to interviewer bias.

It is important to note that even though some research methods commonly are associated with either quantitative or qualitative research, the separation is not that distinct. Some studies often include aspects of both a quantitative and qualitative approach, and some use research methods typical for qualitative research in a quantitative way and vice versa. The connections between quantitative and qualitative research and research methods can be considered tendencies rather than definitive connections (Bryman, 2012). We chose a quantitative approach for our thesis. The nature of our propositions means a qualitative approach would be challenging, since we don't expect managers to be able to answer and describe the relative strengths and weaknesses in their IVC and how this affects their innovation success. Using a quantitative approach meant we could efficiently collect primary empirical data to use for correlational research.

We have given an overview of our research strategy and the preconditions for conducting our research. With our research question and research strategy in mind, we will now consider how to design our research.

Research design

When deciding on a research design, many different considerations come into play. We need to consider the nature of our research question, how it best can be answered, and the scope of the research itself based on resources and time available. With these considerations in mind, we found that a cross-sectional research design would best fit our purpose. In cross-sectional research, one collects samples at a single point in time, to compare two or more variables for association and patterns (Field, 2013). A common way to collect these samples are to create a questionnaire that will be sent out to a random sample of the population you want to generalize your results to. With a cross-sectional design, you can relatively quickly collect the necessary data, which makes it possible to complete within the timeframe of a master thesis project. With our hypotheses, we will try to find relationships between independent and dependent variables, namely balance in the innovation process and innovation success, and this research design is a good fit for this purpose. A disadvantage of the cross-sectional design is that we are not able to find the causality of relationships or patterns, which would require a longitudinal or experimental study. We will now elaborate on three important topics in research design: Validity, reliability and reproducibility.

Validity

When doing quantitative research, we need to account for validity. Validity means that our instrument, our survey, measures what it is meant to measure. Rao and Weintraub, the researchers behind the survey we are using, states that the survey has been checked for statistical validity and field tested over a two year period on over 1000 executives from 15 companies. By using an already tested and proven survey, we have a good indication of statistical validity, although we cannot be entirely confident. We will use the data gathered from the survey for correlational research, which is not what the survey originally was intended for. Validity can be categorized into several different types of validity. For our research, we will elaborate on what is considered as the three main categories of validity evidence (Guion, 1980). This is content validity, criterion validity and construct validity. We will also cover internal and external validity.

Content validity

Content validity exist if the instrument covers every single item of the overall construct we are trying to measure (Anastasi & Urbina, 1997). In our survey, this means that the questions regarding the innovation process should cover every single component of the innovation process. In addition, content validity requires that the questions regarding innovation success actually measure the different parts that together can constitute innovation success. There are many different ways to define and split the different stages of the innovation process. We have chosen Rao and Weintraub's framework of the innovation culture where the innovation process is one part of the culture. Their depiction of the innovation process and it's parts is comparable with Hansen and Birkinshaw's IVC.

By using the original survey as designed by the authors, we will not have content validity for innovation processes that does not fit this model. As this is just one way to describe the innovation process, our results will only be applicable with this definition in mind. Others may view the innovation process as more or less than the three factors of Rao and Weintraub, and the results will in that case be only be partially valid. Rao and Weintraub's definition of the success building block includes not only revenue generated from innovative products, but also how innovative the company is regarded, and how the company develops new and valuable capabilities through its innovation efforts. In this way, more aspects of innovation success are covered than just the net financial gains from innovation efforts. However, we acknowledge that it is hard if not impossible to cover every aspect and detail of what constitutes the construct of innovation success.

Criterion validity

Criterion validity concerns how the instrument is able to accurately predict an outcome, in other words, how it compares to objective real world data (Shuttleworth, 2015). In social research, accurate and truly objective data can be hard to come by. To show evidence of criterion validity, we could compare the self-reporting measures of the innovation success to accounting records. This way we could measure the profits from individual innovative projects and compare them with data collected from the survey. Unfortunately, this data is not made available to us from the respondents of the survey.

Construct validity

We have construct validity if the instrument actually measures what it set out to measure (Cronbach & Meehl, 1955). The survey measures both the innovation process and innovation success. Each factor in the survey is scored from the average of three elements with one question per element. We can question if each one of these questions accurately represent the element and in turn the factor they are scoring. This would be hard to control without having other means of measuring these factors and elements outside the survey. As previously mentioned, the survey has been field tested for validity, but we don't know how this field-testing was carried out. The survey uses a self-reporting measure for success, which means it might not be entirely objective. This can be considered a limitation when it comes to construct validity.

Internal validity

When doing cross-sectional research, one weakness is that it's not possible to draw conclusions on causality (Bryman, 2012). Although we can find a relationship between the balance of the IVC and the innovation success, we can't conclude in what way they affect each other, only that there is a relation. This is the primary concern of internal validity. To have internal validity, we need to prove the correlation and prove that the supposed cause precedes what we believe to be the effect. In addition, we need to rule out any alternative explanations to the phenomena. One specific pitfall for the validity is exactly this last requirement, and is especially relevant for our thesis. We run the risk of confounding, or in other words overlooking a third mediating factor (Bryman, 2012). The balance may be correlated with some other property that again affects the innovation success. One way to reduce the risk of confounding is to include relevant control variables in the analysis to check for potential mediating factors (Bryman, 2012).

External validity

The last category of validity that we will cover is external validity. For our thesis to have any gravity as a scientific contribution, our findings should be able to be generalized to a population significantly larger than just the sample firms. Research where the experiment is more removed from the real world is more vulnerable to external validity issues. Our research will be done in the real world setting, but we still will have to take precautions. To maintain external validity, we need to take a random sample of the population we wish to generalize to. In our case this would be Norwegian industry firms. Preferably we need a large sample to find significance in our results. It should not be necessary to remove the test subjects from their environment to conduct the test, and this will help to preserve ecological validity. We will discuss our sampling later in this chapter as it has some limitations.

Reliability

To be valid, the instrument also needs to be reliable, meaning it will produce consistent measurements if the experiment is repeated (Field, 2013). This is a strong grounding for the scientific method, where the idea is that the experiment can be repeated by different researchers at a different time and yields the same results. Such repeated studies that confirm the original results are what strengthens the research and can eventually lead to it be considered accepted theory. The connection between reliability and validity is show in the illustration below.

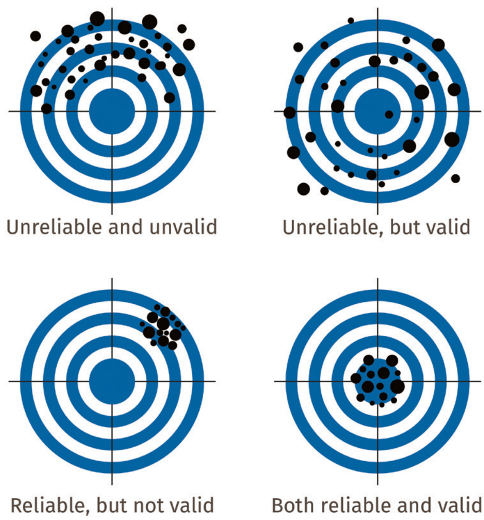

Figure 9. Illustration of the difference between validity and reliability (Nevit Dilmen, Wikimedia Commons).

There are many sources of measuring errors that can lead to missing the target as illustrated below. Measuring errors are usually divided into two types: Random error and systematic error (Taylor, 1999). A random error will lead to unreliable results scattered all over the target. In our research, such random errors can come from imprecise and ambiguous questions in the survey or bad translation from English to Norwegian. If the language in the survey is too complex, some of the questions might be misinterpreted by the respondents, resulting in unreliable results. If the data is valid, random errors and unreliable data can be averaged out with a sufficiently large sample. Systematic errors however, will lead to our results being invalid. With a nonzero mean, systematic errors cannot be averaged out. How samples are selected and if they are random, is a potential source of systematic error. Ideally we should use a probability sample from the population of Norwegian industry firms. Another source of systematic error is response bias. When designing a survey, the choice of scales and questions used can affect the results. The researcher has to take a great deal of care when designing questions and scales to fit the research, and be aware of them when interpreting the results. We have the advantage of using a survey that has already been tried and proven for statistical validity.

Reproducibility

One important goal of this written thesis is to make it possible to reproduce the research and hopefully the results it originally presented. As mentioned earlier, this concept is a strong grounding in the scientific method. Reproducing research can uncover weaknesses with regards to reliability and validity, or further strengthen the findings from the original research. To avoid doing the same mistakes as in the original research, the same researchers should not conduct the reproduced research. Alternative approaches and methods can be used in an attempt to find weaknesses in the original method. To facilitate reproducibility, a thorough review of the method and approach used in the research should be presented. This chapter on methods is written with reproducibility in mind.

In this section we have given an overview of our research design. We have chosen a cross-sectional design and addressed the important concepts of validity, reliability and reproducibility and how we intend to enable them in our thesis.

Research method

In this section, we will cover the different steps of our research method, from data collection to analysis of our findings. The purpose of this is to ensure that our research can be repeated.

Data collection

When doing cross-sectional research in our field, data is usually collected through a survey or in some cases structured interviews. Cross-sectional research is characterized as research having more than one case, collecting quantifiable data at single point in time, and looking for patterns of association between variables (Bryman, 2012). Cross-sectional research has the advantage of often being easily scalable and able to collect a significant amount of data in a short time, and being structured and easy to analyze. For our research, we found using a survey to be beneficial for several reasons. Data collected from a survey is very easily quantified and the data can quickly be analyzed. In addition, a survey can be distributed to a large number of respondents in a short amount of time, both online and on paper. Respondents answering random or incomplete are some examples of possible disadvantages, which could have been avoided if we were to conduct interviews instead. In an interview situation, you would also have the possibility to explain questions and avoid misinterpretation from the respondent, which could be an issue when deploying a survey.

Through the ongoing SISVI-project at NTNU (Sustainable Innovation and Shared Value Creation in Norwegian Industry) we had the opportunity to collect data through a survey sent out to Norwegian industrial firms partnering with the project. The firms partnering with the project span from small firms with five employees and less than ten million NOK in revenue, to large firms with over one thousand employees and hundreds of millions NOK in revenue. The firms represent different industries and are both newly established firms and firms with long traditions. One thing they do have in common is a shared interest for innovation, as they chose to be a part of the SISVI-project. Through selecting firms from the SISVI-projects as participants, we have a limited sampling frame and a non-probability sample. This could turn out to be a weakness in our research. On the other hand this selection gives us a clear sample where we know the context, which could be considered an advantage. Even though the participating firms are different in size, revenue and other characteristics, they are all a part of the SISVI-project, which could imply that they are especially committed to improving their innovation success. One advantage of using firms that may be above average when it comes to innovation is that their employees have better footing when completing the questionnaire. When distributed to a firm that has less knowledge of innovation the results from the questionnaire could be more random and unreliable.

The survey that was distributed contained different sections with questions connected to several ongoing research projects within the SISVI-project. Not all of them were relevant for our thesis. The survey contained a total of 67 questions and included topics such as learning from experience and termination of innovation initiatives. For this thesis we used the section of the survey that was based upon the innovation culture framework by Rao and Weintraub (2013), described in the introduction of this paper. A shorter version of the survey was also sent out to several companies. This version only included questions concerning Innovation Culture, IVC and ambidexterity. The long version of the survey takes approximately 30 minutes to conclude, while the short one takes approximately 10 minutes to complete.

Rao and Weintraub’s survey has been tested over a period of two years for statistical validity, and has already been rolled out to over one thousand executives. It is divided into six sections corresponding with the six building blocks of innovation in the framework. These building blocks are divided further into three factors, which again is divided into three elements. In total, each section will contain nine elements with an accompanying statement. The entire survey consisted of 18 factors and 54 elements. The respondents will rate each statement on a scale from 1-5 using the scale: (1) Not at all; (2) To a small extent; (3) To a moderate extent; (4) To a great extent; (5) To a very great extent. During analysis, the average scores of all elements can be calculated and used as basis for calculating the factor averages, which again can be used to provide the building block average. These scores can finally be used to calculate the firm's *innovation quotient*. The results will also provide a basis for ranking the different building blocks and factors against each others giving insight into which elements of the innovation culture are relatively most and least developed. Rao and Weintraub notes that the value of the survey increases as the sample size increases, especially with participation from respondents on different hierarchical levels and from different units. The results from the survey can later be used to benchmark a company against similar companies based on selected criteria as the pool of results grow giving the participating organizations additional value.

In our research we have used results from two of the building blocks from Rao and Weintraub's framework: *Processes* and *success*.

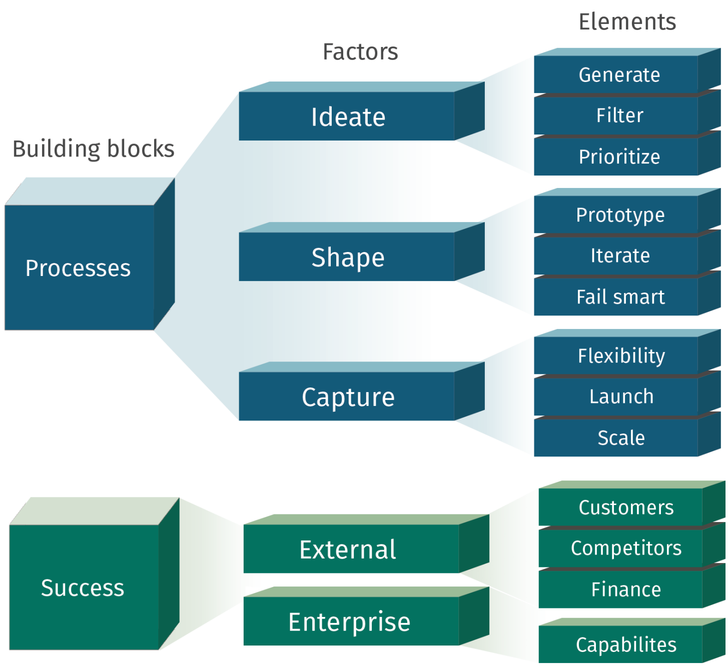

Figure 10. The processes and success building blocks and their factors and elements.

As described in our introduction, the *processes* building block consist of three factors: *Ideate*, *shape* and *capture*, which has been interpreted as the three main steps inn Rao and Weintraub's innovation process. In addition we used the *external* factor of the success building block in addition to the element *capabilities* as a self-reporting measure of the innovation success of the firms. By using a self-reporting measure, we were able to better measure the innovation success, as opposed to just the innovation performance. Using other measures for innovation success, like revenue generated from new products or the number of patent application registered could give valuable information, but we consider the self-reporting measure in the survey a more nuanced measure. Having the factual data and hard numbers behind innovation success would be interesting, but they were not made available from the respondents. When using only self-reporting measures of success we run the risk of getting misleading results.

Partnering firms with the SISVI project were invited to partake in the survey. In addition, we approached a number of industrial firms to try to increase the sample size. We limited our search to Norwegian industrial firms with more than 20 employees. We found it challenging to find firms that were willing to spend the time and resources to participate in the research, as it required all employees to spend an hour filling out the survey. These were given the option to complete the short version of the survey. The survey ended up being distributed to employees in six Norwegian industrial companies. Out of these, three were partnering firms from the SISVI-project. Adding up all employees from these firms, we would have an acceptable sample size. However, it is a weakness that the respondents only represent eight different firms. Ideally, we would like to have a random sample of employees from a wide array of firms. We will take this into consideration when analyzing our data.

The survey was distributed in the period February to April 2015 in both Norwegian and English. When distributing the survey, we emphasized that employees at all levels in the organization should answer, and some background data was collected to use as control variables. The respondents were given the option to answer digitally through an online survey or manually by filling out a questionnaire on paper. The translation from English to Norwegian was done in collaboration with other master students and a professor on the SISVI-project. To ensure that both surveys convey the same meaning and by extensions the same answers, the translations was quality checked and improved in a number of different steps. To start out, two separate translations were created, without communication between the two groups of translators. These two translations were then checked separately by two individual students for idiomatic meaning and grammatical errors, without having access to the original version in English. These two revised translations were then combined into one, discussing each statement and wording as we progressed through the survey. Finally, the last version was again checked for idiomatic meaning and spelling before it was distributed to the participants.

Operationalization and modeling

To formulate and test our hypotheses quantitatively we need a model frame and an operationalization of our concepts into variables usable for analysis. We have already established Rao and Weintraub's framework on innovation culture as suitable for our research. We will use the building block *processes* from this framework and its underlying factors and elements to distinguish different parts of the innovation process in an organization from each other.

Independent variables

Our study aims to uncover the relationship between the different parts of the innovation process and innovation success, measured at the individual level. The factors in the *processes* block, *ideate*, *shape* and *capture*, will serve as our independent variables. This means that we treat the innovation process and its parts as the input that causes the effect, the effect being innovation success. The causality of this relationship can only be assumed in this thesis, as it cannot be proven with our cross-sectional research design. Based on the theory presented in our literature review, a good innovation process often relies on a structure that facilitate innovation. We argue that it is probable that a positive relationship between innovation processes and innovation success would signify that a good innovation process led to more innovation success, and not the other way around. Even though we expect it to be the case in most firms that a good process lays the foundation for innovation success, there could certainly also be cases where it was the other way around. If innovation success came without having the innovation processes in place, the success could lead managers to give more attention and resources to the innovation process in the future, in hopes to replicate their success. In this case the innovation success would lead to an improved innovation process by giving the firm increased motivation and self-confidence in its abilities to innovate. Studies have found that excess resources from past success can lead to managers investing more in research and development (Bourgeois, 1981), but can also lead to risk-aversity and a lack of motivation to innovate (Cyert & March, 1963). Despite the last scenario being plausible, we would argue that the first case is more likely, and have chosen the innovation process factors as independent variables in this study.

We will continue by defining and assigning variables to the three factors of the innovation process: *Ideate*, *shape* and *capture*, and their corresponding elements, which is used as our independent variables.

Each of the elements are assigned their own variable, where this variable is defined as the set of scores for each specific element. E.g. for the element *generate*, we have a set of n scores for each of the respondents to the survey. Together, these scores create the set x_a, formally defined as:

$$x_a = \{x_{a_1}, x_{a_2}, x_{a_3}, \dots, x_{a_n}\}$$

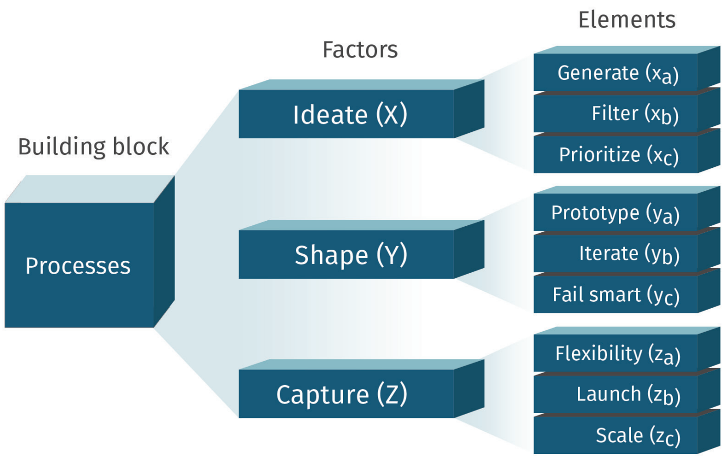

Figure 11. Variables assigned to the different factors in the innovation process and their corresponding elements.

This will be the same for each of the nine elements. Each of the three factors are also assigned their own variable, where similarly this is the set of the average scores for each factor aggregated from the element scores. To get a factor score, we take the average of the three elements scores from the same respondent. E.g. the factor score for *ideate* (variable labeled X) for respondent number i is defined as:

$$X_i = \left(\frac{x_{a_i} + x_{b_i} + x_{c_i}}{3}\right) , for\ i \in [1, n]$$

And the set X of average factor scores is simply:

$$X = \{X_1, X_2, X_3, \ldots, X_n\}$$

This derivation is the same for the factors *shape* and *capture*, which are labeled as variables Y and Z respectively. In addition to the above-defined variables, we will use metrics derived from the independent variables and how they interact. These will also be used to analyze the relationship with our dependent variable and try to find support for our various hypotheses. We will define a set V for the variance between the factors in the innovation process that will represent the balance in the innovation process. A high variance, that is a large spread between the levels of the innovation process parts, is thus the equivalent of low balance. The set V consist of the variance Vi of the factor scores X_i, Y_i and Z_i for respondent i which we find in the three sets, X, Y and Z. The set V is defined as:

$$V_i = Var(X_i, Y_i, Z_i) , for\ i \in [1, n]$$

And the set of variances V is:

$$V = \{V_1, V_2, V_3, \ldots, V_n\}$$

The set A consist of the average scores over all three factors in the *processes* building block.

We define the average score as:

$$A_i = \left(\frac{X_i + Y_i + Z_i}{3}\right), for\ i \in [1, n]$$

Then the set A of all average scores are:

$$A = \{A_1, A_2, A_3, \dots, A_n\}$$

Lastly, we need to define three more sets. The sets Min, Med and Max will contain the weakest, median and strongest link in the IVC of the respondents. By using these sets we can explore how the weakest link affect innovation success compared to the stronger factors. We start by defining three variables:

$$Min_i = min(X_i, Y_i, Z_i), for\ i \in [1, n]$$

$$Med_i = median(X_i, Y_i, Z_i), for\ i \in [1, n]$$

$$Max_i = max(X_i, Y_i, Z_i), for\ i \in [1, n]$$

Their corresponding sets are defined as:

$$Min = \{Min_1, Min_2, Min_3, \dots, Min_n\}$$

$$Med = \{Med_1, Med_2, Med_3, \dots, Med_n\}$$

$$Max = \{Max_1, Max_2, Max_3, \dots, Max_n\}$$

Now that we have defined our independent variables and other variables necessary to test our hypotheses, we will move on to the dependent variable, innovation success.

Dependent variable

As the discussion in the above section presents, innovation success serves as our dependent variable, or effect variable. As we have already described, we distinguish between innovation performance and innovation success. As opposed to only looking at financials and accounting data, we approach innovation success as a multifaceted construct. In addition to financial profits, our dependent variable includes developing new capabilities the firm did not have before, the employee's feeling of success and resulting motivation and the increased reputation of innovation from customers.

Innovation success is measured by a subset of the success building block in Rao and Weintraub's innovation culture framework consisting of the element *customers*, *competitors*, *finance* and *capabilities*. The reason for choosing only four of the nine variables in the success building block is that they are more suitable as measurement variables for the innovation success within a company. The variables left out, *purpose*, *discipline*, *satisfaction*, *growth* and *reward*, are more about how good the company is at incentivizing innovation. Our choice of variables focus on what the company has achieved and the perception of what the company has gained from its innovation efforts, rather than how they facilitated to get these results. Innovation success has been assigned the variable S, with corresponding variables for the four elements.

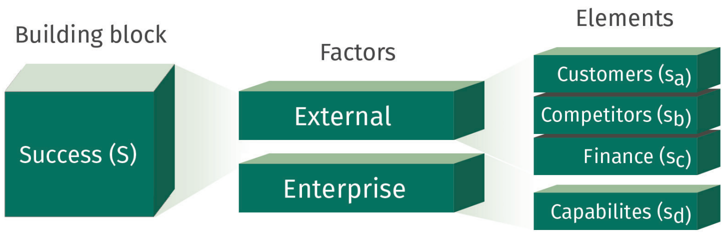

Figure 12. Variables assigned to the different factors of innovation success and their corresponding elements.

The set S consist of the average score from the four elements and are defined as:

$$S_i = \left(\frac{s_{a_i} + s_{b_i} + s_{c_i} + s_{d_i}}{4}\right), for\ i \in [1, n]$$

And the set S is defined as:

$$S = \{S_1, S_2, S_3, \ldots, S_n\}$$

Control variables

To be able to control for confounding effects, we include several control variables in our research. This background information is collected as metadata in the survey. We will control for firm, age of respondent, the respondents education level, their total work experience, gender and what hierarchical level the respondent belongs to in the firm.

In addition to calculating the correlation coefficient with innovation success and the average score of the innovation process for each bracket in table 1, we will also find the partial correlation coefficients associated with the correlations in connection to H1, H2, H3 and H4. The partial correlation coefficient corrects our results for influence from other variables that could also affect innovation success. If the partial correlation coefficient deviates to a large degree from the correlation coefficients we will discuss the possible reasons for this discrepancy.

Control variable	Classification
Firm	A, B, C, D...
Age of respondent	Years
Education	Primary school, high school, bachelor, master, Ph.D.
Work experience	Years
Hierarchical level of respondent	Employee, middle manager, top manager
Gender	Male, female

Table 1. Control variables that will be used in the research.

We expect the control variable firm to affect our results to some degree as many of our respondents work in the same firm. Nevertheless, as they might work in separate divisions or units, there might be different opinions on how their innovation is rated. The other control variables are expected to not affect our results and not be correlated with innovation success.

Statistical methods

Before we move on to our hypotheses and analysis, we will describe what statistical methods we will be using in our research. We will be collecting cross-sectional data at a single point in time, and want to test for relationships between the variables. We will use three types of statistical methods: Bivariate correlation analysis, partial correlation analysis and multiple regression analysis.

Correlation analysis

To attempt to find linear relationships between the innovation process and innovation success, we will apply bivariate correlation analysis. More specifically, we will calculate Pearson's product moment coefficient for pairs of data sets. The coefficient, *r*, will be an estimate of the linear association of our sampled data, and will indicate the magnitude and direction of the relationship between the data sets (Schindler & Cooper, 2003). The value of *r* will range from -1 to 1, where both indicate a perfect correlation, but in opposite directions. If a variable tend to increase as the other increases, they have a positive correlation. If a variable tend to decrease as the other increases or vice versa, they have a negative correlation. If the value of the coefficient *r* is 0, they have no relationship. The magnitude of *r* signifies the strength of the relationship. In our analysis we will use Dancey and Reidy's (2004) guideline for how the value of *r* corresponds with the strength of the relationships (see table 2).

In addition to the bivariate correlation analysis, we will test the influence of our control variables with partial correlation analysis. Partial correlation analysis checks for the relationship between two variables, with the effect of a third variable, a control variable, removed.

Correlation coefficient	Strength of relationship
1	Perfect
0,7 - 0,9	Strong
0,4 - 0,6	Moderate
0,1 - 0,3	Weak
0	None

Table 2. Guideline for the strength of the relationships (Dancey and Reidy, 2004).

To use correlation analysis, we need to make some assumptions. First, we need to assume linearity. That is, that there exists a linear relationship between the variables we are testing. By studying a scatterplot of the variables we are correlating, we can check for outliers and patterns signifying a nonlinear relationship. Second, we need to assume that the data is normally distributed. After the data is collected, we will check for normality and calculate skewness and kurtosis of the sample distribution.

Regression analysis

To find more complex relationships between more than two variables, we will use multiple regression analysis. This can be used when looking at P2 and P5 where we want to examine the relationship between different aspects of the process, like variance and average, and the success. In our regression analysis, we will investigate the relationships between a continuous dependent variable, innovation success, and several independent variables, called predictors. With three variables, a polynomial regression will span a plane in three dimensions. This way we can easily visualize the relationship between the variables, and see how well they can predict the innovation success. A polynomial regression can fit a nonlinear relationship between the independent and dependent variables and will result in a nth grade polynomial. Even though the regression function is nonlinear, the statistical estimation problem is linear, and polynomial regression is considered to be a special case of multiple linear regression (Montgomery, Peck, & Vining, 2012).

In regression analysis we also have to make some assumptions about multicollinearity, singularity, normality, linearity, homoscedasticity and the independence of residuals (Tabachnick & Fidell, 2001). If the independent variables are highly correlated, above 0,9, we have multicollinearity (Tabachnick & Fidell, 2001). We will check for this before performing our regressions analysis. If one of the independent variables is a combination of other independent variables, we have singularity. We will avoid singularity in our analysis by carefully choosing our independent variables. We will check the assumptions on normality, linearity, homoscedasticity and independence by examining scatterplots of the residuals.

Hypotheses and analysis

Now that the variables and statistical methods have been described, we will move on to translating our propositions presented earlier into hypotheses and describe how we want to analyze them. From the propositions we have formulated five hypotheses we wish to test with the data collected. Our first hypothesis concerns how the innovation process affects innovation success

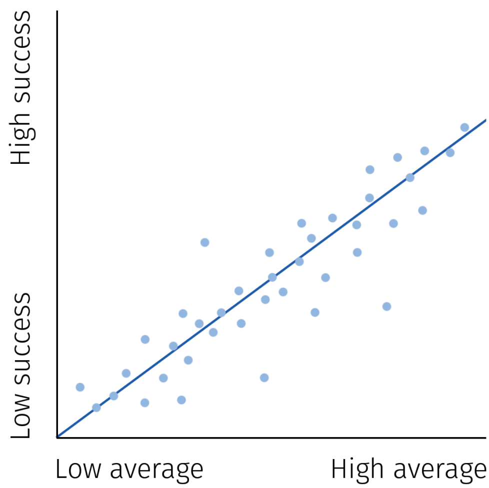

Figure 13. A diagram illustrating H1 as a strong linear relationship between the innovation process average score (A) and innovation success (S).

H1: *A higher average level in the innovation process factors is correlated with higher innovation success.*

For H1 we will do a bivariate analysis to find the strength and direction of the relationship between the innovation process and the innovation success. More specifically, we will find Pearson's correlation coefficient for the sets A and S and use a p-value of 0,05 to test H1. Our next hypothesis will test if one or more of the innovation process factors is more important than the others.

H2: *One of the innovation process factors is significantly more correlated with innovation success than the others.*

Hypothesis 2 will be performed by correlating the three sets X, Y and Z with the set S. We will require a p-value of 0,05 and based on Fisher (1921) test if there is a significant difference between the correlations. If we find a p-value below 0,05 between the correlations of X, Y or Z and success S, then this will be regarded as some factor being significantly more correlated with innovation success than others. We will on these grounds reject the null hypothesis and find support for H2. We consider this a strict but appropriate level of significance. If we don't find support for H2 or have a too limited sample, we will still take into discussion any differences in correlations between the factors, even though we cannot conclude anything.

In addition to the correlation analysis a regression model will be tested for the dependent variable S, with X, Y and Z as independent variables. The coefficients from the regression will serve as a measure of the factors effect on innovation. A non-zero constant will imply that others variables affect the success set S. This would not be unexpected as the framework developed by Rao & Weintraub lists four other blocks that all are expected to be determinants of innovation success. The overall regression function will be tested for strength by the measure of R-squared. A threshold for R-squared of 0,5 will be applied, whereas if the model has score below, the results will not be utilized in the evaluation of H2. Our next hypothesis will examine the weakest link perspective:

H3: *The set of weakest links (Min) will be significantly more correlated with success (S) than the sets (Max, Med) containing the strongest and middle links.*

Hypothesis 3 will be tested in the same way as H2, by correlating the three sets Min, Med and Max with the set S. We will again, based on Fisher (1921) calculate the p-value for which the correlations is significantly different. If the weakest link, set Min, have a higher correlation with S than Med and Max, with p-value results <0,05, this will support H3. For the balance perspective we have formulated our fourth hypothesis:

H4: *The variance (V) in the process factors, measuring the degree of unbalance, will be negatively correlated with the innovation success (S).*

To test hypothesis 4, we will calculate Pearson's r for the sets V and S, to try to find relationships between the balance and the success. This will uncover possible linear relationship between the two variables. However, it will not uncover if there is a polynomial relationship between balance and success.

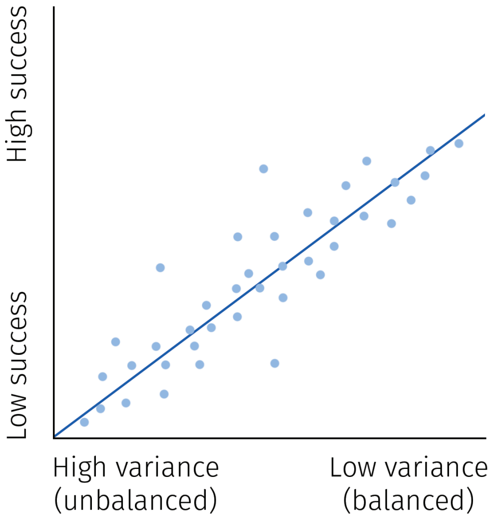

Figure 14. A diagram illustrating H4, where an unbalanced innovation value chain (high variance), leads to reduced success.

Our last hypothesis will cover this possibility that effect of balance depends on the quality of the innovation process.

H5: *At high average levels of the innovation process factors, variance will be more correlated with innovation success than on low average levels.*

For hypothesis 5, we will have two independent variables, the average set A and the variance set V. To check for both these independent variables against the dependent variable S, we will perform a multivariate analysis with a polynomial regression. The goal is to find the relationship between the success, the average process score and the process balance. The resulting function with three unknowns will span a plane in three dimensions, and by studying the graph and function we can see how the effect of variance changes with the quality of the innovation process. If the plane bend downwards as the variance rises, it will imply a negative relationship between unbalance and success, supporting H5.

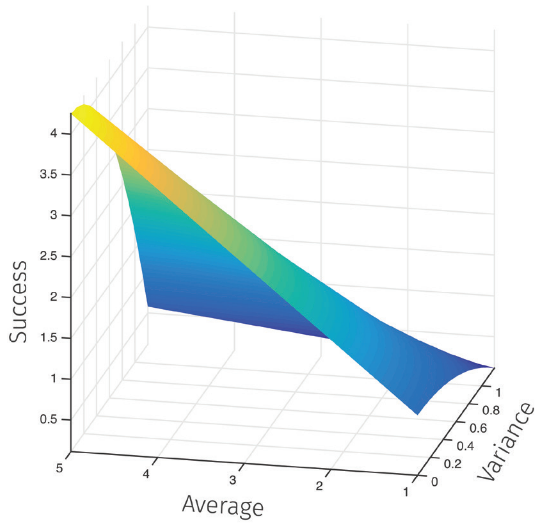

Figure 15. A plot of success (S), average innovation process score (A) and balance in the innovation value chain (V), if H5 is true.

To find support for H5, the plane should bend more for higher averages and less, ideally not at all, for low averages. This will support the hypothesis H5 that suggest that a balanced innovation process is only connected with innovation success for high averages. The logic is, as mentioned, that if a company scores very low on each step of innovation process, it does not positively affect success that the company is equally bad at all steps, thus having a balanced process. This multivariate polynomial regression will be tested for significance, measured by the r-squared value. We will use a threshold of 0,5 for r-squared, resulting in no conclusions being drawn should the model have a fit below this value. A significant and positive coefficient for the independent variable A and a negative and significant coefficient for the independent variable V will support H5. A p-value of 0,05 will be used to test the significance of the coefficients as well as the constant.

At the extremes, when we have a maximum or minimum average score for the innovation process, the variance would be zero and we would have perfect balance. This logic means that we can expect the data to naturally be in favor of H5 as the average approaches the maximum or minimum value. To account for this, we will split the scores into categories of low, medium and high averages to analyze the effect of uneven balance.

The data analysis will be performed using Excel, RapidMiner and SPSS. Excel and SPSS will serve as the main tools for testing hypothesis 1-4, while hypothesis 5 requires multiple polynomial regression, which will be performed in RapidMiner. The result from this regression will be tested in SPSS for significance. In addition to reviewing the aggregated data, we will also analyze the control variables to reveal any bias from these.

To perform the aforementioned analysis we need a clean and complete dataset. The responses will therefore be filtered based on predetermined criteria. Responses with no valid answers for the questions related to X, Y or Z will be removed as we need a valid sample in these to produce the sets A, V, Min, Med and Max. If a respondent only answer one of the questions in e.g. X, namely Xa, Xb or Xc, the instance in the set X will be equal to this value. In the case where samples are missing, reducing the possibility of applying statistical analysis, these values will be set to the average of the others instances in the same set.

Findings

This section will present the data collected from our survey, as well as explain and interpret the key findings from the testing of each hypothesis. We will begin by describing the collected data, what parts it consists of, the quantity and the quality. The section will continue with a walkthrough of each perspective and their respective hypotheses, and present the relevant data connected to each.

We will based on the conducted analysis, described in the methodology chapter, first evaluate whether we have found support for H1. We will then look at the hypotheses connected to the three perspectives, namely H2, H3 and H4, before we will continue with the findings related to H5, which extends H4. At the end we will assess and evaluate the collected data against our control variables. We will also point out limitations and aspects that we find important for our discussion.

Data

The survey was distributed to 6 companies where 4 of them participated. A total of 108 responses were collected, counting for a 63% response rate. A total of 32 were removed, reducing the amount of usable data to 76 samples, 45% of the total distributed.

To be able to conduct the correlation analysis we need normally distributed independent data with a linear relationship. To test these conditions we examined scatterplots for each of the correlations. Related to H1, the correlated data had an undoubtedly linear relationship. The same result was found for the three correlations related to H2 and H3, but with a slightly weaker relationship. There is no linear relationship between variance and success, related to H4, and a polynomial regression will therefore be utilized to identify the relationship between them. As a single person anonymously answered the survey without any influence we could argue for independence in the dataset. As the number of firms participating is quite low, the individual responses will still not be completely independent. We will take this into account

Firm	Employees	Responses	Response rate	Usable respons.
A	30	21	70%	15
B	42	39	93%	23
C	42	16	38%	15
D	55	32	58%	23
Total	169	108	63%	76

Table 3. Overview of responses to the survey sent out.

when we perform the partial correlation analysis adjusting for firm. The datasets used in the correlation analyses can also be characterized as normally distributed making it eligible for regression analysis. As an example, the processes factor (A) gives us the following histogram.

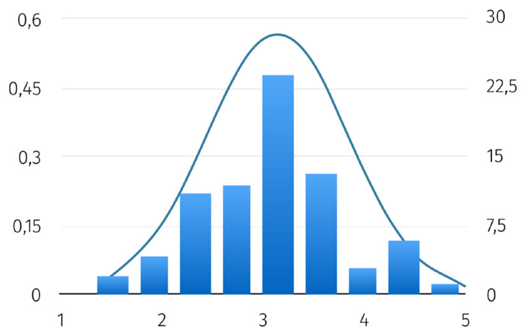

Figure 16. Histogram of dataset A, showing normally distributed data. The other datasets had a similar distribution.

A very low skewness of 0,15 and a kurtosis of 0,022 confirm the normal distribution. Data for the other factors display the same characteristics and are included in the appendix. Based on the characteristics of the data, described above, we argue that the assumptions for correlation analysis are plausible and will therefore conduct the described analysis.

The regression analysis will build on the assumption of multicollinearity, singularity, normality, linearity, homoscedasticity and the independence of residuals. Normality and linearity have already been described for the sets that go into the regression related to H2. The F-test value of 44,66 and a significance < 0,01 for the regression underlines the linearity. Linearity will not be applicable for the regression in H5, as it seeks a polynomial relationship between the independent and dependent variables. Multicollinearity was also tested for the regression in H2, where we got tolerance levels of 0,44, 0,40 and 0,45 for X, Y and Z respectively. These values should be larger than 0,1, which they are (see appendix for data). Multicollinearity was not present in the multiple polynomial regression related to H5 either. Singularity was not present in any regression performed. The regression of the independent variables X, Y and Z on the dependent variable S was tested for autocorrelation by the Durbin-Watson test. The result for this was 1,549, which is between the two critical values of 1.5 and 2.5. The regression in H5 gave a Durbin-Watson value of 1,512. We therefore assume that there is no first order linear autocorrelation in our multiple linear and polynomial regression data.

Homoscedasticity and the independence of residuals were tested for both regressions and both characteristics. As SPSS does not support the Goldfeld-Quandt test we analyzed the homoscedasticity and independence of residuals with the Q-Q-Plot of z*pred and z*presid. The plot indicates that our multiple linear and polynomial regression analysis does not contain tendency in the error terms. If that was present the graph would be formed like a staircase. The spread in the scatterplot of the standardized residuals and the standardized predicted values indicate that there is no homoscedasticity in our data. If this were the case, the scatterplot would be less spread out, forming a nest in the graph.

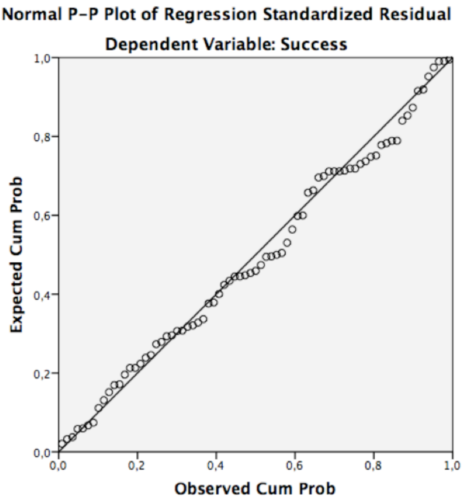

Figure 17. Normal P-P plot for the regression connected to H2.

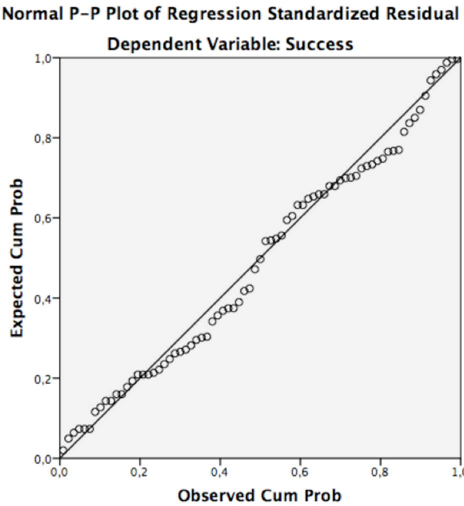

Figure 19. Normal P-P plot for the regression connected to H5.

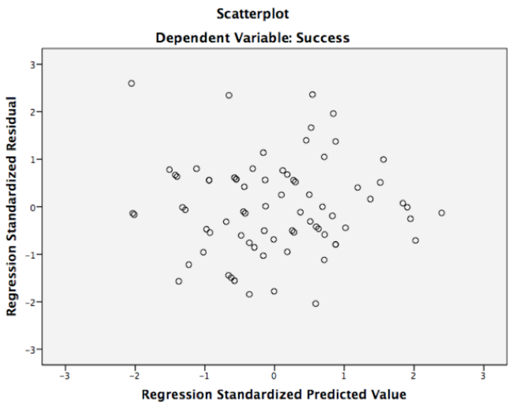

Figure 18. Scatterplot of residuals for the regression connected to H2.

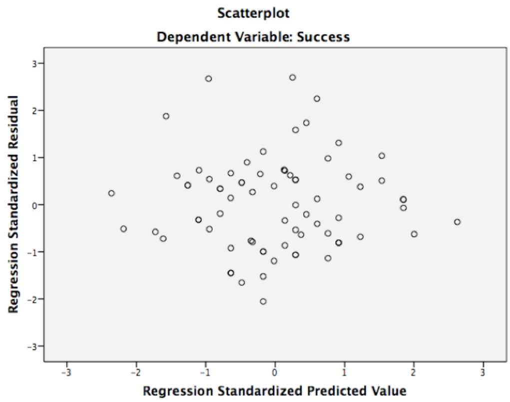

Figure 20. Scatterplot of residuals for the regression connected to H5.

Based on a total review of the datasets characteristics we argue that the assumptions are met and will continue with the different analyses as described in the methodology chapter.

Innovation process average

The first logic we wanted to confirm with empirical data was that innovation success to a large degree depends on the average level of the innovation process factors. The corresponding hypothesis, H1, will serve as a foundation for our thesis and states that:

H1: *A higher average level in the innovation process is correlated with higher innovation success.*

The values in the set A proved to be significantly correlated with the set innovation success set S. The average innovation process

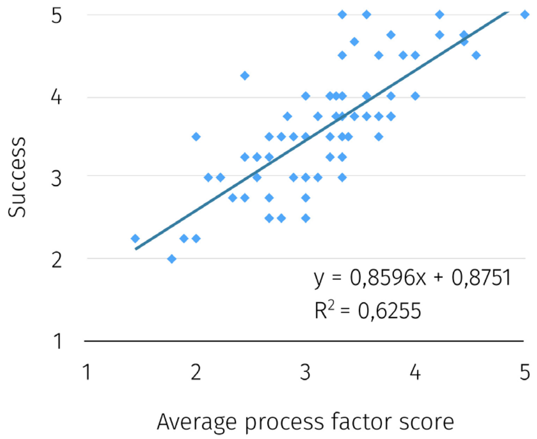

Figure 21. Scatterplot of A and S with the regression line.

level, computed by the geometric average of set X, Y and Z, was found to have a 0,79 correlation with the success set S, and a corresponding p-value of 0,0. These results do not take variance into consideration. The correlation is significant at both the 5%-level and 1%-level, and the corresponding 95%-confidence interval is 0,69-0,86. This is in line with theory and our assumption, providing support for H1.

As the survey also spanned other building blocks of innovation culture, we correlated each one to compare with processes, the focal point of our thesis. The *values* building block had a 0,77 correlation with innovation success, our dependent variable, almost at the same level as *processes*. *Behaviors* had a smaller correlation with a 0,72 coefficient. *Climate* had the same correlation as *processes* with a coefficient of 0,76, while *resources* had a lower score of 0,75. The *success* building block, where our definition of success constitute one third of the survey questions, naturally had a high correlation of 0,94. This supports the innovation culture framework developed Rao & Weintraub, as all parts of the culture are found to positively affect innovation success. It is also in line with the positive and significant constants in the regressions related to H2 and H5, where the success is not only affected by the formal innovation process, but also other parts of the innovation culture.

The pivotal part perspective

Proponents of the first perspective argue that some parts of the IVC might be more pivotal, and thus more correlated with success than others. Managers following this perspective should therefore put more effort into improving that part of the value chain. To test and find evidence for such a perspective we tested the following hypothesis:

H2: *One of the innovation process factors is significantly more correlated with innovation success than the others.*

To test this hypothesis we used correlation analysis on both the element and factor level to identify relationships between different parts of the innovation process and innovation success. The *ideate* factor (X), where X indicates set X, had a correlation coefficient of 0,65 with innovation success (S), with a p-value of 0,0. This signals a medium to strong relationship between the two variables in our sample, and that the results are significant according to our 5%-level. The *shape* factor (Y) showed similar results with a correlation coefficient of 0,69 and a 0,0 p-value. The same test was performed on the *capture* factor (Z), giving a 0,78 coefficient with a corresponding 0,0 p-value.

Factor/Element	Corr. with success	P-value	Average score	95% conf.interval
Generate (x_a)	0,56	$9,3 \times 10^{-9}$	2,931	0,38 - 0,69
Filter (x_b)	0,57	$4,8 \times 10^{-8}$	2,904	0,39 - 0,70
Prioritize (x_c)	0,57	$5,1 \times 10^{-6}$	2,781	0,39 - 0,70
Ideate (X)	0,65	$3,1 \times 10^{-10}$	2,879	0,49 - 0,76
Prototype (y_a)	0,63	$2,9 \times 10^{-9}$	3,065	0,47 - 0,75
Iterate (y_b)	0,43	$8,4 \times 10^{-8}$	3,364	0,23 - 0,60
Fail smart (y_c)	0,54	$2,1 \times 10^{-5}$	2,933	0,36 - 0,68
Shape (Y)	0,69	$9,9 \times 10^{-12}$	3,118	0,55 - 0,79
Flexibility (z_a)	0,62	$7,7 \times 10^{-8}$	3,310	0,46 - 0,74
Launch (z_b)	0,60	$1,7 \times 10^{-5}$	3,583	0,43 - 0,73
Scale (z_c)	0,76	$5,7 \times 10^{-11}$	3,333	0,65 - 0,85
Capture (Z)	0,78	$4,2 \times 10^{-11}$	3,418	0,67 - 0,85
Variance (V)	-0,04	0,48	0,176	-0,26 - 0,18
Success (S)	1	N/A	3,57	N/A
Average (A)	0,79	$4,0 \times 10^{-11}$	3,13	0,68 - 0,86
Weakest link (Min)	0,69	$7,0 \times 10^{-8}$	2,74	0,56 - 0,80
Medium link (Med)	0,75	$1,1 \times 10^{-11}$	3,12	0,63 - 0,84
Strongest link (Max)	0,78	$1,0 \times 10^{-11}$	3,55	0,67 - 0,86

Table 4. Correlation of variables with success (S) with p-values, averages and a 95% confidence interval.

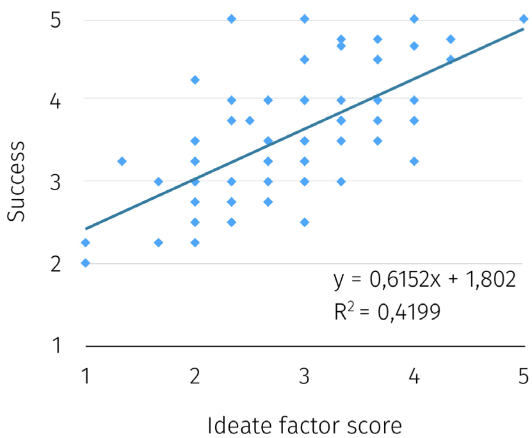

Figure 22. Scatterplot and regression line for the ideate factor score (X) and success (S).

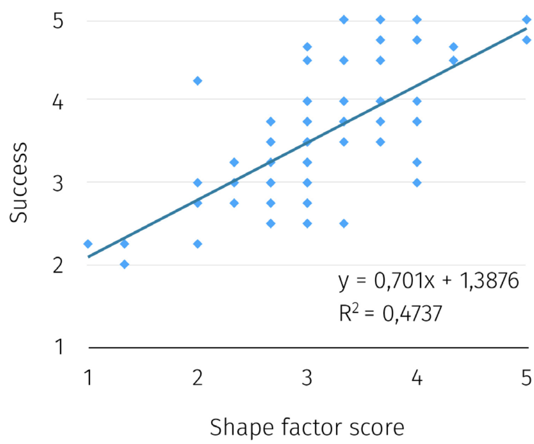

Figure 23. Scatterplot and regression line for the shape factor score (Y) and success (S).

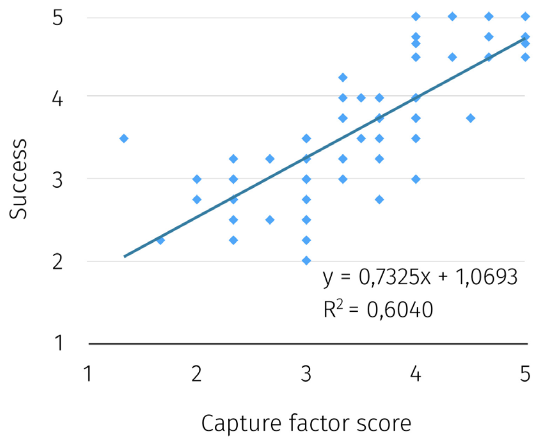

Figure 24. Scatterplot and regression line for the capture factor score (Z) and success (S).

Each factor, X, Y, Z, was found to have a close relationship with innovation success, S, but neither of the factors were found to be significantly more correlated than others. The coefficients indicate that *capture* is most important, followed by *shape* and *ideate*. The difference of 0,13 between the correlation coefficients of *capture* and *ideate* could indicate that *capture* is the most pivotal part of the innovation process. On the other hand we see that the confidence intervals are overlapping, meaning that the results could be random or attributed to sampling errors. We tested whether these correlations are significantly different based on Fisher (1921). With a sample size of 75 and the correlations for *ideate* and *capture* of 0,65 and 0,78 respectively, we found that these are significantly different at a 90% level. This does not meet our predetermined criterion of $p < 0{,}05$. An even larger p-value was found between the correlation coefficients of *ideate* and shape, and *shape* and *capture*. Based on the findings we found no support for H2 in that some factor of the innovation process is significantly more correlated with success than others. Still there is some evidence that *capture* might more important than *ideate* and shape, but nothing can be concluded with the given sample size and significance level.

Each of the factors were found to be correlated with each other with correlation coefficients between *ideate* (X) and *shape* (Y), *shape* (Y) and *capture* (Z) and *capture* (Z) and *ideate* (X), at 0,71, 0,68 and 0,57 respectively. On element level, we found that *generate* (x_a), *filter* (x_b) and *prioritize* (x_c) have a 0,56, 0,57 and 0,57 correlation with success (S) respectively. This could indicate that the quality and quantity of ideas generated within the company affects innovation success more than the prioritizing efforts. *Prototype* (y_a), *iterate* (y_b) and *fail smart* (y_c) have a 0,63, 0,43 and 0,54 correlation with success (S) respectively, again indicating that some elements affect innovation success more than others. We see the same result in the *capture* factor (Z), as *flexibility* (z_a), *launch* (z_b) and *scale* (z_c) have a 0,62, 0,61 and 0,77 correlation with success (S) respectively. Each performed correlation was significant with a p-value $< 0{,}05$.

The next test we performed was a linear regression analysis with success (S) as the dependent variable and *ideate* (X), *shape* (Y) and *capture* (Z) as independent variables. We got the following model for success:

$$S = 0{,}13X + 0{,}22Y + 0{,}50Z + 0{,}76$$

The weakest link perspective

The second perspective argued for a weakest link approach to innovation process management. Managers should thus pinpoint and improve this part of the process, regardless of cost or the level of the other links. The following hypothesis was tested:

H3: *The set of weakest links (Min) will be significantly more correlated with success (S) than the sets (Max, Med) containing the strongest and middle links.*

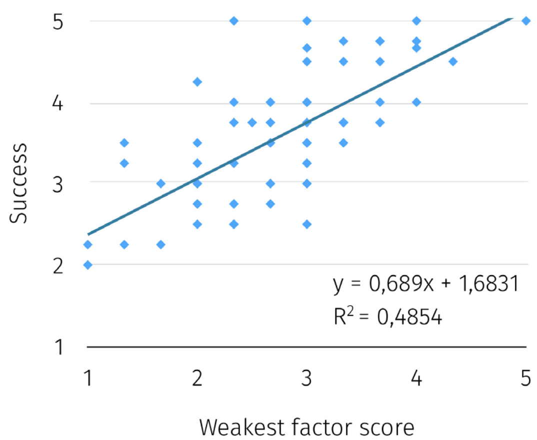

Figure 25. Scatterplot and regression line for the weakest link (Min) and success (S).

Our data showed that the weakest link (Min) was correlated with innovation success (S) with a correlation coefficient of 0,7, a p-value of 0,00 and a confidence interval of 0,56-0,8. For comparison, the strongest link (Max) had a correlation coefficient of 0,78, p-value of 0,00 and confidence interval of 0,67-0,86. The medium link (Med) had a correlation coefficient of 0,75 and a confidence interval of 0,64-0,84. There is thus no indication of a stronger relationship between Min and S than other links, on the contrary, the strongest link seemed to have a closer relationship than the weakest link. Therefor we conclude, based on the collected data, that there is no support for H3.

As each X is calculated by the average of x_a, x_b and x_c, X differ with only a small amount compared to the element scores x_i. There is thus often little or no difference between the weakest link (Min) and the second weakest link (Med), something that might affect the results of this test. To compensate for this we ran the same test on element level to see if this would result in support for the proposition. The set of weakest elements had an even lower correlation with S of only 0,58 with a p-value of 0,00 and a confidence interval of 0,41-0,71. The best scoring elements had a higher coefficient of 0,74 with a p-value of 0,00 and a confidence interval of 0,62-0,83, further refuting the proposition that the weakest link is the determinant of innovation success. In total, our data provided no evidence for H3.

The balance perspective

According to the third perspective, managers should improve their innovation success with a balanced innovation process, achieved by leveling out the different factors X, Y and Z. This is not limited to improving the weakest link (Min), but rather weighing of cost over benefit for different process management initiatives. As mentioned in the theory section, an overdeveloped factor could in extreme cases also cause reduced innovation success, something managers following the balance perspective has to take into account when reviewing the innovation process. The hypothesis connected to the balance perspective states that:

H4: *The variance (V) in the process factors, measuring the degree of unbalance, will be negatively correlated with the innovation success set (S).*

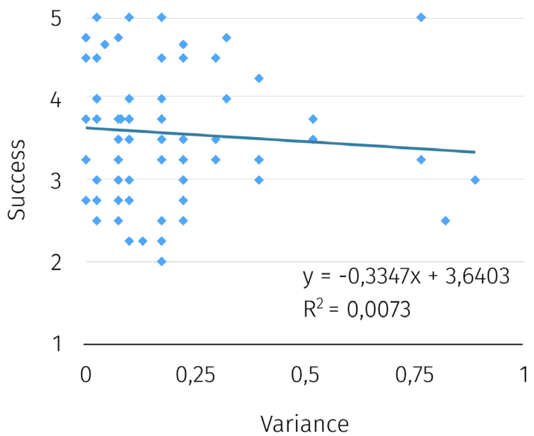

Figure 26. Scatterplot and regression line for the balance in the innovation process (V) and success (S).

We used the sets X, Y and Z as a basis for calculating the variance in the factor scores from each respondent. The variance, V_n, was used as a measure of the innovation process balance. A high V_n indicates an unbalanced process where some of the factors X_n, Y_n or Z_n deviate from the average, while a small Vn indicated balance in the process. The data showed a slightly negative relationship with a correlation coefficient of -0,04 with p-value of 0,48 and a confidence interval of (-0,27)-0,19. The data is too small to conclude that this relationship is significant at 5% level, but could very vaguely indicate that the direction of the correlation might be slightly negative. A negative correlation coefficient means that higher variance (less balance) is related to lower innovation success, which is in line with our proposition. Nevertheless, the data could not be used to provide significant support for H4 even though the results indicate a relationship that could match the hypothesis.

Hunch proposition

In addition to these three perspectives and accompanying propositions, we presented an additional proposition based on our own logic and research interest that incorporates both P2 in the balance perspective and P1. This proposition extends the balance perspective and provides further insight into how both variance and average scores affect innovation success. This proposition was the inspiration for the title of this thesis: “Is all balance created equal”. Based on the literature supporting a balanced IVC, we wanted to test whether this was the case for all innovation process averages. Put another way, given that a company has a below par factor average of 1,7 out of 5, would the balance still affect the innovation success? Or does the balance come into play only when a company reaches a certain average level in their innovation efforts? This question will be explored testing H5:

H5: *At high average levels of the innovation process factors, variance will be more correlated with innovation success than on low average levels.*

Our data show little support for the notion that balance should be more important in innovation process with a higher average. We divided our results into two brackets. One consisting of averages of An = [3,2 , 5,0], and one with averages An = [0,0 , 3,2]. The intervals are calculated such that 50% of our samples will be in each bracket. The correlation between balance and innovation success for samples with high average value between 3,2 and 5 have a correlation coefficient of -0,06, compared to the low-average samples with averages below 3,2 which have a correlation coefficient of -0,12. To find support for H5, we were expecting to find the opposite, namely that high averages should be more strongly negatively correlated with variance. Our data shows that the firms with a low average are more negatively affected by a high variance (V) in the innovation process than companies with a high average. Nevertheless, the p-values are both too large to invalidate the proposition with significant negative support. We conclude that our data at least show no sign of a higher value of V having larger negative effects on higher values of A. On the contrary, unbalance and a large V seem to have a larger negative effect on a low value of A, meaning that innovation processes that are poorer will suffer more from an unbalanced process. As a side-note, and in line with our results connected to H4, we find that V in both cases is negatively correlated with S.

To shed further light on the relationship between V, A and S we performed a regression analysis in addition to the correlation of different averages in the two brackets presented in the above section. Figure 28 shows innovation success plotted against innovation balance V on the x-axis and the factor average on the y-axis. This plane is the results of a multiple polynomial regression with two independent variables Vn and An defined by the function:

$$S = 0{,}85A - 0{,}51V^5 + 0{,}9$$

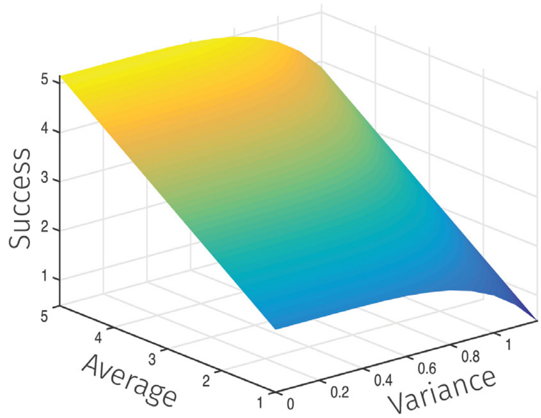

Figure 27. 3D-plot of the regression plane from V, A and S.

This function describes the relationship between success (S), variance (V) and the average of the process factors (A). The plane fit is acceptable with an R-squared-value of 0,63. The coefficient of 0,85 for A is larger than the coefficient of -0,51 for V and is in addition positive. The coefficient of V is negative, which gives the plane a characteristic bend towards lower innovation success with higher variance V. The interpretation of this function generated by our data indicates that un-balance and a high V reduces innovation success S slightly compared to samples with the same A and lower V-score. At low levels of V the effect will be small because of the small coefficient of -0,295, but since the term is to the power of 5, the effect will increase rapidly as variance increases. This shows that proportionally, V will be more determining for success than A as V increases. As our data set includes vari-

Hypothesis	Supported?	Reason for no support	Comments on result
H1	Yes		
H2	No	Correlations not significantly different	Regression and correlation in favor of H2
H3	No	Correlations not significantly different	
H4	No	Results are not significant	Correlation coefficient has right sign
H5	No	Results are not significant and conflicting	Regression indicates support, correlation indicates the opposite of H5

Table 5. Summary of the findings.

ance samples with a range between [0 , 0,8] and the possible range of V is [0 , 3,56], the result from the regression would not have to account for what happens when V grows beyond the V_{max} of our data. As the balance term -0,51V^5 would yield approximately -263 with a V of 3,5, the regression function can possibly produce negative S as the maximum of An is 5. This function is thus poor at describing the relationship between A, V and S outside the range of V [0 , 0,8] which is the possible values V takes on in our dataset.

Evaluation of data

Now that we have presented our findings, we will evaluate our data and discuss the limitations of our data.

Control variables

The data in the above section takes certain

Sample group	Firm A	Firm B	Firm C	Firm D	Total
Average process score	3,11	2,57	2,96	3,71	3,14
Average ideate score	2,93	2,34	2,52	3,55	2,88
Average shape score	3,16	2,47	3,12	3,52	3,12
Average capture score	3,24	2,91	3,23	4,05	3,42
Average success score	3,35	3,20	3,38	4,19	3,57
Average corr. with S (H1)	0,74	0,76	0,63	0,78	0,79
Ideate corr. with S (H2)	0,48	0,66	0,33	0,59	0,65
Shape corr. with S (H2)	0,63	0,61	0,59	0,73	0,69
Capture corr. with S (H2)	0,73	0,68	0,57	0,86	0,78
Min corr. with S (H3)	0,59	0,75	0,40	0,65	0,70
Med corr. with S (H3)	0,75	0,71	0,59	0,74	0,75
Max corr. with S (H3)	0,66	0,65	0,65	0,84	0,78
Variance corr. with S (H4)	0,34	-0,35	0,17	0,23	-0,04

Table 6. Comparison of scores between firms to check for firm bias.

control variables into consideration by calculating the partial correlation coefficient. In this section we will comment on possible sources of bias and test whether such bias could have affected our findings. These results will be taken into account when discussing the implications of our findings in the next section. As noted in our methodology chapter, we will use the control variables in table 1 and test for possible correlation with our dependent variable S. Table 6 displays the findings from our correlation analysis, both as an average and for each participating firm. All four firms had relatively similar correlation coefficients but still with differing results when it comes to some of the variables. This was confirmed by plotting A against S in figure 29.

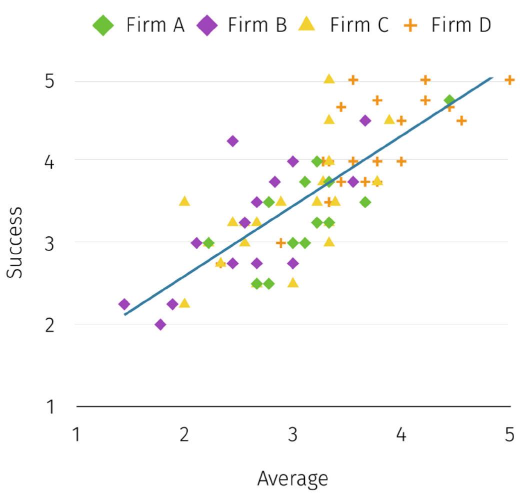

Figure 28. Firm-level scatterplot of A against S, showing signs of clustering of the firms.

Most of the samples lie along the regression line of A against S, which supports our findings connected to H1. We can see that the samples from the different firms are clustered to some degree along the line from the lower left quadrant to the upper right quadrant. The clustering is expected as each respondent answers with the firm's innovation success in mind and scores the innovation process based on how well the firm performs various activities. As these are perceived levels and we assume that internal circumstances could impact how well they perceive variables X, Y, Z and S, it is reasonable that they would spread along the regression line, but tend to cluster to some degree. A significant clustering would provide reliability to our data on firm level, but in reality reduce the heterogeneity of the sample as one effectively would have fewer differing pairs of An and Sn on firm level as each respondent tended to answer the same. If we were to have a larger sample of firms, the clustering of answers from different employees within a single firm would be a smaller part of the sample, and thereby reduce this bias. As we can see from the scatter plot, the clustering is nevertheless not dramatic, and we still have a spread of responses, even within a single firm.

As we can see from table ?? below, the only control variable which resulted in a differing partial correlation coefficient where which firm the respondent belonged to. All other control variables only exhibited negligible deviations from the correlation coefficients. This result matches the observation that respondents tend to cluster, as the control variable "firm" affects innovation success. Nevertheless, the effect is not considerable, and all relationships that were tested still had relatively strong correlations with innovation success, with the exception of variance that were not correlated in the first place.

	Control	Firm	Age	Education	Work exp.	Gender	Hiearch.lvl.
A and S	0,79	0,75	0,80	0,79	0,79	0,79	0,81
X and S	0,65	0,57	0,65	0,65	0,65	0,64	0,66
Y and S	0,69	0,65	0,70	0,69	0,69	0,68	0,70
Z and S	0,78	0,73	0,78	0,78	0,79	0,77	0,79
V and S	-0,04	-0,05	-0,04	-0,04	-0,04	-0,04	-0,04
Min and S	0,70	0,65	0,70	0,70	0,70	0,69	0,71
Med and S	0,75	0,72	0,76	0,76	0,76	0,75	0,77
Max and S	0,78	0,74	0,79	0,78	0,80	0,78	0,80

Table 7. Partial correlation coefficients of control variables compared to the average as control.

Ex-post limitations

Our findings are based on the collected data and this information is subject to some limitations found during analysis. These limitations could affect the implications of our findings and must be taken into consideration when evaluating the applicability in different situations.

The first observation is that our data to a large degree is concentrated around the middle values. This is not unnatural as the data are approximately normally distributed, but the lack of samples towards the edges makes it harder to say something about the relationship at the entire scale. This is especially prominent with the variance, as most samples report a low variance. The fact that our factor values X, Y and Z are aggregated from the element average strengthens this tendency further.

As some of the samples were incomplete, we needed to correct the data to have complete data sets on which we could perform our analysis. As we used mean values where data was missing, this skewed the responses further towards the mean. The fact that only 4 firms decided to participate in the survey, and that only 10 firms received the survey means that the ability to make any conclusions on firm level is reduced. The total number of 75 respondents is on the low end, as firm bias will count for some of the relationships in the findings.

As all firms tend to answer similarly at an aggregated level when it comes to innovation process average A and balance V, it seems that the participating firms is too homogeneous. This will reduce the possibility to infer our results on the entire population of Norwegian industrial firms and make generalizations.

The fact that the partial correlation coefficients, when controlled for the variable "firm", all were lower indicates that firm association affects the responses at an individual level to some degree.

Discussion

In this section we will provide a discussion of our most important findings and relate them to our research question and existing theory on the subject. We will start with a summary of the main findings before we explain what they mean and how they fit into the existing body of literature, as well as interpret and explain how and why they differ from earlier research.

In the findings section we provided an objective and thorough presentation of what we found in our research without discussing its implications. In this section we will take a step back and take a look at the big picture, discussing what our findings mean, and what the implications for both managers and future research will be. We will also try to find alternative explanations, both for the findings that support our propositions and the ones that reject them. At the end of this section we will critically evaluate the strengths and weaknesses of our paper, pointing out limitations in our research and data, before proposing the direction for future research on the subject.

Findings

The findings section of this thesis presented several interesting aspects and results derived from our research. Many of them were directly related to our research question, while some of them were found as a byproduct of our analysis where we aimed to shed light on our propositions. The most important findings were:

1. The average score of the innovation process is correlated to innovation success.
2. No significant evidence that some of the innovation process factors are more important than others for innovation success, but the data still indicates that *capture* could be more a more important driver.
3. The weakest link is *not* found to have a significant relationship with innovation success.
4. No clear support for balance in the innovation process as a significant factor determining innovation success.
5. It is not clear from the findings how innovation process balance affects innovation success at different innovation process averages.

The above findings will be discussed in this section, putting the results into a larger context. As our thesis is the first attempt to quantify and empirically determine the importance of different parts of the innovation process and how the balance of these affects innovation success, it is hard to compare it directly

Paper	H1	Pivotal part	Weakest link	Balanced
Cooper and Kleinschmidt (1995)	+			
Ernst (2002)	+	+		
Birkinshaw, Bouqet and Barsoux (2011)	+		+	+
Govindarajan and Trimble (2010)	+	+		
Cooper and Edgett (2012)	+			
Jaruzelski, Dehoff and Bordia (2005)	+			
Stockstrom, Verworen and Nagahira (2005)		+		
Cooper and Kleinschmidt (1986)	+			+
Cooper (1990)	+	+		
Berg et al. (2009)		+		
Bassiti and Ajhoun (2013)		+		
Preez and Louw (2008)		+		
Hansen and Birkinshaw (2007)	+		+	+
Dervitsiotis (2011)				+

Table 8. Overview of literature that supports the different perspectives on innovation process balance.

to other studies. Our findings therefore must be viewed in comparison to existing qualitative research on our subject.

Innovation process average

Our initial finding was of the more confirmatory sort, and provides the foundation for the rest of the discussion. Our data points to a significant relationship between the average score of the innovation process and innovation success, exhibiting a moderately positive correlation. This implies that improving the average, no matter which part of the process or current balance level will yield an increase in innovation success. Existing theory is assumed to acknowledge this finding as both Cooper and Kleinschmidt (1995) and Ernst (2002) support that innovation processes are needed and improves innovation performance. Our findings support this notion and extend it by suggestion that it also improves innovation success, which is a broader term than innovation performance. As all three factors of the innovation process were positively correlated with innovation success, this strengthens the credibility of our data as it matches relevant theory and intuition. On the element level we found that some elements are more correlated with innovation success than others, but the small differences makes it hard to conclude whether some elements can be left out of the managers focal point. This leads us to the findings concerning hypothesis 2. Is any part of the innovation process more important than others?

Is there any pivotal part in the innovation process?

The research described in our literature review mainly focus on explaining and making a case for why a certain part of the innovation process is important. Even though few papers claim explicitly that one part of the innovation process is more important than others, this could be interpreted as the author's implicit message. Both Ernst (2002) and Stockstrom, Verworen and Nagahira (2005) argue for the early phases of innovation process being crucial for innovation performance. In addition, as mentioned in our theory section, the amount of theory covering the early ideation phase might be an indirect sign that this part is considered more important. Alternatively, it could be that the vast amount of literature on this early phase is due to reasons such as how easy this phase is to research and how many researchers that acknowledge it as a part of the innovation process. Nevertheless, our correlation analysis does not find that any part of the innovation process is more correlated with innovation success than others when testing for significance as according to Fisher (1921). We did however find some support for the pivotal part perspective and hypothesis 2 in the regression analysis, where the factor *capture* had a larger contribution to success than the factors *ideate* and *shape*. This finding is very much in line with Govindarajan and Trimble (2010) who writes that ideation is too highly emphasized in many companies. One should rather focus on implementing and executing ideas, instead of just generating ideas. According to them, innovation does not equal ideas, but rather ideas plus execution. This could also serve as an argument for using the resources in a more effective way to increase the innovation in a company. According to them it is easy to facilitate ideation, as it is more glamorous and energizing, while implementation is more "dirty-work". Nevertheless, as our findings could indicate, this "dirty-work" might be just the work that results in innovation success and should deserve more attention.

In contrast to the research of other scholars (e.g. Birkinshaw, Bouquet and Barsoux, 2011), this is an odd finding as they mostly argue for the early phases to be of more importance. *Capture* is the last part of the innovation process in Rao & Weintraub's framework, making our finding the opposite of what we might have suspected by reviewing the literature. The main elements of the *capture* factor that increase innovation success according to our reviewed literature are speed to market (Chen, Reilly and Lynn, 2005; Cooper and Kleinschmidt, 1994) and flexibility (MacCormack et.al, 2001; Kanter, 2006), but out of our reviewed literature, only Govindarajan and Trimble (2010) advocate for the last phases being more important than other parts of the process. Based on the performed tests we cannot reject or support hypothesis 2 without further research. As the correlation analysis is the most significant of our results, this is weakly in favor of the notion that there is no pivotal part in the innovation process. This means that managers will not gain any extra improvement on innovation success by improving "the most pivotal part" instead of others. As all parts are approximately equally correlated with innovation success, one cannot determine which one(s) of them that actually is the causal effect on innovation success. In fact, it could be that causality is the other way around, that success induces improvements in the process. It could also very well be that respondents are not able to distinguish each part of the process and scores them at an average they see fit for their organization's innovation process. This would yield correlations that are approximately similar. The fact that the factor sets are highly correlated with each other also supports this explanation, but it could be that our relatively small sample of firms are very similar and thereby does not make for large variations.

The notion that the weakest link in the innovation process determines innovation success does not find support in our data either. In fact there is a stronger relationship between the strongest link of the innovation process and innovation success. This supports the advice by Rao & Weintraub (2013) to focus on improving the strongest link and not aim for a balance by addressing their weakest link. Nevertheless, we do not believe that improving what you are already good at will improve innovation success indefinitely just because the two are highly correlated. At some point we would expect that innovation success could be more improved by improving other less developed parts, as e.g. the weakest link. In total, we do not find that the weakest link is the factor determining how high innovation success can be.

The importance of balance

As mentioned in our introduction and pointed out in our literature review, the literature rarely says anything about how one should prioritize resources or compare the impact different parts of the process has on innovation success. In other words, how to balance the innovation process. The ones that do, favors a balanced approach where all parts should be equally developed. This leads us to the core of our research question, assessing how the balance of the innovation process affects innovation success. Our findings are to a large degree not in line with the studies proposing that innovation success or innovation performance to a large extent depends on the balance in the innovation process or the weakest link. This does not fit in well with the relevant literature that states that balance in the innovation process should have a clear positive relationship with innovation success. Both Hansen and Birkinshaw (2007), Cooper and Kleinschmidt (1986) and Dervitsiotis (2011) point towards balance as important for innovation success. Hansen & Birkinshaw (2007) and Birkinshaw, Bouquet and Barsoux (2011) also argue strongly that the weakest link in the innovation process will determine innovation success, and that improving this link will lead to a better balance and thus success. Our findings cannot support this argument, but again, the result does not reject it either. This means that innovation success to a large degree depends on the average score of the innovation process with the effect of balance still undetermined. Our research question was to uncover how balance of the different parts in the innovation process affects innovation success. The above-mentioned finding indicates that the balance may not affect innovation success as much as the average score affects innovation success, meaning that managers could improve any part randomly without considering the balance and still improve innovation success.

This is nevertheless a truth with modifications. Even though we do not find significant support for the proposition that balance affect innovation success, the fact that both the regression analysis and the relationship between innovation success and variance is in the negative direction indicates that there might be a relationship even though there is a relatively large probability for these results to have occurred by chance. The function from our regression analysis even points to an exponential relationship between the variable balance and success, which means that variance will contribute to amplifying the negative effect on innovation success as it increases above 1. This function is, for large variances, difficult to apply on our dataset. As mentioned earlier, should the variance reach its maximum of 3,5 then the regression function would calculate innovation success as less than -230. This is far outside the possible range of [0,5] predetermined in the survey. Therefore, the interesting part is the exponential relationship, not the exact function. The fact that balance has a stronger and stronger impact on success as it becomes more unbalanced is in fact very interesting. It is also in line with what our logic proposes even though the regression is based on data that is sparse both when it comes to breadth in responses and types of firms. For this type of function to represent reality and fit with the bounds on all variables, it would be needed to either decrease the coefficient or the power of the variance-variable. If the findings of our regression analysis and correlation between balance and innovation success are true, they will provide support for Hansen and Birkinshaw (2007), Dervitsiotis (2011) and Cooper and Kleinschmidt (1986), verifying empirically that managers also need to keep an eye on the internal development of the innovation process to maximize innovation success.

Nevertheless, our data cannot conclude, as the findings are insignificant. Few of the studies and literature found in our literature review have done quantitative analysis to verify their results, but merely suggested what is important and why. They provide the frameworks and thoughts based on theory but do not back up their findings with empirical data. This could make our findings important, if the sample is good enough, as it provides more credibility to existing research. For managers this will be in favor of managing the innovation process more tightly and provide rationale for surveys such as the one proposed by Rao and Weintraub on a regular basis, and possibly to include a formal approach such as e.g. “Stage-Gate” (Cooper, 1990) or the “Innovation Management Life Cycle” (Bassiti and Ajhoun, 2013). It will also highlight the importance of developing research on all the phases of innovation process, and not only on e.g. the ideation part, which already has a significant body of literature.

Balance at different averages

Our initial assumptions and arguments in favor of balance in the innovation processes having more to say when it comes to innovation processes with a higher average are, as noted above, challenged. As our data showed, respondents that score their innovation process lower on average, has a larger negative relationship between balance and innovation success. If these findings are true, an alternative explanation based on our own speculations can be that in a firm with a low average, an unbalanced process would have a larger impact due to the poor quality of some parts of the innovation process. At a very low average level, some parts might not be developed at all, or they are so poor that no system is in place to handle the inflow to that part of the process. Imagine for example a process where they are good at generating ideas, but terrible both at shaping them into products and launching them to the market. The ideation process could both decrease moral as no ideas are developed into products, and resources will be spent on work that gets nowhere. In another company with an equally unbalanced process they are magnificent at developing ideas, but only good at shaping them and launching the new products. As they have developed all parts of their process, the possible negative effects connected to ideas not being developed could to some degree be mitigated. The firms with a high average have a system in place that can transform the ideas into innovations and are not that dependent on balance to have innovation success. On the other hand, the firms with a low average benefit more from balancing their innovation process, as they could be in dire need to develop the missing parts of a system for capturing value from their ideas. This explanation is the opposite of what we proposed and anticipated, as we thought balance would have a larger impact on innovation success as the average scores increased. Our argument for this statement was as noted earlier in the thesis, that it does not help to have balance when nothing is working. At low averages, we thought it would make more sense to make some part better, rather than focusing on all at once. Our data indicates that this is not the case.

Contributions and implications

Our findings make some contributions to the literature regarding innovation processes. They are also valuable for managers, as they provide guidelines for what contributes the most to innovation success. These findings could be used to determine how resources could and should be distributed to different initiatives in the innovation process. We will first elaborate on the contributions to the literature before we sum up the managerial implications.

Contributions to theory

As noted earlier in our thesis, literature with empirical data regarding how one should balance the innovation process and distribute resources to get the most innovation success for their efforts is very scarce. Our thesis in such contributes to this area of research with a starting point from which one could develop even more sophisticated and comprehensive results. Our thesis has uncovered challenges for doing empirical research on our subject, and uncovered what aspects that are necessary to include making valid conclusions in regard to our research question. To be able to generalize and provide results that are more reliable and significant, researchers need to take into account the limitations and aspects elaborated on in our further research chapters. In such, this thesis can be used to provide a head start for researchers wanting to explore the same areas as the authors of this thesis.

The literature review has covered a vast amount of the theory, making good arguments for what the innovation process consists of and why each part of the process is important. Still, no consensus is reached regarding the innovation process composition. Our thesis also provides empirical evaluation of some of the stances posed by different authors. As we do not find support for the propositions arguing for the importance of balance in the innovation process (Dervitsiotis, 2011; Birkinshaw, Bouquet and Barsoux, 2011; Cooper and Kleinschmidt, 1986; Hansen & Birkinshaw, 2007) and that the weakest link will work as a bottleneck (Hansen & Birkinshaw, 2007), the papers supporting these stances are being questioned.

Even though we do not find support for some of the hypotheses it does not mean that we reject them, but that they should be tested with a larger sample that is significant enough to make generalizable conclusions. Although some of our propositions (P2 and P3) based on theory failed to find support in our dataset, the average score of the innovation process factors is significantly positively related to innovation success (P1). This is an addition and extension of existing theory, and shows that improvements in the innovation process will contribute to innovation success no matter what part of the innovation process that is enhanced. This is contrary to the notion regarding balanced levels and how the weakest link will set a ceiling for contributions for perceived innovation success as proposed by Hansen & Birkinshaw (2007). The fact that the average scores of the innovation process is significantly correlated with innovation success might not come as a surprise as it feels intuitive that improving the innovation process increases the innovation success.

Managerial implications

For managers our findings are important for several reasons. The average is correlated with perceived innovation success without any significant penalties for an unbalanced process or the boundaries set by a weakest link. This holds as long as the process is moderately balanced, and thereby gives managers the freedom to choose which parts of the innovation process to improve. With this in mind, managers wanting to maximize their innovation success through the innovation process should stimulate the factors with the highest benefit-to-cost ratio. They will improve the part of the process that increases the average to the lowest cost per increase. This makes for a simpler decision-making process for managers, as they do not have to take into consideration aspects that would be more difficult to evaluate on a regular basis. This applies where the process is moderately balanced, and the variance in the scores is not above 1, as unbalance above this threshold yields increasing negative returns on innovation success. Even though variance is not significantly negatively correlated, both the correlation coefficient and the coefficient in the regression analysis indicate a weak negative relationship with innovation success. As a result, managers therefore cannot only consider the increase in the average when variance is large. For organizations with a reasonably balanced innovation process where all parts are attended to, this can still be used as a rule of thumb. Managers should evaluate their innovation process intermittently to assess whether some parts are being overdeveloped, and thereby could reduce their impact on innovation success as variance increases. The benefit-to-cost ratio is still valuable as an evaluation criteria, but assessing variance and factor scores which is needed to do this is much more time consuming and complex than increasing a random part according to the lowest cost. These results are visualized in figure ?? where we can see the plane bending downwards with variances>1, affecting the perceived innovation success severely. Our dataset does not contain data points with such large variances but the trend is for this relationship to increase. Further research is needed to uncover the true function of this multivariate relationship.

Even though our findings do not unequivocally support that the balance is as important as stated, or that the weakest link should impose limits on innovation success, we nevertheless cannot reject these propositions based on our data. Managers should therefore not use our conclusions to increase innovation process factors randomly, assuming that the average is the only thing that is important, but could uses this as a rule of thumb if they know that their efforts are approximately balanced. If managers are to focus on any particular part, our research points towards the end of the innovation process as most important for innovation success. This is based on our findings, which indicate that the *capture* factor of the innovation process is most associated with innovation success. As it does not meet our criteria for making conclusions, the implications for managers can not be stated with certainty, but they are very much in line with what Govindarajan and Trimble (2010) conveys in their book “The Other Side of Innovation: Solving the Execution Challenge “. Focusing too much on ideation, and too little on implementation makes it hard to capture value from the innovation initiatives.

“Innovation is 1% inspiration, 99% perspiration” -Thomas Alva Edison

As a byproduct, our findings also contribute to managers by giving them a thorough analysis of the most important literature on the subject of innovation processes. The theory section of this thesis summarizes what aspects are important for a good innovation process and why they are important, in addition to pointing out best practices among best practitioners. The use of frameworks such as Rao & Weintraub’s innovation culture assessment also gives managers the tools necessary to evaluate their own innovation culture and identify their weakest areas. Knowledge of what constitutes an innovation culture makes managers and employees more aware of the factors that are important to sustain and foster innovation. This thesis will bring such knowledge to the reader and put the subject on the agenda. It also makes for a good starting point if managers wish to put hard numbers on their innovation culture and assess improvements in their innovation process or innovation success over time, providing a foundation for evaluating initiatives.

Nevertheless, best practitioners have an innovation process and tend to each part of it, making sure that they are both good at ideation, shaping and capturing. The findings in our thesis do not find reasons to reject this approach as a sensible solution to innovation process management and confirms that innovation processes indeed exhibit a positive relationship to innovation success.

Limitations

The paper is the first empirical study covering the relationship between innovation processes and innovation success. As the survey is both created and distributed in a manner that ensures reliability and validity to the results, this reinforces our findings. Nevertheless, the survey asks for individuals' perception of how their organization performs at a company level. This means that our results only can be valid for the relationship between employee's perception of the innovation process and their perception of its organization's innovation success. Even though it is likely that the actual success of the company and individuals perceptions to a large degree are aligned, our findings can only to a limited degree say something about innovation success at firm level based on our unit of analysis that is at the individual level. To be able to do so, one would need a much larger pool of respondents from more companies than the four that participated in our survey. On the other hand, since we have enough answers to make significant claims on an individual level, one could argue that these are also valid at a company level as long as one takes into account the bias from having so few companies.

Another limitation is the fact that perceived innovation success is not equal innovation performance. In such, one could imagine having high perceived innovation success but actually perform low on innovation activities. Self-reporting measures are often used in social studies, as they are easier to implement. Numbers measuring innovation performance in form of sales of new products and alike were not easily obtainable. This makes self-reporting measures the only choice, even though they are prone to several limitations. The fact that the respondents are asked to rate their company's performance might mitigate some of the dangers connected to under or over reporting. One does not have the same incentives for doing so when the results are not directly connected to one's person. Still, one cannot be sure that the respondent has the same interpretation of the survey question as the researchers, thereby being unable to give a good answer and instead try to answer what they think will benefit the company or answer what they think is expected (Austin, Deary, Gibson, McGregor, & Dent, 1998). The direction of the inconsistency is also hard to make assumptions about a-priori. In general, the notion of bias in self-reporting measurements is complex and hard to understand, and proper methods for dealing with this bias are still in development (Donaldson & Grant-Vallone, 2002).

Since our data shows relatively large internal correlation between factors and the fact that innovation success is highly correlated with other factors of the innovation culture, makes it hard to pinpoint the exact effect innovation processes has on innovation success and what causal relationships that exist. In line with Rao & Weintraub's assumptions, all building blocks of innovation seem to be correlated with innovation success at a relatively equal level. Even though we found a relationship between the innovation process and innovation success, it might be that the scores on innovation processes are a result of other variables, thereby mediating the effect. It could be that e.g. a good innovative leader is the true driver of innovation success, and that with a good leader comes good processes that lead to innovation success. A good innovation process could also very well be a moderating variable. In such it could enhance or reduce the effect other variables has on innovation success. If we imagine that the true source of innovation success lies within their innovative leader, and that other factors might be moderating the effect the leader has on innovation success, then the innovation process could serve as a moderating variable. This could either increase the effect of an innovative leader if the process is good or reduce it if bad. As we in our thesis deal with perceptions of how developed parts of the innovation process are and whether the organization has innovation success, our findings depend on the individual's ability to represent the actual reality. It is likely that these perceptions are influenced by other factors in the work environment not covered by Rao & Weintraub's framework. As noted, our research cannot say anything about the causal relationship that are working, but merely that some aspects tend to vary simultaneously.

Our research is also prone to selection bias as some of the firms were pre-selected. As a result, we were not able to reduce the impact of variables such as size, age and industry. This leads to more uncertainty concerning the validity of our findings, as they are not from a random sample within our pool of firms in Norwegian industry. Another problem with a non-random sample is that the companies themselves chose to participate in the project. As mentioned earlier, this means that the companies may be less representative than the rest of the pool as they are more focused on innovating than their peers. The survey also suffers, as it does not measure the constructs and variables in different ways, meaning that we do not have the possibility to ensure validity. If the survey measures the constructs in different ways, we could have performed e.g. a Cronbach Alpha-test to check for internal consistency.

Concerning our regression results in connection to H5, the goodness of fit is not at a level at which anything can be said with certainty. These results, and the accompanying function, will therefore only be an indication of how this relationship could be modeled. Small variations in the dataset could yield different functions, and even the choice of which outliers should be removed, or how missing data should be treated would alter the functions characteristics. This presented function is nevertheless the one with the best fit based on our data and our treatment of it.

Due to the limited amount of time to conclude this thesis, we were not able to test and retest the respondents, meaning that we cannot ensure reliability over time. This would, in combination with providing several questions for each construct and the use of multiple methods, have been a way to reduce "common method bias" (Kamakura, 2010). Common method bias will result in variance resulting only from the use of common methods as noted by Kamakura (2010) "the fact that subjects are asked to report their own perceptions or impressions on two or more constructs in the same survey is likely to produce spurious correlations among the items measuring these constructs owing to response styles, social desirability, priming effects which are independent from the true correlations among the constructs being measured." (abstract). The fact that the questions are difficult and concerns very specific parts of the company's innovation process, may also result in random answers as the respondents are not able to give a qualified answer.

Further research

Our research provides a first effort in taking an empirical approach to establish the importance of different factors in the innovation process. Further research is needed to elaborate on the results and produce results that can be used to generalize from our findings. As most of our findings are insignificant and based on a small selection of different firms, further research needs to be done based on a sufficiently large sample that includes engaged participants for best results. A sample of at least 30 different firms is recommended, where all employees in each firm participate in the survey. By adding a set of predetermined hierarchical levels as a metadata question and identifying to what team/unit/division the employee belongs, one would also be able to identify relationships at a team/unit/division level more easily. In addition, the survey should have at least two ways of evaluating how well the firm performs a specific factor and how employees score innovation success. It would be an advantage if there were a possibility to retest these answers within a short time frame to check reliability. By this approach one could aggregate the average answers in a company and use the new sample of 30 companies in a correlation analysis on a company level. This will also make for a good foundation to perform regression analysis to uncover what type of function best describes the relationship between the average in the innovation process, the balance in the innovation process and the innovation success.

Our efforts in determining the above mentioned function could be argued for using logic, but does not have a sufficiently large dataset to convince us that it truly represents the researched relationship. Future researchers need to include firms from all categories within the segment in the dataset. Companies covering the entire scale, from good innovators, to poor innovators, large and small companies and companies with differing geographical location, differing products and different sub-industries need to be represented. Our dataset was to a large degree represented by companies that are moderately good at innovating, making our findings hard to generalize, and the breadth of answers low. The problem with results and scores that average to the mean represented a challenge when correlating, but with a sufficiently large sample, even small differences would be significant.

Conclusion

In this thesis we have explored the relationship between the innovation process and innovation success, and more specifically how the balance of the factors within the innovation process affects innovation success. We used Rao & Weintraub's framework for innovation culture to describe the innovation process, and also drew parallels to Hansen & Birkinshaw's IVC.

Based on a thorough literature review of the subject we established that there are three different perspectives describing this relationship. (1) That one of the innovation process factors are more important than others, (2) that the weakest link in the innovation process determines innovation success and (3) that the balance of the different factors is most important for innovation success. By doing cross-sectional research and evaluating different firms based on self-reporting measures concerning their innovation culture we found that neither of these perspectives could be supported with our dataset. Nevertheless, we found significant support for the relationship between innovation process and innovation success. We cannot say with certainty if any of the above perspectives are correct, but the data were most in favor of the perspective (1), while perspective (2) and (3) found little support although they revealed some tendencies. The results in this thesis challenge the assumptions from theory as we expected the balance to be of more importance than the data revealed.

Even though we had a limited sample, our research has laid the foundations for future research and pointed out what aspects that need to be present to research this relationship further. We recommend that managers pay attention to their entire innovation process, and improve the parts where they get the most benefit per cost. As innovation processes seem to be tightly linked with innovation success, improving the innovation process should be an area of focus. For further research, we recommend a thorough approach with a large sample consisting of several firms and a survey tailored to measure constructs in different ways. By doing this, one should be able to make firm level conclusions and provide more generalizable results.

This thesis has, to our knowledge, been a first attempt to empirically find evidence for the relationship between the innovation process, the balance of its sub factors and innovation success. It confirms the foundation, namely that the innovation process is linked with innovation success, and suggests that there might be other characteristics that affect the outcome. Characteristics such as innovation process balance, and the strength of the capture factor in the innovation process might be valuable for creating superior innovation success, even though our research can make no definite conclusions. We encourage other researchers to explore this highly relevant and interesting subject further, and to use our thesis as a starting point for future research.

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Appendix

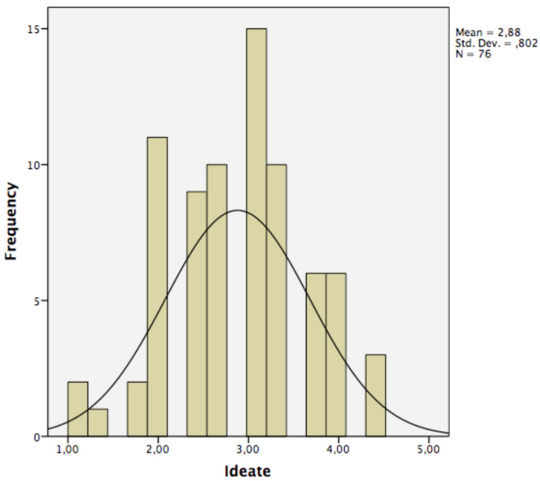
Appendix 1. All building blocks, factors, elements and question from Rao and Weintraub's (2013) framework. Survey questions are rated from 1 to 5 on a Likert scale.

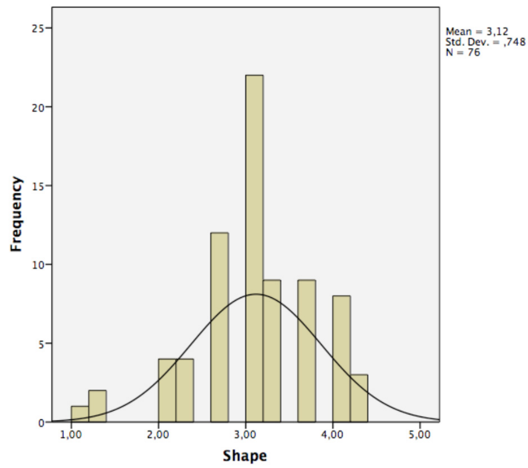
Building blocks	Factors	Elements	Survey questions
Values	Entrepre-neurial	Hungry	We have a burning desire to explore opportunities and to create new things.
		Ambiguity	We have a healthy appetite and tolerance for ambiguity when pursuing new opportunities.
		Action-oriented	We avoid analysis paralysis when we identify new opportunities by exhibiting a bias towards action.
	Creativity	Imagina-tion	We encourage new ways of thinking and solutions from diverse perspectives.
		Autonomy	Our workplace provides us the freedom to pursue new opportunities.
		Playful	We take delight in being spontaneous and are not afraid to laugh at ourselves.
	Learning	Curiosity	We are good at asking questions in the pursuit of the unknown.
		Experiment	We are constantly experimenting in our innovation efforts.
		Failure OK	We are not afraid to fail, and we treat failure as a learning opportunity.
Behaviors	Energize	Inspire	Our leaders inspire us with a vision for the future and articulation of opportunities for the organization.
		Challenge	Our leaders frequently challenge us to think and act entrepreneurially.
		Model	Our leaders model the right innovation behaviors for others to follow.
	Engage	Coach	Our leaders devote time to coach and provide feedback in our innovation efforts.
		Initiative	In our organization, people at all levels proactively take initiative to innovate.
		Support	Our leaders provide support to project team members during both successes and failures.
	Enable	Influence	Our leaders use appropriate influence strategies to help us navigate around organizational obstacles.
		Adapt	Our leaders are able to modify and change course of action when needed.
		Grit	Our leaders persist in following opportunities even in the face of adversity.

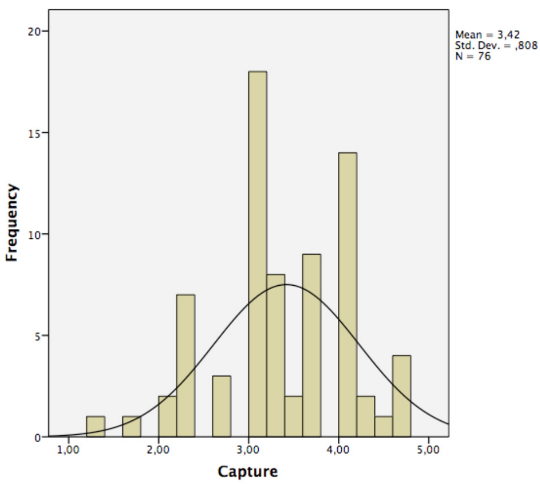
Building blocks	Factors	Elements	Survey questions
Climate	Collabora-tion	Community	We have a community that speaks a common language about innovation.
		Diversity	We appreciate, respect and leverage the differences that exist within our community.
		Teamwork	We work well together in teams to capture opportuni-ties.
	Safety	Trust	We are consistent in actually doing the things that we say we value.
		Integrity	We question decisions and actions that are inconsistent with our values.
		Openness	We are able to freely voice our opinions, even about unconventional or controversial ideas.
	Simplicity	No bureau-cracy	We minimize rules, policies, bureaucracy and rigidity to simplify our workplace.
		Account-ability	People take responsibility for their own actions and avoid blaming others.
		Deci-sion-mak-ing	Our people know exactly how to get started and move initiatives through the organization.
Resources	People	Champions	We have committed leaders who are willing to be cham-pions of innovation.
		Experts	We have access to innovation experts who can support our projects.
		Talent	We have the internal talent to succeed in our innova-tion projects.
	Systems	Selection	We have the right recruiting and hiring systems in place to support a culture of innovation.
		Communi-cation	We have good collaboration tools to support our inno-vation efforts.
		Ecosystem	We are good at leveraging our relationships with sup-pliers and vendors to pursue innovation.
	Projects	Time	We give people dedicated time to pursue new opportu-nities.
		Money	We have dedicated finances to pursue new opportuni-ties.
		Space	We have dedicated physical and/or virtual space to pursue new opportunities.

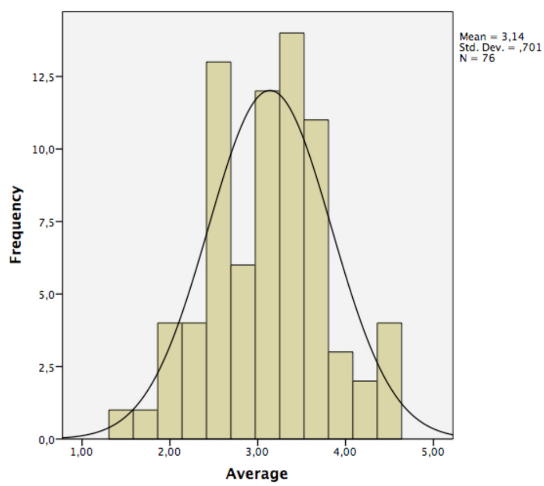
Building blocks	Factors	Elements	Survey questions
Processes	Ideate	Generate	We systematically generate ideas from a vast and diverse set of sources.
		Filter	We methodically filter and refine ideas to identify the most promising opportunities.
		Prioritize	We select opportunities based on a clearly articulated risk portfolio.
	Shape	Prototype	We move promising opportunities quickly into prototyping.
		Iterate	We have effective feedback loops between our organization and the voice of the customer.
		Fail smart	We quickly stop projects based on predefined failure criteria.
	Capture	Flexibility	Our processes are tailored to be flexible and context-based rather than control- and bureaucracy-based.
		Launch	We quickly go to market with the most promising opportunities.
		Scale	We rapidly allocate resources to scale initiatives that show market promise.
Success	External	Customers	Our customers think of us as an innovative organization.
		Competitors	Our innovation performance is much better than other firms in our industry.
		Financial	Our innovation efforts have led us to better financial performance than others in our industry.
	Enterprise	Purpose	We treat innovation as a long-term strategy rather than a short-term fix.
		Discipline	We have a deliberate, comprehensive and disciplined approach to innovation.
		Capabilites	Our innovation projects have helped our organization develop new capabilities that we did not have three years ago.
	Individual	Satisfaction	I am satisfied with my level of participation in our innovation initiatives.
		Growth	We deliberately stretch and build our people's competencies by their participation in new initiatives.
		Reward	We reward people for participating in potentially risky opportunities, irrespective of the outcome.

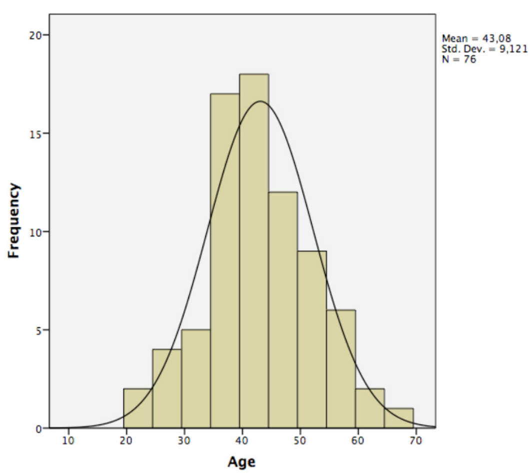
Appendix 2. Histograms showing distribution of collected data for H1 - H5.

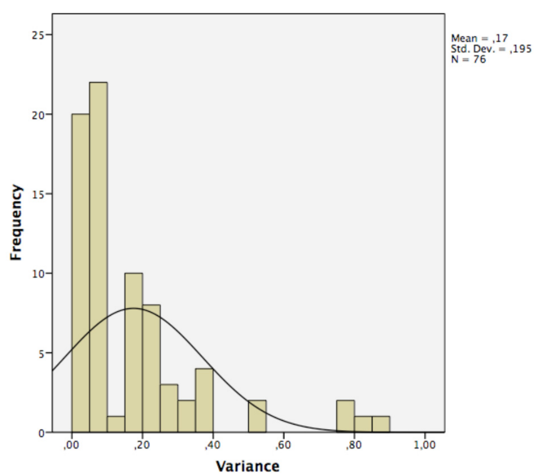










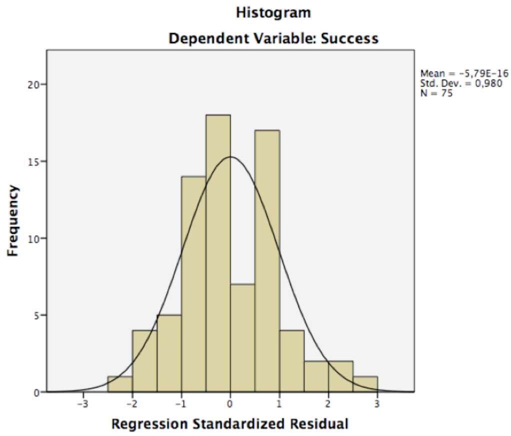


Appendix 3. Regression with dependent variable Success and independent variables ideate, shape and capture for H2.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	,785	,249		3,153	,002	,288	1,281		
	Ideate	,133	,100	,140	1,324	,190	-,067	,333	,438	2,285
	Shape	,217	,113	,213	1,927	,058	-,008	,441	,400	2,502
	Capture	,505	,098	,535	5,150	,000	,310	,701	,451	2,216

a. Dependent Variable: Success



Appendix 4. Regression with dependent variable Success and independent variables average and variance for H5.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	,913	,253		3,614	,001	,409	1,417		
	Average	,852	,078	,784	10,917	,000	,697	1,008	,992	1,008
	Variance5	-,705	,636	-,080	-1,108	,271	-1,972	,563	,992	1,008

a. Dependent Variable: Success