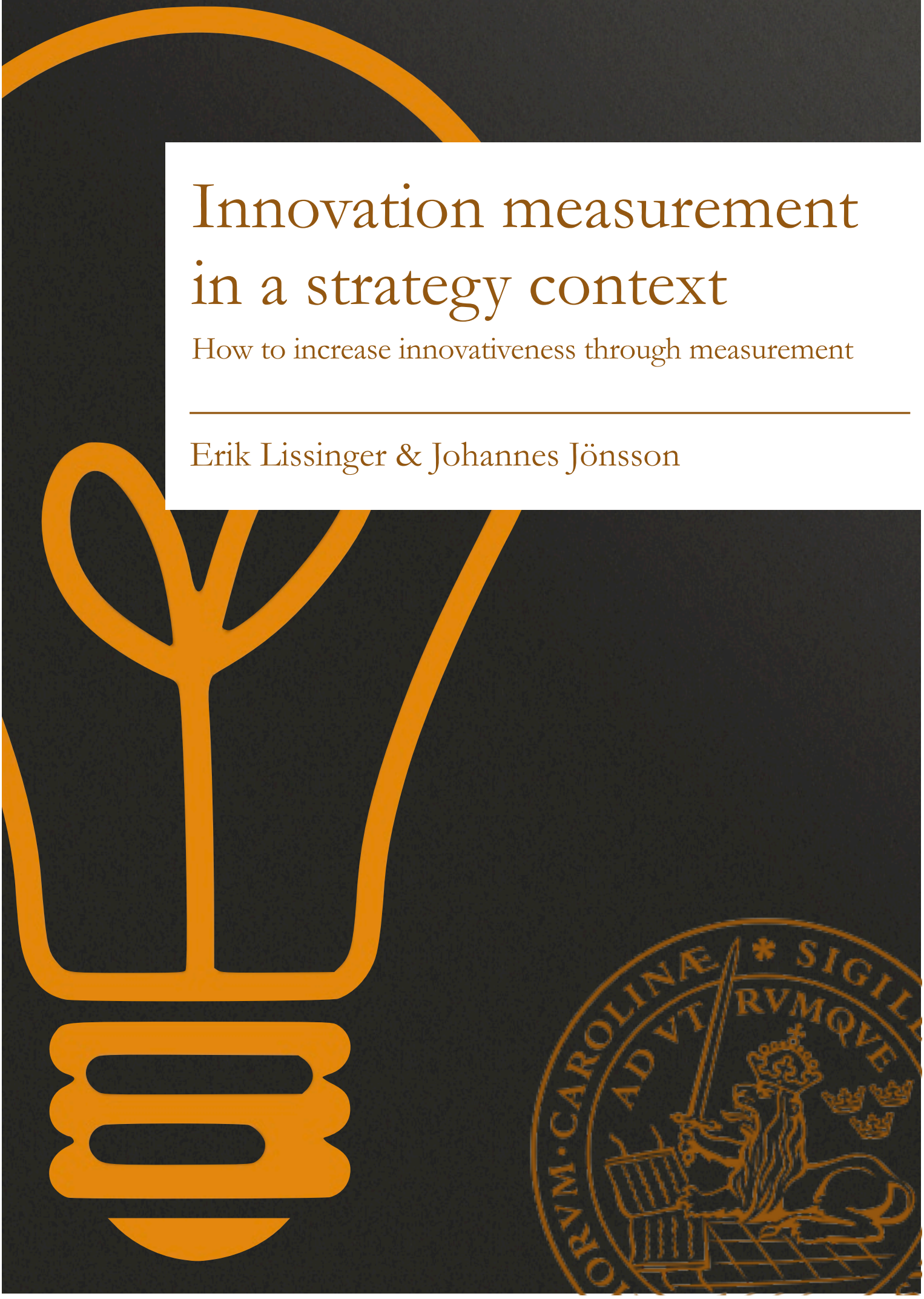
Innovation measurement in a strategy context

How to increase innovativeness through measurement

Erik Lissinger & Johannes Jönsson



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Master Thesis

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LUND UNIVERSITY

Innovation measurement in a strategy context
- How to increase innovativeness through measurement

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Master Thesis, Technology Management – Nr 252/2013
ISSN 1651-0100
ISRN LUTVDG/TVTM−13/5252−/SE

Printed in Sweden by Tryckeriet i E-huset, Lund.

Abstract

Title Innovation measurement in a strategy context
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Issue of study Recent innovation measurement literature recognizes the need for uniqueness and suitability in a company's innovation activities. Previous contributions construct a measurement framework with examples of metrics for the intended company to choose from. But recommendations are sparse on how to select which to use and how they will affect the organization. It is here a gap is identified in the current literature; no real attempts have been made to relate innovation measurement against innovation strategy. The importance of linking strategy and performance measurement has been stressed by many authors and it can be said to be an agreement that the internal innovation process should look differently depending on what type of innovation that is intended i.e. incremental or radical. With this in mind, it follows by logic that measurement should be fitted to the intended innovation outcome accordingly. The aim with a mapping like this is not to create predefined sets of metrics for practitioners to choose from, but rather to outline guidelines for how to select metrics contingent on innovation strategy.

Purpose The purpose of the thesis is to outline guidelines for how to work with innovation measurement contingent on innovation strategy.

Methodology First, a literature review was conducted to gain insight into the theoretical areas of innovation, innovation strategy and performance measurement. This was followed by semi-structured interviews with representatives from four case study companies, to understand the hurdles they were facing with innovation measurement. Further interviews were conducted with experts with experience of innovation measurement, which was used as a condensed complement to the theoretical areas studied. The knowledge gained through theory and interviews were then synthesized into a set of guidelines, a framework and a tool, all which are intended to aid practitioners in their innovation measurement effort.

Conclusions The biggest hurdle for measuring innovation identified through the study, was that the inherent complexity of the innovation process leads to uncertainty of what and how to measure. Practitioners struggle when trying to implement an all-inclusive measurement system, which leads to the attempts being futile. It is argued that a better approach is to start small and focus on adding attention to the weakest part of the innovation process by using only a small set of metrics related to that area. This approach is not a way to monitor the innovativeness of an organization but aims to strengthen its innovation process from the core.

Keywords Innovation, strategy, innovation management, innovation measurement, performance measurement

Preface

The production of this thesis has been a very interesting process that ended at a place we could not anticipate when we started. The area of innovation has been present throughout the duration of our studies, and to be able to further deepen our knowledge within this field has been very rewarding and is something that we will carry with us in our future endeavors.

First, we would like to thank our supervisors, Andreas Larsson and Fredrik Häglund for the discussions and knowledge provided. Your support has helped us along the way, both through inspiration and feedback, which in turn has pushed us further and made our thesis better. Secondly, we thank our opponents Emma Petersson and Linda Runesson for providing us with thoughtful constructive feedback, which helped us fine-tune the thesis.

Finally, we wish to direct our gratitude to the experts and company respondents for letting us conduct the interviews, which provided us with interesting insights into working with innovation in practice. This thesis would not have been made possible without your help.

Lund, May 2013

Erik Lissinger and Johannes Jönsson

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1 Introduction

The introductory chapter will present a background to the subject, followed by the problem discussion and purpose of the thesis. A more detailed disposition of the thesis will then be outlined together with its delimitations.

1.1 Background

> "In the creative economy, innovation is more important than ever. Innovation is the only insurance against irrelevance." (Hamel and LeBarre, 2012)

Innovation is a hot topic and the interest for innovation from both practitioners and the academic sector has increased dramatically over the last few decades (Benner, 2005). Just looking at the amount of scholarly articles published annually with the word "innovation" in the title, it has increased tenfold since innovation studies emerged as a separate discipline in the 1960's (Fagerberg, 2006). It seems like everyone wants to be —or claims to be— innovative, ranging from public institutions such as hospitals to private sector start-ups as well as global corporations. This trend is not that surprising as there is a strong economic incentive to be innovative today. Previously, innovation was seen as one of many ways to gain a competitive advantage. Today, it is a complete necessity for your company to survive the margin-crushing competition (Brown & Eisenhardt, 1995; Hamel & LeBarre, 2012). As all your competitors claims to be innovative, so do you, as you otherwise would lose shareholder interest when investors doubt your ability to stay ahead of the game.

As investment is a game of uncertainty, conveying confidence through innovation in the market is key to gaining the investors' trust (Kilroy, 1999). So even though all companies do not know how to be innovative, most have increased their focus on the matter (Christensen, Raynor & Anthony, 2003). This is manifested in the ever increasing amount of Chief Innovation Officers, more talk about innovation in annual reports and the increase in innovation focused courses in the curriculums at academic institutions (Kwoh, 2012). The question is if these initiatives really are leading to any significant and sustainable change within

organisations or if it is just window dressing. Every now and then a new management hype surfaces, which is said to "completely redefine the business environment". Although some credit must be given to practices such as business process reengineering, they seem to come and go and every time in a new shape or form (Kuczmarksi, 2003). Innovation is something different. Innovation has been in the centre of attention since economists started debating on the matter of economic growth (Trott, 2012). Although there still is an on-going debate on how innovation affects growth, it seems beyond dispute that it is of integral importance (Verspagen, 2006). So, innovation in companies is definitely not something new, it has been around for ages, but recent changes in market dynamics due to the positive feedback loop based on the current innovation hype has given it a salient position in the company's competitive portfolio (Weerawardena, O'Cass & Julian, 2006).

There are evident reasons for both the private sector with its competitive focus and others such as governments with an aim for economic growth to increase their knowledge of innovation. But a large hurdle to acquire this knowledge is the current inconsistency in describing and defining the innovation process (Hagedoorn & Cloodt, 2002). What might be an innovation in one industry or firm might be regarded as something completely lacking novelty in another. The sheer complexity of innovation and the breadth of the topic have led to vast and fragmented body of research. Wolfe (1994:p405) argues, "[T]he most consistent theme found in the organizational innovation literature is that its research results have been inconsistent". However, what research does have in common is the perceived importance of the topic.

Lawson and Samson (2001:p378) amongst others claim that "successful innovation contains core elements and processes, regardless of the industry or firm". Several descriptive studies have been made to study successful innovators to find the holy grail of innovation such as Tom Peters and Robert Waterman's *In search of excellence* from 1982 (Peters & Waterman, 1982). This type of best practice evaluation implies that there are some actions that can be taken by firms to reach maximum innovativeness, irrespective of the company context. In contrast to this unitary view, research based on contingency theory claims that innovation instead is industry specific or even company specific (Lam, 2006). Contingency theory argues that the most appropriate way to for instance innovate is the way that best fits a given company characteristic, e.g. organizational structure or market maturity. When many of the companies listed as excellent innovators by Peters and Waterman (1982) started to falter after a few years, a company specific innovation process made sense. As Hansen and Birkinshaw (2007:p1) argues, "Beware

conventional wisdom about how to boost your innovation capacity. Every company has unique innovation challenges. So another firm's best innovation practice could become your worst nightmare." Consequently, there is likely no one size fits all generic solution to the innovation conundrum.

Innovation is by many companies regarded as a black box phenomenon which might be the reason to why it is handled differently from other organizational processes (Kline & Rosenberg, 2986; Muller, Välikangas & Merlyn, 2005). Innovation stands out as a very complex process and despite attempts towards standardization such as Cooper's stage-gate model for new product development (NPD) (Cooper, 1990), it must still be regarded as non-sequential (Kline & Rosenberg, 1986; Adams, Bessant & Phelps, 2006). For most other processes, a performance measurement system is a commonly used management tool for planning and follow-up (Lindvall, 2001). There are several benefits of using such as system and from a knowledge perspective it leads to a better understanding of how a process works and how to control it (Bohn, 1994). In a McKinsey Global Survey from 2008 (Chan, Musso & Shankar, 2008), on average, respondents from a wide range of industries attributed as much as 30% of their organic growth to innovation. The growth was perceived to be even higher by those who had a well-developed innovation measurement system in use that was closely linked to their strategy. Despite this, the current innovation performance level is not measured as rigorously as for other processes (Andrew, et al. 2009; Källman & Sandqvist, 2012). There are many reasons for this, one suggestion being the difficulty of quantifying and gaining a correct measure (Smith, 2006; Källman & Sandqvist, 2012).

1.2 Problem discussion

Recent innovation measurement literature recognizes the need for uniqueness and suitability in a company's innovation activities (e.g. Dávila, Epstein & Shelton, 2006; Källman & Sandqvist, 2012; Nilsson, et al. 2010). All these contributions construct their own measurement framework with examples of metrics for the intended company to choose from. But recommendations are sparse on how to select which to use and how they will affect the organization. Previous research on contingency factors and innovation has focused on environmental uncertainty, organizational size, industrial sectors, types of in- novation, and stages of innovation adoption (Damanpour, 1996). It is here a gap is identified in the current literature; no real attempts have been made to relate innovation measurement against innovation strategy. The importance of linking strategy and performance measurement has been stressed by many authors (e.g. Kaplan &

Norton, 1992; 1996; Simons, Dávila, & Kaplan, 2000) and it can be said to be an agreement that the internal innovation process should look differently depending on what type of innovation that is intended i.e. incremental or radical (Nicholas, Ledwith & Perks, 2011; Nilsson, et al. 2012). With this in mind, it follows by logic that measurement should be fitted to the intended innovation outcome accordingly. The aim with a mapping like this is not to create predefined sets of metrics for practitioners to choose from, but rather to outline guidelines for how to select metrics contingent on innovation strategy. Furthermore, most research on innovation measurement lacks a connection to current knowledge within performance measurement, strategy and the link between these areas. Today, there exists a vast body of knowledge within these fields, but when developing innovation metrics they have been regarded separate from other management metrics. By combining this knowledge with the process of evaluating innovation metrics, the intention is to add a dimension that hopefully can bring new insights into the matter.

1.3 Purpose

The purpose of the thesis is to outline guidelines for how to work with innovation measurement contingent on innovation strategy.

1.4 Delimitations

The thesis will not try to give an all-embracing answer to the question if performance measurement in general, and innovation measurement particularly, improves the innovation activities within an organization. That is something that is already assumed.

1.5 Disposition

First, the methodology for the thesis will be presented to give the reader an understanding of the work process and methods chosen. Second, the theoretical part will function as a foundation for the subsequent report and work partly as a literature study to synthesize the fragmented literature on the subject, and partly work as a way to build a tentative framework for the analysis. The empirical section consists of the information gathered through interviews at the selected case study companies and with experts. In the analysis the theoretical framework will be combined with the empirical findings to help answer the purpose of the thesis. Lastly, reflections from the work process will be presented in the concluding part of the thesis.

2 Methodology

This chapter deals with methodological questions such as chosen research strategy and how to ensure trustworthiness of the study. The theoretical and empirical approach is presented together with an explanation of how the analysis was conducted.

2.1 Research strategy

According to Eisenhardt (1989), is a case study approach well suited for new research areas or for situations where the theory within an area is regarded as inadequate. The reason for this is the possible strengths that theory developed from case studies has like novelty, testability and empirical validity. As a consequence, the case study approach was chosen as research strategy as this helped to get a detailed and thorough understanding of the dynamics within the chosen setting (Eisenhardt, 1989; Bryman & Bell, 2005). The evidence from the case study could be both qualitative, quantitative or both, and is generally collected by combining different data collection methods such as archives, interviews, questionnaires and observations. As it is important to understand the innovation process and the concept of innovation to be able to measure it, a qualitative approach was regarded as most suitable. This implies that focus was placed on primary data from interviews instead of gathering and analysing quantitative data. This in turn enabled a deeper understanding of the mechanics of a company's innovation process, which aimed to aid the evaluation of possible discrepancies between current theory and the empirical findings of this study.

When conducting social science research, there are two dominant methods: the deductive and inductive method (Bryman & Bell, 2005). When following a deductive approach, one or several hypotheses are first formulated based on theory. These are then tested against the gathered empirical data. The inductive approach starts with an empirical data gathering, which then works as a basis for theory generation. As a combination of these approaches, the abductive research approach can be found. According to Dubious and Gadde (2002), an abductive approach is suitable if the objective is to make new discoveries. The approach constitutes a continuous interplay between theory and empirical findings throughout the work process. As case studies are argued to benefit from an

abductive reasoning method (Kovács & Spens 2005; Dubious & Gadde, 2002), this was the method chosen for the study.

2.2 Theoretical approach

The theoretical study had its starting point in a literature study reviewing articles covering the broader topic of innovation. This gave a general understanding of the subject and created a preliminary mapping of potentially relevant theoretical contributions. The review of articles followed a simplified systematic structure and focused mainly on aspects such as the amount of citations. The theoretical gathering was followed by an evaluation and categorization of the articles, which led to the grouping into three theoretical themes: innovation, innovation strategy and performance measurement (depicted in Figure 1). The three areas are closely related to each other, and it is here argued that all three has an integral part when discussing the aspects of innovation measurement. In-depth literature reviews were conducted within these theoretical themes to gain a deeper understanding of the areas and their relation. The theory was synthesized into a tentative analytical framework (see Table 4, p32), which was used as a foundation to identify discrepancies between theory and practice when conducting the case studies.

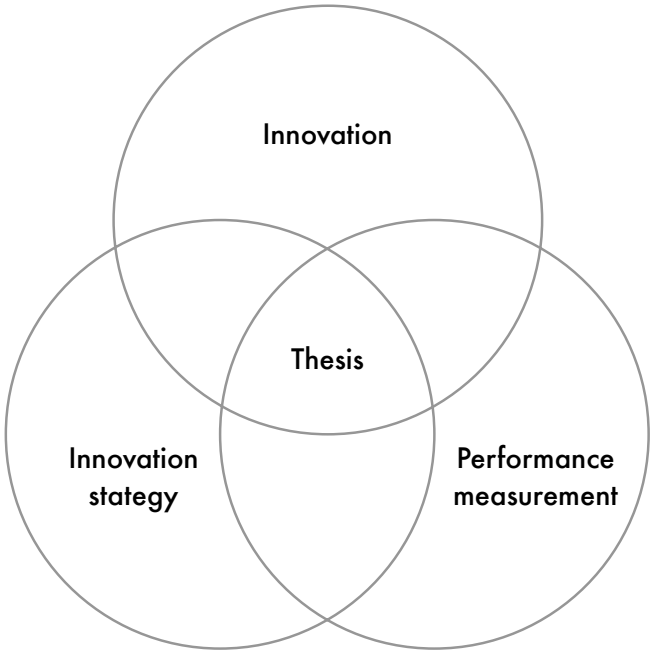

Figure 1. A Venn diagram illustrating the layout of the theoretical framework used in the thesis.

2.3 Empirical approach

When collecting empirical data for a case study, the most common techniques are interviews, observations and archival analysis (Höst, Regnell & Runeson, 2006). Due to the nature and purpose of the thesis, conducting interviews was decided to be most suitable for the research approach, and was therefore used as the main source of empirical data. Since the innovation effort in most companies is, and arguably should be unique, was the decision made to extend the empirical gathering to more than one company. There was thus no close collaboration with any single company, which ensured the objectivity of the study as it was less affected by internal stakeholders. The interviews were conducted by telephone and face-to-face with employees at selected case study companies as well as with experts experienced within the field of innovation measurement (interviewees are listed in Table 1). The empirical gathering started with interviews with company representatives to gain a practical understanding of how the selected theoretical themes were addressed in organizations. By using the tentative analytical framework (see Table 4, p32), it was possible to identify the main hurdles practitioners face when working with innovation measurement. Even though previous theoretical contributions provide their view of the difficulties, this was a way to see why practitioners had trouble overcoming them. The findings from the company interviews in combination with previous theory thus highlighted the issues that need to be addressed when creating guidelines for working with innovation measurement in practice. However, as the sample size was small, it was hard to draw general conclusions from the interviews, and a broader knowledge base was needed. By complementing with interviews with experts within the field of innovation, and innovation measurement in particular, more condensed information from a broad range of industries and companies could be gathered. All experts have several years of both theoretical and practical experience within innovation and could thus contribute with valuable insights.

2.3.1 Interview subject selection

When selecting case companies and interview subjects, mainly two considerations were taken into account. First, the company needed to be of considerable size. According to Andrew, DeRocco & Taylor (2009:p16): "Small companies often manage innovation less formally because there are fewer projects to track and fewer resources to allocate, and leaders can have a bigger impact". As the intention of the interviews was to understand how organizations in practice structure innovation with regards to measuring and strategy, larger companies with an established process were seen as more suitable. Second, to get a broader picture and ensure generalizability, companies in different industries were chosen. The

industries represented were: electric utilities, telecom and electronics manufacturing, automotive manufacturing and consumer goods. The range of industries was a result of the availability of companies willing or suitable to participate in the study. Some companies that were approached did not have any innovation activity in Europe, which ruled out interviews and others did not want to share information regarding their innovation process. But the final variety of industries was seen as sufficient as it covered a wide span of industry specific characteristics such as project lead-time. All company representatives interviewed held a managerial position and had good insight into the company's innovation process. As some of the interviewees did not want their company name to be disclosed, all company names have been substituted with fictive names. The selection of which experts to interview was apart from availability, based mainly on their previous contributions that were encountered during the literature review. All experts interviewed are based in Sweden and researches or works within the field of innovation measurement.

There is a high degree of homogeneity when considering the gender of the interviewees, as all experts and three out of four company representatives were male. This was obviously not an active choice and despite a small sample size, it could potentially be an indication of a male bias within the field of innovation. It is hard to argue whether or not this affects the empirical gathering, but it is noted as an interesting circumstance.

Table 1. The interviewees consisted of representatives from four case companies as well as four experts within the field of innovation and innovation measurement.

Companies	
Primatech	Telecom and electronics manufacturer
Water & Power Co.	Electric utility provider
Westcoast Inc.	Automotive manufacturer
ABC Industries	Consumer goods producer

Experts

Jan Sandqvist	Partner at Googol Business Navigator
Fredrik Nilsson	Professor at Lund University
Stefan Cedergren	Associate Senior Lecturer at Mälardalen University
Tobias Larsson	Chaired Professor at Blekinge Tekniska Högskola

2.3.2 Interview technique

The interviews were conducted either face-to-face or by telephone depending on the availability and geographic location of the interviewee and lasted between 30 and 60 minutes. A semi-structured approach was used during the interviews, were questions were asked regarding the three theoretical themes: innovation, innovation strategy and innovation measurement. The initial questions were followed by more specific questions depending on the answers received. The aim of the company interviews was to identify how they worked with innovation in practice and their use of innovation strategy and innovation measurement. More specifically the questions concerned:

- The company's practical work with innovation.
- Innovation strategy; if the company had one and how it was utilized.
- Innovation metrics and how the company worked with measurement of innovation; what metrics was in use and what difficulties had been experienced when working with measurement.

The expert interviews were based on the same questions to get their general input on the subject, though they were intentionally more controlled by the interviewee. This was a way to learn more about their current research and insights from several years of working with innovation and not restrict the interview to the questions listed above.

2.3.3 Quality of empirical approach

When working with empirical gathering, Bryman and Bell (2005) emphasize the importance of ensuring trustworthiness during a qualitative study. Trustworthiness can be divided into four subcomponents: credibility, transferability, dependability and conformability.

Credibility should be assessed to guarantee that the study has been done appropriately and that the social context has been interpreted correctly. One way to do this is by letting the respondents read and give feedback on the compiled material they were a part of.
Transferability refers to the degree to which the findings from the study can be generalized; is it possible to transfer the result to different contexts and circumstances? This is achieved by describing the context in a detailed way to give the reader a possibility to make up their own mind concerning the generalizability.
Dependability is the equivalent of reliability in quantitative research. To perform a dependable qualitative study, researchers should act as auditors to ensure that a complete description of all the phases of the process is created.
Conformability ensures that the study, to the greatest extent, is not affected by the researchers own backgrounds and opinions to avoid biased conclusions. This implies that it should be obvious when reading the report that the authors have not consciously let their own opinions affect the result.

During the empirical gathering the above-mentioned criteria were followed to maintain a high study quality. One example of how trustworthiness was ensured was to send the interview material to the participants to receive their feedback and approval. Furthermore, both authors were always present when conducting interviews, so that their educational backgrounds or opinions would not influence the following analysis. This in turn increased the conformability of the thesis. Since the case companies are multinational and are of similar size, the findings could be generalized within these settings.

2.4 Analytical process

In the initial literature review, a basic understanding for the areas of interest was developed which provided a tentative analytical framework. This framework consisted of key aspects based on the three broad theoretical themes; innovation, innovation strategy and performance measurement. It was, in line with the abductive approach, continuously revised when new knowledge was gained through further literature reviews. The result was a tentative analytical framework that functioned as a frame of reference when conducting the interviews and was both complemented with best practice and used as a tool to identify discrepancies between theory and practice. The abductive process resulted in the guidelines presented in section 5.3, which consist of the condensed insights gained through the theory gathering and interviews. Finally, these guidelines were incorporated into a framework aimed at practitioners, which can be found in section 5.4.

3 Theoretical framework

The three theoretical areas of innovation, innovation strategy and performance measurement are presented. The first subchapter, which covers innovation, provides a terminological foundation and is intended to function as a general introduction to the concept of innovation. It is followed by theory on innovation strategy and performance measurement that combined creates the tentative analytical framework that can be found at the end of this chapter.

3.1 The anatomy of innovation

One of the biggest difficulties with innovation is the actual definition of the concept (Trott, 2012). As with any term without one universal explanation for what it means, it opens up for subjective interpretation. This adds to the already vast terminology within innovation research, as new views on innovation require new supporting concepts to explain these views. To avoid linguistic hair-splitting and semantics, no attempt to boil down all views into one single definition will be made, as that would be enough work for a separate thesis in itself. Instead, the following will be an explanation of the authors' view that innovation can be crudely differentiated according to four categories: type, degree of newness, amount of internal change and innovation impact. All categories will not be used explicitly in the subsequent chapters, although they are thought to be needed, to give the reader a fuller picture of the concept of innovation.

3.1.1 Types of innovation

When trying to untangle the definition clutter, the first and most fundamental cornerstone of the definition of innovation is usually to differentiate innovation from invention (Fagerberg, 2006). Commonly, an invention is seen as an idea or concept and an innovation as an implementation of that same idea (Fagerberg, 2006). The implementation can be either through commercialization of a product or introduction of a new process or business model within the firm. The roll out step is one of the few agreements of the definition and is important to keep in mind as it implies a more extensive process than just coming up with ideas, which is a common misconception. To actually take an idea all the way from an abstract

notion to a market ready product or process relies heavily on other capabilities than just coming up with ideas. Just to name a few, it demands both good market understanding as well as efficient production abilities. There is some debate whether an innovation has to be successful in the market to actually be regarded an innovation (Trott, 2012). Using the definition from the UK Department of Trade and Industry (DTI, 1998) that innovation is 'the successful exploitation of new ideas', it boils down to the question if successful means if the exploitation had market success or if it just succeeded to reach the market. The latter interpretation is chosen here which means that there can be both successful and unsuccessful innovations.

Diving deeper into the definition, the next natural step is to find what types of innovations there are. The Organisation for Economic Co-operation and Development **(**OECD) has produced three reports outlining guidelines for understanding and collecting innovation data which are often referred to for a contemporary categorization. The first report was published in 1992 and mainly focused on technological innovation but as the field of innovation research has developed, the original report has undergone two additional editions with the latest one published in 2005 (OECD, 2005), expanding the scope of what is considered to be an innovation. In the third report, four types of innovation are identified:

- Product innovation
- Process innovation
- Marketing innovation
- Organizational innovation

When juxtaposing to earlier categorizations such as that of Schumpeter (1934), which focused mainly on product innovation, it is easy to see that the definition has not narrowed; on the contrary, it is even broader than before. This might be an indication of the difficulty in defining the concept or that previous research has tended to focus on NPD, i.e. product innovation (e.g. Cooper & Kleinschmidt, 2007; Ernst, 2003), but has recently started to include other types of innovation as well (Adams, Bessant, and Phelps, 2006).

It can be concluded that the concept of innovation has widened to accommodate the developments of how business is conducted today, with non-physical activities such as services taking a larger part. What is not explicitly included in this categorization is the recent attention given to business model innovation (Mitchell & Coles, 2003). With accelerating change and new ways of doing business being

introduced through information and communications technology, a company does not only need to have a value capturing business model in place, it needs to be able to innovate it (Chesbrough, 2007). As a business model could include any or all of the above listed OECD categories, it does not fit properly in the current form of the categorization. So, the OECD categorization of innovation types benefits from an expansion by business model innovation for generalizability. In closing; there is really no need to distinguish further between different forms of innovations to be able to answer the purpose of the thesis, and the discussion of suggested categories presented above is seen to suffice.

3.1.2 The degree of newness

Having introduced various forms of innovation, it is of interest to know what is considered to be an innovation and for whom? All innovations need to include some form of novelty (OECD, 2005); the question is in what context it needs to be considered a novelty. The most widely used definition of innovation is according to Hage (1999), that it is the adoption of an idea or behavior that is new to the organization. OECD (2005) complements this by offering a broad three level differentiation where *new to the firm* is the minimum entry level for an innovation. The other two levels are *new to the market* and *new to the world*. Through this differentiation, it is clear that an innovation does not need to be completely new to be considered an innovation. Other authors are of another opinion, where a school of thought, based on Barnett (1953:p7), sees innovation as "... any thought, behaviour or thing that is new because it is qualitatively different from existing forms." This is in line with the OECD level of *new to the world* and is thus a much stricter definition of the required newness. Choosing a scope of the required newness is highly subjective but for the sake of generalizability *new to the firm* is seen as most suitable, which is the view of OECD (2005) and Hage (1999).

3.1.3 The amount of change: incremental or radical

Relating to the degree of newness, is the much-discussed concept of radical and incremental innovation. In line with the narrower view of newness, some authors (e.g. Leifer, O'Connor & Rice, 2001; Henderson, 1993) define the radicalness of an innovation on the basis of the extent of market impact. In contrast it is here argued that radicalness and market impact should be separated. If an innovation is to be classified as incremental or radical depends rather on internal conditions which is reasserted by Damanpour (1991:p561): "[Radical innovations] produce fundamental changes in the activities of an organisation and represent clear departures from existing practices, […][while] incremental innovations [ ] results in little departure from existing practices." It has thus less to do with the innovation's market impact even though a radical innovation causes a large impact with higher

probability (Dávila, Epstein & Shelton, 2006). The concepts are rather a way to describe what underlying factors of the current product or process that has been altered and to what extent.

The spectrum of incremental and radical innovation is often regarded as one-dimensional but Henderson and Clark (1990) recognize the need to extend the incremental-radical spectrum. They argue that an innovation is formed through changes to a product's core concepts and/or the linkages between those core concepts and components. The linkage between the amount of change and terminological outcome is shown in Figure 2. Worth noting is that the study of Henderson and Clark was based on a technology focused industry and thus predominantly covers only product innovation.

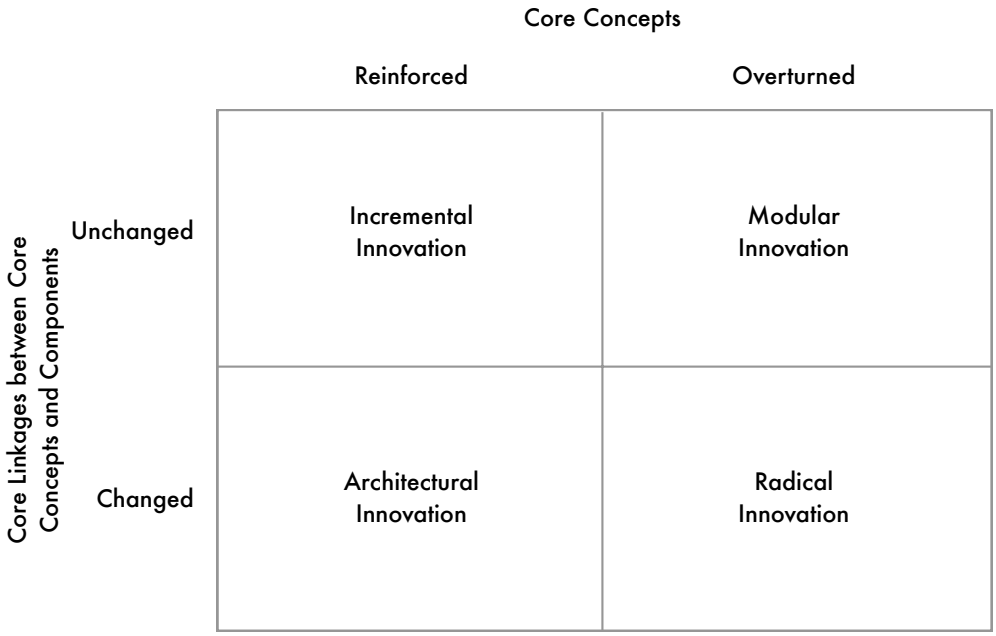

Figure 2. Henderson and Clark (1990) introduced the concepts of architectural and modular innovation to expand the incremental-radical spectrum.

Even though this framework is not claimed to be the only way to describe the incremental-radical relationship, it is a good illustration highlighting the fact that the spectrum has more than one dimension. In more recent years, Dávila, Epstein and Shelton (2006) puts forward a similar framework but takes a broader stance and makes technical changes to the product one of the dimensions and incorporates the company's business model as the second. The concepts of architectural and modular innovation are not relevant in this framework, as it is not focused on product innovation. Apart from incremental and radical

innovation, the model is instead supplemented with a mix of the two: semi-radical innovation. There is a problem with defining the differentiating factors (or axes) for radicalness that these two frameworks have, as it limits what types of innovations that can be radical. For instance, with technical change and business model on the axes, there can't be any radical innovations within either product or business model innovation solely. A more general way to define the amount of change of an innovation without using different terminology would be to disregard what factors that needs to be changed and just include if there has been a reinforcement or alteration. That is, using a metaphor, an innovation is seen as incremental if the change helps keep speed up while a radical innovation is a change of direction which complies to the definition put forward by Damanpour (1991) quoted above. Using this definition, it is possible to decouple the degree of innovation (i.e. incremental or radical) from the type of innovation such as product or process innovation.

3.1.4 Innovation impact

As argued, it is important to see the spectrum of incremental and radical innovation rather as a measure of the degree of *internal* changes on current offerings or processes. When it comes to innovation impact or *external* changes, terms such as disruptive, non-linear, discontinuous, breakthrough, paradigm-shifting and revolutionary have all been used to describe innovations with a large market impact (Thomond & Lettice, 2002). They are all ways of describing innovations that challenge the status quo and changes the dynamics of the current market or creates a completely new one that makes the old market redundant. There are numerous examples of these types of innovations with a recent example being the DVD industry disrupting the older VHS technology. Bower and Christensen (1995) popularized the term disruptive innovation with a case study of the hard-disc-drive industry, which clearly shows how new technologies matured and outcompeted incumbent technologies (depicted in Figure 3).

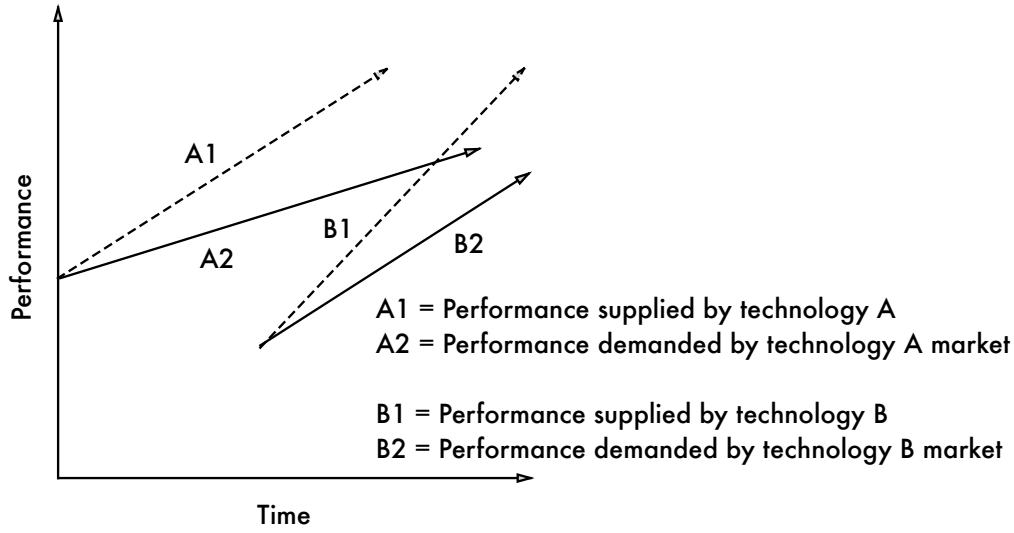

Figure 3. The performance trajectory of a newer technology surpasses the incumbent technology as the technology matures and is adopted by the (new) market (Bower and Christensen, 1995).

Just as in the categorization of incremental and radical innovation by Henderson and Clark (1990), the term disruptive innovation is focused on new technologies and products and disregards any other type of innovation. To keep the concept of innovation market impact compatible with all innovation types, the terms continuous and discontinuous innovation (Robertson, 1967) are adopted. Not in a strict sense but rather as a way to give a name to core concepts used, and to avoid terminological trespassing into specific technical terms such as disruptive innovation.

3.1.5 Models of innovation

Models help individuals to reduce complexity and make sense of their surroundings (Harkema, 2003), something that is very true for the elusive innovation process. Models that have evolved over time have to a large extent reflected the current economic environment. The first and most basic models of innovation were linear in nature and tasks or activities were regarded in a sequential manner. These linear models were developed in the mid-twentieth century and have lived on until today, much because of their simplicity. As the western world experienced high economic growth with new technologies such as the semiconductor and other electronics, it led to a rapid industrial expansion (Rothwell, 1994). When demand exceeded supply it was close at hand to believe that technology was the driving factor behind the progress of innovation. This

type of technology-push view of innovation where science and technology determined what products reached the market dominated up until von Hippel (1978) introduced the concept of market-pull innovation; with decreasing demand, the needs of the consumer in the marketplace got a bigger focus. The linearity of the models was later criticized as innovation were argued to not be fit for reductionism and modeled into a linear chain of events (e.g. Kline and Rosenberg, 1986; Schroeder, et al. 1989). Although it might be easier to depict the innovation process as a straight path from point A to point B, it is much more complex than that and Kline and Rosenberg (1986) states that:

- Innovation is not a sequential (linear) process but one involving many interactions and feedbacks in knowledge creation.
- Innovation is a learning process involving multiple inputs.

Following this line of thought a model, which Rothwell (1994) refers to as the third generation innovation model, was proposed: the coupling model (see Figure 4). It was still partly sequential but now with added feedback loops which added a nonlinear element to the model.

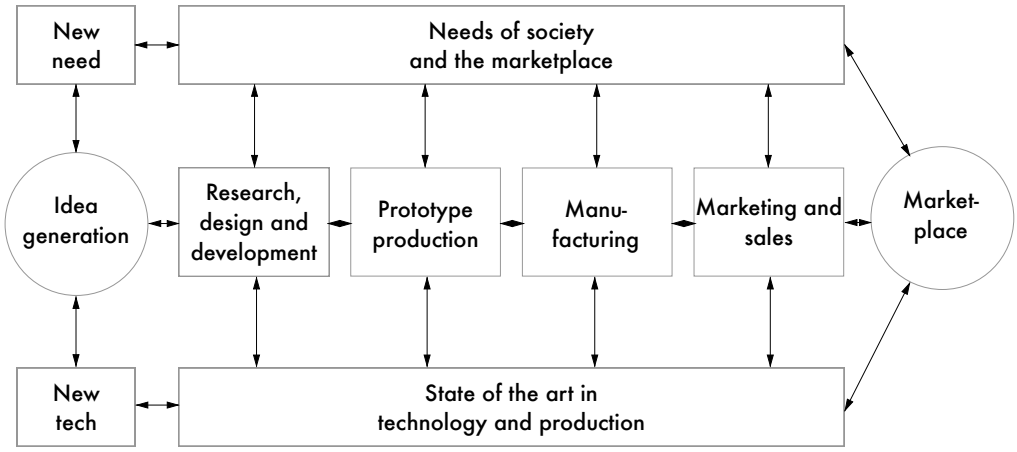

Figure 4. The simultaneous coupling model of innovation. (Adopted from Rothwell (1994))

No other dominant models of the innovation process have emerged but contemporary research acknowledges the high degree of complexity inherent in innovation, both dynamic and behavioral (Cedergren, et al. 2010). Researchers have applied complexity theory to model the process (Frenken, 2006), or modeled NPD as a complex adaptive system (McCarthy, et al. 2006). Even though much

research has been conducted within models of innovation, practitioners in their quest for higher efficiency use simplistic models even if it is widely accepted that it is not a true illustration of the innovation process.

3.1.6 Synthesis: so what is an innovation?

Based on the concepts laid out above, innovation can be categorized according to: type, degree of newness, amount of internal change and innovation impact. These concepts are visualized in Table 2 below.

Table 2. Innovation can be differentiated according to four categories: type, degree of newness, amount of internal change and innovation impact.

Innovation type	Product, process, organizational, business model, marketing
Degree of newness	New to the world, new to the market, new to the firm
Amount of internal change	Incremental or radical
Innovation impact	Continuous or discontinuous

3.2 Innovation strategy

3.2.1 The role of innovation strategy

When looking at what determinants that influence innovation, there is a consensus that innovation strategy is of great importance (Cooper & Kleinschmidt, 2007; Rothwell, 1994; Dávila, Epstein & Shelton, 2006; Martins & Terblanche, 2003). In fact, innovation strategy is by some authors considered to be the most important dimension in the case of successful NDP practice (Kahn, et al. 2012; Nicholas, Ledwith & Perks, 2011). However, it is not only the world of academia that considers innovation strategy important. According to innovation surveys conducted by the Boston Consulting Group (Andrew, et al. 2010) and McKinsey & Co (Chan, Musso & Shankar, 2008), 72 % and 65 % of the respondents respectively, stated that innovation is among the top-three strategic priorities and this number has increased the past years. But even though the surveys show that there is an acknowledged importance of innovation strategy, many companies do not seem to either adopt or work with them properly. A reason to this is according to Dávila, Epstein and Shelton (2006), the hurdle that arises when crafting

strategies without a coherent and narrow definition of innovation. As without it, one does not know what to improve or how to improve it to become more innovative. To be able to craft strategies with the aim to improve innovation, the companies must first state what innovation is and then clearly communicate this throughout the organization (Cooper & Kleinschmidt, 2007).

Robbins (1996) states that an innovation strategy is a strategy that promotes the development and implementation of new products and services. It should further work as a support to the business strategy by defining work processes and the ratio of incremental and radical innovations (Dávila, Epstein and Shelton, 2006). In a broader perspective Voûte (2000:p354) argues that: "Innovation is the process by which an organization renews its assets and structure, processes and products to be able to survive and fulfil its mission". In this view, it is implied that innovation strategy is more or less the same thing as the business strategy. Either way, there is no doubt that innovation strategy is an integral part of the overall company strategy. To be able to achieve the overall goals with the innovation strategy it needs to be clear, specific and integrated into the organizational activities (Dávila, Epstein & Shelton, 2006; Cooper & Kleinschmidt, 2007; Adams, Bessant & Phelps, 2006). Furthermore, the strategy must be communicated clearly by management to all levels and stakeholders within the organization.

3.2.2 Characteristics of an innovation strategy

As of today, there is no general accepted set of generic innovation strategies that companies can choose from. Instead most authors seem to be in agreement that it is important to recognize that the optimal innovation strategy for a company will vary to a large extent and should be crafted by the stakeholders of that specific company (Dávila, Epstein & Shelton, 2006; Muller, Välikangas & Merlyn, 2005; Goffin & Mitchell, 2010). Even though there are no generic strategies to choose from, one can talk about different strategic views depending on the innovation focus of the company. Dávila, Epstein and Shelton (2006) uses the terms Play-to-Win (PTW) and Play-Not-to-Lose (PNTL), which can be seen as two extremes at each end of a spectrum, although most companies would be regarded to have adopted a mix of the two. A PTW-strategy focuses more on radical and semi-radical innovation while a PNTL-strategy would focus more on incremental innovation. As radical innovation diverges from existing routines and knowledge, it involves a larger risk component, which needs to be taken into account (Jalonen, 2011). Usually, mature companies within more established industries tend to follow a PNTL-strategy whereas start-ups tend to use a more risky PTW-strategy. One reason being that start-ups often need to pursue a radical approach to be able to compete against the more mature incumbent companies. Incumbents in

contrast tend to build a more rigid structure where attention is given to efficiency and effectiveness gains, where the radical mindset consequently is harder to achieve (Dávila, Epstein & Shelton, 2006). A complementary view of innovation strategy is the division of innovative systems as either exploratory or exploiting (Martin, 2009). Start-ups have a tendency to focus more on exploration to find new ways to solve problems and when the start-ups have found a solution to the problem they start a more exploiting approach to reap the benefits of the solution. Established companies on the other hand, tend to focus more on exploitation by improving their current solutions instead of searching for new products (Martin, 2009). A more in-depth discussion of the dichotomy of incremental and radical innovation will later be presented in the section 3.2.4. Apart from the internal perspectives of the innovation strategy, Moore (2004) argues that the periods of the market development life cycle will require different innovation focus. Moore claims that for a company to be able to challenge the competitors for revenues and margins through innovation, it needs to recognize and act according to the characteristics of the market development, i.e. external aspects.

As a conclusion, one can say that even though different aspects and terminology is used to describe innovation strategy, there are evident similarities. First, both academia and the world of business agree on the importance of having an innovation strategy that is well communicated within the organisation. Second, the chosen strategy should be in line with the overall business strategy to fulfil the company mission. Finally, there are no one-size fits all strategies for companies; instead all companies need to develop a strategy with regards to their external and internal environment.

3.2.3 Innovation portfolio management

While a company can experience success by only pursuing incremental innovation, a mix of innovations is necessary in the long run (Leifer, O'Connor & Rice, 2001; Corso & Pellegrini, 2007; McLaughlin, Bessant & Smart, 2005). Incremental innovation is important to sustain and ensure profitability in short term, and radical innovation is important to keep up the competitive advantage of the firm and ensuring that the company survives in the long run (Tushman & O'Reilly, 1996; Dávila, Epstein & Shelton, 2006). So apart from promotion and support of the innovation effort, the innovation strategy should outline the internal balance between innovation projects. This innovation portfolio needs to fulfil both short and long-term goals which requires projects with varied lead times and levels of uncertainty. Several authors mention portfolio management as a key aspect of the innovation process and stress its importance (Cooper & Kleinschmidt, 2007; Adams, Bessant & Phelps, 2006; Goffin & Mitchell, 2010; Kahn, et al. 2012) as

most organizations have several projects running at any given time. Despite this, work done by Cooper, Edgett and Kleinschmidt (2002) shows that only 21 % of the companies have a portfolio management system that is well-executed, in addition, many companies rate their portfolio management as very weak. This is paradoxical as companies working with portfolio management often experience positive results. According to Chan, Musso and Shankar (2008), companies that pursue and measure innovation projects as a portfolio, reports a higher organic growth rate than their competitors and state that at least 31 % of their organic growth rate came from innovation.

The construction of an innovation portfolio should further not be seen as a static one-time activity, but rather as a dynamic working process (Goffin & Mitchell, 2010). Innovation projects and external factors change over time and as a result, some projects will need to be pushed forward and others terminated. Therefore, the need to continuously optimize the allocation of resources between projects will always be important, even more so as projects over time will differ in their level of uncertainty and potential yield (Jalonen, 2011). A major issue when selecting what innovation projects to focus on is the uncertainty factor, as much of the information needed to make knowledge-based decisions regarding the priority of the different projects does not exist. Some factors can even be unknown at the end of projects, for instance to what degree the product will be accepted on the market. As a consequence, it is necessary to embrace the inevitable uncertainty when working with portfolio management (Goffin and Mitchell, 2010). In the midst of this uncertainty, the actions of management play a key role in steering the innovation projects, both by exploiting new opportunities and to counteract innovation hurdles. One such hurdle is the human aspect of innovation (Muller, Välikangas & Merlyn, 2005). Since employees get attached to their projects while working on them, making unbiased decisions can be hard as individuals overestimates the importance of their own projects. This means that having a rigid decision-making process with well-established evaluation factors is of great importance. The system then works both as a way to reassure employees that they are being listened to and treated fairly, as well as a way to increase the likelihood that the most promising projects are being pursued (Goffin & Mitchell, 2010).

3.2.4 The incremental-radical innovation dichotomy

As suggested, should an innovation portfolio consist of a mix of both incremental and radical innovation, which implies that companies need to adapt capabilities and organizational structure for two different outcomes. However, in practice this is not easy to achieve, as they require different skill sets and structures (McLaughlin, Bessant & Smart, 2005; Corso & Pellegrini, 2007; O'Connor &

DeMartino, 2006; Nilsson, et al. 2012). One dimension often mentioned with regards to the differences between incremental and radical innovations concerns the uncertainty attributed to each (Jalonen, 2011; Tushman & O'Reilly, 1996). Dávila, Epstein and Shelton (2006), states that technical and market factors constitute the principal part of the uncertainty that can be related to radical innovation. As radical projects involves a larger divergence from current knowledge and processes, their development and market impact are harder to predict. There is of course some degree of uncertainty within incremental innovation as well, however it can often be reduced during the progress of the project so the uncertainty is low when it is close to reach the market or implementation, which provides a way to mitigate risk.

To manage a hybrid strategy with both incremental and radical innovation, McLaughlin, Bessant and Smart (2005), argues that a company needs to be able to manage the balance of uncertainty in relation to a structured work process to still promote intra-company creativity. They further state that when focusing on incremental innovation, an organization benefits from having a functional structure with formalized roles and responsibilities, a centralization of procedures, strong manufacturing capabilities with an efficiency-oriented culture. The management style should work to encourage conformance to rules and to work according to procedures. Furthermore, management should work to be supportive of a "do better" approach, where the co-workers mind-set is on increasing efficiency and decrease lead-time.

In contrast, when focusing on radical innovation, the organization should instead utilize small entrepreneurial units with an exploratory culture, which encourages risk taking and experimentation. According to Thomond and Lettice (2002), radical innovations struggles to get internal support in many companies, which further increases the importance of a supportive culture. To support finding new methods and technologies with the possibility of radical change, the environment should be creative with informal networks to create both market and technological insight (McDermott & O'Connor, 2002). Furthermore, it benefits from being loosely structured and decentralized; a clear divergence from the standard linear and discrete process of incremental innovation process (Ettlie, Bridges & O'Keefe, 1984). Table 3 highlights the major differences between projects focusing on either incremental or radical innovation (adopted from Nilsson, et al. 2012).

Table 3. There are large discrepancies between incremental and radical innovation with respect to uncertainty, time, flexibility and control.

Dimension	Incremental	Radical
Uncertainty	Low risk and low uncertainty	High risk and high uncertainty
	Market uncertainty will be low during the whole innovation process and very low during commercialization	Market uncertainty will remain high beyond commercialization
	Systematic search within familiar areas	New business opportunities through weak signals of emerging trends
	Always aligned to strategies and current business models	May or may not fit existing strategies and may challenge current business models
Time	Typically short and predictable lead times	May require more than a decade of investment before financial returns are seen
	Characterized by a ordered and less dynamic innovation process	Characterized by evolving in a disordered, sporadic and dynamic manner
Flexibility	Operates with a set of routines and structures/procedures	More flexible, integrative and improvisational models to manage emergence, based on simple rules
	Exploit and enhance strong ties - work closely with existing customers and suppliers, in formal cross-functional teams	Explore and develop parallel and heterogeneous less established 'weak ties' inside and outside the organization
	Makes use of advanced project and risk management approaches linked to predefined strategies and processes	Probe, fast failure and learn rather than manage risk
	Strategy, directions and goals are set at the beginning	Strategy evolves through experimentation for market learning
Control	Need formal cross-functional teams from start	Need bottom up initiatives using informal relations and highly motivated, persistent champions in initial stages
		Need strong top management support and commitment for implementation in the later stages
	Reward and recognition system in place need to support short goal achievement	Feedback, reward and recognition system in place need to support risk taking and persistence

As a conclusion, one can say that companies with an intention of managing both incremental and radical innovation have to take these differences into account. Moreover, it has to make hard decisions regarding the appropriate resource allocation between the two outcomes to balance the risk and resources within the company to succeed on both short and long term.

3.3 Performance measurement

3.3.1 What is performance measurement?

The need or will to measure tasks and processes has been around for long, with references as early as in the Old Testament (Ramberg, 1997). A more recent and maybe more famous example of performance measurement is that of Frederick W. Taylor in the early twentieth century. Taylor introduced scientifically optimized methods for individual tasks in production and through that sought to improve industrial efficiency. Every task was scrutinized and timed in search of "the one best way" to perform a task or structure an organization (Kanigel, 2007). Taylor was one of the first to utilize management through measurement in this precise manner and although the principles of his scientific management live on, the individual is given a more prominent role today. The need for individual motivation and a feel of non-substitutability has been recognized to be significant in reaching higher efficiency within organisations (Sandkull & Johansson, 2000). This adds a large amount of complexity to the equation, as the human involvement that Taylor tried to exclude is never that predictable. Despite this, the goal of measuring is most often the same: to increase efficiency and/or effectiveness (Lindvall, 2001). There are various definitions of what a performance measurement system is and one example is presented by Wettstein and Kueng (2002:p1): "A performance measurement system tracks actual performance of an organization, helps identifying weaknesses, and supports communication and decision-making processes."

"What gets measured gets done" is a classic cliché but it is worth recognizing, here from a meta perspective, as heaps of authors refer to it (e.g. Eckerson, 2009; Dávila, 2006; Källman & Sandqvist, 2012; Kaplan & Norton, 1992) which might indicate some degree of truth. Although Catasús, et al. (2007) states that at best, the adage makes a *promise* of a perfectly controllable organization. By measuring and conveying results, managers try to increase control over processes through steering behaviour of employees to reach predefined goals (Lindvall, 2001). There are contrasting views between academia and the industry on the way this should be done. Academic research tends to be more theoretical with poor real life applicability and the industry on the other hand is sometimes said to be too

practical (Johnson & Kaplan, 1991). A general approach to performance measurement divides it into a sequence of four separate activities: planning, measurement, evaluation and action (Ramberg, 1997; Lindvall, 2001). This sequence is a way to align performance with strategy (Eckerson, 2009) and requires metrics to be able to assess them, i.e. specific measures of tasks or processes. A performance metric can be any measure that is regarded as relevant for the company and can be chosen to be communicated internally and/or externally. Historically, financial metrics have been dominant but through new perspectives such as the Balanced Scorecard (BSC) (Kaplan & Norton, 1992), other non-financial aspects have been acknowledged to impact at least as much. It is argued that financial metrics are a causal result of previous actions, thus a lagging indicator of past performance, whilst some non-financial metrics can be used to predict future outcome, i.e. leading indicators. Another dysfunction of financial measures such as return on investment (ROI), is that they do not take any spill-over effects into account. Measuring the specific ROI for a single project does not include synergies that might have been reached through the project, which might instead be reflected in a higher ROI for other projects.

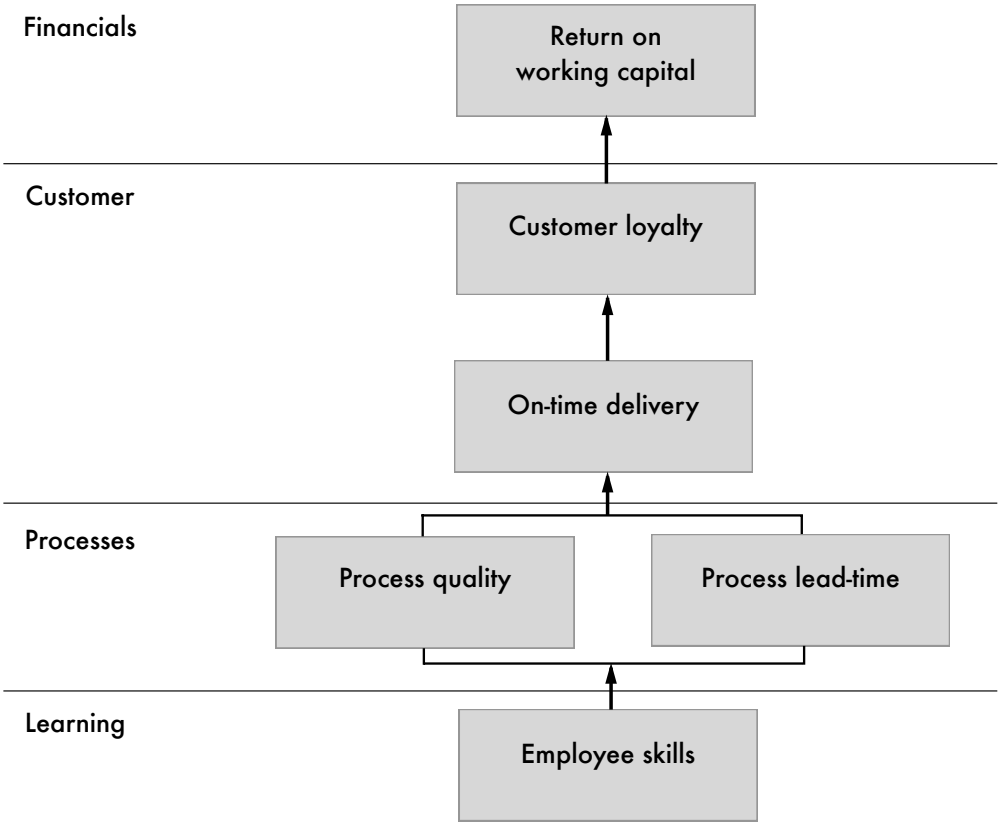

Figure 5. Using financial metrics to predict possible future outcome will give poor accuracy, as they merely are a result of the causal relationship of other activities. (Adopted from Kaplan & Norton, 1996)

3.3.2 Dysfunctional consequences of measuring

Performance measurement is not without its flaws. Ridgway (1956) was one of the first to voice critique towards the blind faith in using metrics to improve current business processes. He refers to a study conducted by Blau (1955) where a public job employment agency was studied:

> The agency's responsibility was 'to serve workers seeking employment and employers seeking workers.' Employment interviewers were appraised by the number of interviews they conducted. Thus the interviewer was motivated to complete as many interviews as he could, but not to spend adequate time in locating jobs for the clients. The organization's goal of placing clients in jobs was not given primary consideration because the measurement device applied to only one aspect of the activity. (Ridgway, 1956:p241)

This example shows one of the most typical dysfunctions with performance measurement: behavior and actions are directed around the intended goal to boost figures of what is actually measured (Kerr, 1975). This stems from the possibility to manipulate the metrics or just focus on what gives most impact and can be traced back to the fact that the underlying reason for the metrics are not communicated clearly to the employees. As Halachmi (2002:p232) puts it: "A necessary, though not sufficient, condition for the success of performance measurement is a demonstrated personal conviction in its importance by key stakeholders." If not properly anchored with stakeholders it might lead to a short-sighted perspective, with individuals satisfying their own needs, which is suboptimal for overall performance. This is closely linked to the agent-principal problem and the complex relation that incentives incur. In more cases than not, compensation is linked to the performance measures (Lindvall, 2001). If compensation is based on measures that are combined formulaically, employees will manipulate the measures. If compensation is based on a subjective connection between performance and measures, employees will have a hard time understanding it and will thus be less motivated (Meyer, 2002).

Another common problem relates to the "wrong type" of metrics, e.g. short term financial metrics that are used to proxy a long term strategy effort (Hayes & Abernathy, 1981; Eccles, 1991). A counter reaction to this was Kaplan and Norton's (1992) introduction of the BSC, which takes other non-financial aspects into consideration as well. This made sense, as it had been recognized that it was good performance in non-financial measures that drove good financial performance (Dávila, 2000). But caught in the BSC hype of the mid 1990's were the employees that got burdened underneath a stream of new metrics thought to be needed by company executives (Meyer, 2002). The sheer amount of metrics and the effort it took to get used to them, redirected attention away from where it was most needed. This meant that more focus was put on the measurement process instead of the actual process it was intended to measure. This kind of bureaucracy leads to an imbalance between planning and follow-up actions and not to increased efficiency as intended.

Apart from the dysfunctions that occur on an individual level, there are difficulties also at a company level. The measurement techniques used in reality is different from what is expected when looking at current theory and often is a more complex measurement system proposed than is actually implemented (Lindvall, 2001). This reflects the fact that best practice is not suitable for all organizations, as it requires a certain amount of maturity. Learn to walk before you run is a suitable metaphor,

which is acknowledged in the performance measurement context by Eckerson (2009), who presents a simple maturity model for measurement within organizations. It consists of three levels that start with getting a better understanding of key performance indicators and ends with a capacity to drive strategy at full maturity.

Performance measurement is a way to standardize what to evaluate and leads to standardized behavior, something that is encouraged by the ISO 9000 Series Standards as it is said to increase efficiency and quality. Research on motivation has on the other hand shown that standardization is contra productive for an individual's motivation and in extension, an innovative environment (Hertzberg, Mausner & Snyderman, 1959; Burns & Stalker, 1961; Kondo, 2000). A result that is highly relevant from an innovation perspective. Beugelsdijk (2008) and Xavier Molina-Morales, et al. (2011) have extended the individual perspective and showed that autonomy of, and trust for, employees increased the innovativeness of a company. It is clear that performance measurement used too extensively without proper anchoring can have severe implications for an innovation process. All in all, a measurement system with metrics that are not properly configured for the current setting can cause more harm than good (Eckerson, 2009; Dávila, Epstein & Shelton, 2006).

3.3.3 Overcoming dysfunction: the optimal measurement system?

As a negative consequence of the nature of performance measurement systems, it is often regarded as a way for management to monitor, control and hold employees accountable for their work (Källman & Sandqvist, 2012). This type of follow-up usage of the system is argued to not utilize its maximum potential as it is a type of one way communication. Furthermore, unilateral control tends to produce defensiveness and closedness (Argyris, 1976), which as previously argued is contra-productive for an innovative climate. Instead the system should be used in a way that captures value and reinforces learning through feedback, knowledge creation and understanding, an argument for which Norton and Kaplan (1992) were early proponents. This value creation happens throughout the whole organization which implies that measurement should not be a prerogative for top-level management but should be vertically cascaded down to the operational level as proposed by Eckerson (2009). The importance of including all stakeholders for the system to reach its full potential is also recognized by Atkinson, Waterhouse & Wells (1997). They further argue that a measurement system has a diagnostic role and that measurement has an intrinsic value; giving more focus to a certain process promotes understanding for how the process affects the organizational performance. This understanding helps to identify facilitators and obstacles for

improving the process, something management can use to direct actions to eliminate deficiencies and thus improve overall performance. Now measurement is not only used to monitor a process, but instead uses the causal relationships within the organization to ultimately give higher financial returns (Kaplan & Norton, 1996).

The higher level of understanding gained through feedback by measuring can be related to the theory of single-loop and double-loop organizational learning, a concept introduced by Argyris and Schön (1974). In this context, learning is defined as the detection and correction of errors. When an error is encountered, the most common reaction is to find a different strategy to attack the task to eliminate the error, which according to Argyris and Schön is single-loop learning. Double-loop learning on the other hand questions the governing variables themselves which from a measurement system perspective would be the reported metrics. Meyer (2002) argues that a prolonged use of a metric deteriorates its explanatory capacity as behavior converges around the measure. To counteract this and add dynamism to the measurement system, an increased use of double-loop learning would include all stakeholders in the evolution and replenishment of metrics, so they keep producing valid feedback.

Leaving the system perspective for a less abstract and more practical view, there is an ongoing debate on how the metric suite for a performance measurement system should be constructed. Through the literature review, two lines of thought has been identified: the first building on Kaplan and Norton's BSC with an emphasis on balance between metrics covering as much as possible of a process, *the including approach* (e.g. Källman & Sandqvist, 2009; Muller, Välikangas & Merlyn, 2005). Just as uncertainty of what to measure can lead to a tendency to measure everything, this approach leads to an accumulation of metrics that can be overwhelming. To overcome this several authors (e.g. Dávila, Epstein and Shelton, 2006; Kuczmarski, 2001; Franczek, 2007) stress the importance of choosing only a few metrics that are clear and sharp, which limits the overhead needed to use them continuously, here labeled *the focus approach*. This is also supported by Meyer's (2002) view that one of the five characteristics of an effective suite of metrics is parsimony. Apart from minimizing company overhead, there are interesting psychological aspects of not having too many metrics to handle. Kahneman (1973), presents several situations where an individual's attention is limited both at a certain point but also over an interval of time. Measuring is of course not the only task an employee has to tend to but it is worth noticing that apart from the possibility of limiting overhead, there is a mental aspect to take into account. Furthermore, when presented with a set of metrics, there is a possibility that

attention will be limited to those, which thwarts other possibilities and leads to single-loop learning. So, what gets measured gets attention might be a more suitable version of the old adage.

3.3.4 Innovation measurement

When measuring innovation it can be done at different levels such as national (Arundel & O'Brien, 2009; Nelson, 1993), company (Hagedoorn & Cloodt, 2002; Carayannis & Provance, 2007) or team level (Nilsson, et al. 2010), which all use different approaches. Apart from these levels there is also an internal or external perspective which reflects how the measurements are used and reported. For the scope of this thesis, the focus has been on a company or team level and seen from an internal perspective.

Even though the great importance of innovation is widely accepted by companies, its measurement is not given corresponding amount of attention and resources (Dávila, Epstein & Shelton 2006; Andrew, et al. 2008). This is likely due to the fact that it is poorly understood and thus hard to measure (Smith, 2006; Kline & Rosenberg, 1986; Adams, Bessant, & Phelps, 2006). Furthermore, innovation is perceived to differ from other processes within an organization, as other processes tend to have larger element of standardization. Turell (2004) points out that groups that use measurable targets gets better support from management, and a lack of these measurements thus risks to further ostracize the innovation work within the organization. With the BSC, a goal is to identify causal relationships between action and financial outcomes and construct metrics to visualize the efficiency between them (Lindvall, 2001). Due to the high degree of uncertainty, this is much harder when it comes to the area of innovation, as the causal links are more difficult to understand. Simplification and generalization can be convenient but there is a risk that core characteristics of innovation are overlooked as discussed in section 3.1.5. The uncertain and complex nature of innovation creates difficulties in choosing the right metrics, which is reflected in a survey on innovation measurement from 2009 (Andrew, et al. 2009). The most common reason for not pursuing the amount of innovation measurement thought to be needed was not knowing what to measure. The same issue was identified in a survey conducted on Swedish companies in the same year, where poor intra-company transparency and historical legacies also was stated as reasons for poor innovation measuring activity (Källman & Sandqvist, 2012). There is apparently an unwanted discrepancy between measurement of a company's core business and its innovation efforts. This is a problem as without measurement, companies have a tough time basing innovation decisions on hard facts (Andrew, et al. 2009).

It is common, for the sake of simplicity, to decompose the innovation process into three separate parts: input, process and output (Simons, Dávila & Kaplan, 2000; Källman & Sandqvist, 2012). Early suggestions for innovation measurement systems such as Cordero (1990), tends to focus on inputs and outputs; the most tangible parts. Output is often measured as the number of patents or commercialised novel products (Smith, 2006) and examples of input measures can for instance be the amount of funding or time spent on a project, or to what extent there exist interdisciplinary backgrounds in a team. The default of those two being output as it gives the manager a sense of being in control of the result and it is more convenient to track (Ouchi, 1977). By using output metrics, measurement only gives lagging indicators, i.e. ex post information of a process. As the innovation process can be very time-consuming, only output measures are not preferable as it does not give much information about what led to the output and the feedback loop has a large time-lag. Furthermore, as there is a distinction between invention and innovation, and patents are used to protect inventions, it can be questioned if patents are an adequate proxy for innovation. In a study of the biotech industry, and DeAnglis (2007:p3) questions the empirical methodology for patent measuring in itself:

> [Our] findings lead to a cautionary corollary for patent metrics generally - fundamental uncertainties associated with the statistics of innovative success cannot be overcome by sophisticated empirical methods. Ironically, the current enthusiasm for empirical work may have caused academics to reify abstract statistics over the obvious complexity of innovative processes.

Despite a demonstrated incompleteness, there is some correlation between inputs and outputs of the innovation process (Hagedoorn & Cloodt, 2002), but real world examples have shown that there is more to it (Muller, Välikangas & Merlyn, 2005). However, such measurement of the underlying processes that produce the outputs is much rarer (Adams, Bessant & Phelps, 2006). The trouble with measuring the factors behind these causal relationships, apart from the complexity of innovation, is according to Nilsson, et al. (2012) the intangible nature of the factors that contributes to a company's innovation capability, such as knowledge.

3.4 Tentative analytical framework

The tentative analytical framework consists of key areas that according to theory are of importance when working with innovation measurement in practice. It will be used as the foundation for which the empirical gathering from the interviews is evaluated.

Table 4. The framework highlights important aspects of innovation measurement.

Innovation strategy	Performance measurement
It is important to define innovation within the company	When choosing metrics, it is important to take the causality of the metric into consideration
Companies should have uniquely crafted innovation strategies taking into consideration the internal and external environment	Problems that occur often when companies work with metrics are: • Measuring the wrong things • Wrong type of metrics • Too many metrics
The innovation strategy should be communicated throughout all levels within the organization	The maturity level of the company affects how the innovation metrics should be used
The innovation strategy should be supported with a portfolio management approach	The companies need to take the trade-off between standardization and creativity into consideration
Its important to both pursue incremental and radical innovation	When choosing metrics it is important to include all stakeholders
There exist a dichotomy between radical and incremental innovation, which means that different structures and work processes are needed	Companies should use metrics as a diagnostic tool that leads to a learning process

4 Empirical data

This chapter summarizes the interviews that were conducted with employees with a role related to innovation at four companies in different industries, as well as with experts within the field of innovation and innovation measurement. The chapter is divided into subsections with a brief background of the interviewee and organizational affiliation. The subsections are structured differently depending on if it is a company or expert interview.

4.1 Companies

During the interviews with company representatives, the tentative analytical framework was used as a foundation for the questions asked together with basic questions regarding their innovation process. The goal with the interviews was to get information on how innovation work is conducted in a practical setting which is intended to complement the theoretical perspective.

4.1.1 Primatech

Background

Primatech is a multinational manufacturing company within the electronics and telecom industry. The industry where it is active is characterised by high competitiveness and a large emphasis on timely product launches. The interviewee has worked within the company for several years in different departments and has had positions such as line manager, project leader and project sponsor. The past four years has been spent within their corporate technology office, which is the global research organization for both hardware and software development. During this period, tasks have mainly included clarifying product requirements within the innovation organization as well as work relating to the idea generation phase selecting the most promising projects.

Innovation

The innovation process at Primatech is structured around parent projects to which there are side-projects connected. The parent projects concern development of core technologies for new products with side-projects contributing with new

functionalities. The smaller projects can range from practical testing to acquiring more theoretical knowledge. Primatech always has a number of parent projects running at the same time, where these projects are in different phases and have different time frames.

Innovation strategy

Primatech does not have a pronounced innovation strategy, around which they structure their innovation work. Instead the overall global strategy within the company dictates the financial goals for the projects and sets higher level strategic goals. Despite the absence of a specific innovation strategy, a distinction between incremental and radical innovation projects can be identified. The incremental innovation projects work as a way to develop its products in an evolutionary fashion while radical innovation projects are used to differentiate its products from competitors. Due to the higher degree of uncertainty involved in radical innovation development and the difficulty in proving its potential profits, it is often these projects that are scrapped when resources such as time are scarce. In times of economic downturn and reduced demand, risk aversion increases further as met deadlines are a base for salary related bonuses.

> "As long as the product is released on time and that the quality is sufficient, it does not matter what functionalities we incorporate."

More than anything else, deadlines and key management personnel dictate the innovation conditions at the company. While one of the goals for the development departments is to push through as novel technology as possible, it is for the project leader of the parent project to choose what to incorporate into the final product. This decision is often based on getting the project finished on time, why the product often does not reach its full technical potential.

Performance measurement

The performance measurement system of Primatech is built around a suite of metrics that are updated in accordance to needs and changed conditions. While some of the metrics are given from management, some stem from the department itself. Although developed in different places, most of the metrics are linked with bonuses for the employees and line managers. Some examples of metrics relating to innovation was the number of white papers produced, the number of patent applications and the number of key seminars where an employee had spoken. The metrics was said to be quite blunt but was believed to give a general picture of the situation. On the other hand, there had been situations where all of the metrics reached their goal, but no significant improvements could be discerned after the

period. After the period, employees at the department were satisfied as reaching the goals led to a bonus, however nothing extraordinary was really produced.

> "These metrics are fairly blunt and the question is if they really are effective. Sometimes all of our KPIs was green and looked good even though we did not produce any significant innovations."

One problem mentioned with the performance measurement system within the company was the measurement time horizon. All reporting of metrics were made on a yearly basis but most development projects are longer than one year. So when management expects results at the end of the year, it affects how the projects are carried out. Another difficulty with metrics that was discussed was the subjectivity of the results; the numbers that metrics produce does not give any indication of its relative value except for if the goal is reached or not.

4.1.2 Water & Power Co.

Background

Water & Power Co. is a multinational electric utility service provider operating in more than 30 countries. The industry is more stable than for Primatech and is characterized by longer development times. The interviewee has a role within the company's global development organization with main responsibility to work with innovation project portfolio management by evaluating projects and assessing their overall fit.

Innovation

Innovation within the company is structured around thirteen innovation centres that focus on different areas of development. Some have a more incremental focus where the main task is to further develop old technologies, and others focus on new, more radical areas such as energy intelligence. During the past years the organization has worked to become more interconnected in their innovation effort, as a way to decrease the amount of overlap in innovation projects. This way, the overall perspective is enhanced and it improves the ability to distribute resources effectively. As a way to share knowledge, collaboration with other manufacturers in different industries is used to develop, build partnerships and exchange information

Innovation strategy

Just as with Primatech, Water & Power Co. does not have a pronounced innovation strategy. However, it has innovation centres with different focus and height of innovation. As a result, the company has both short and long term

projects in their project portfolio to be able to stay competitive in both the near future and on a longer time horizon and they work with having this portfolio structured.

> "There is a good overall picture of the portfolio and how the projects relates to each other. When we get a new project proposal it is easy to relate it to the overall portfolio and see whether or not the new project is aligned with the current portfolio."

Due to the nature of the industry with large complex projects, there is a close link between the degree of radicalness of a project and the development time. The company evaluates projects mainly depending on the amount of novelty from a technical and a business perspective. As breakthrough innovations in technology for energy production are rare, the business side of innovations is stated as a very important factor.

Performance measurement

When Water & Power Co. is working with its innovation portfolio qualitative parameters is used to evaluate the portfolio and new potential projects. No specific metrics for innovation measurement are used, but time-to-market has been in focus lately.

> "We want innovation projects with both technical and business novelty. At the same time it should have a short time-to-market."

A reason for this change is that much previous research never reached commercialisation, which was seen as an inefficient use of resources. Today a more holistic view has been adopted, looking at both the technical aspect, the business model and if the time-to-market is reasonable. But the economic potential of a project still governs the viability as it is reported upwards within the organization at the end of the year. But innovation in itself is not monitored with metrics, it is instead the qualitative parameters that are being discussed during evaluations of projects. Throughout the organization a formal performance system exists that follows up performance, which is constructed through a bottom-up approach with individual development goals for employees.

4.1.3 Westcoast Inc.

Background

Westcoast Inc. is a multinational manufacturing company with global development, production and sales functions. The interviewee has worked several

years at the company and holds a role as director at the innovation office. Before the current position, assignments have been at different parts of the organization concerning research coordination, human-machine interaction and product strategy, amongst others. In the current role, tasks range from structuring innovation projects within the company to acting as innovation facilitator for other departments. In addition, the department is contributing to the overall innovation climate of the company. The department has evolved from a separate innovation project to a formalized function of the company.

Innovation

The organization in general sees innovation as something important and tries to promote a more innovative culture through the introduction of the innovation office. The day-to-day innovation effort is outlined through a formalized innovation process but is mainly focused on incremental innovation projects. The aim with the incremental projects is to improve the technology of well-established products as this is seen as the core business; continuous incremental innovation is the status quo within the company. The standard innovation process has a sequential structure, following a stage-gate model as opposed to when working with radical projects, which use an exploratory approach, not following a stringent process. Working on radical innovation has sometimes proven to be hard, since the employees are used to work in a specific way. Overall the company is working with improving its innovation capability and is taking steps to improve their innovativeness.

Innovation strategy

According to the interviewee there exists a document outlining the corporate innovation strategy, however it has yet to be formally established within the organization.

> "The [strategy] document describes in what ways we would like to work with innovation, how we should organize to be able to work these ways and how the resources should be divided."

Therefore, the document works more as support for innovation rather than an acknowledged corporate innovation strategy. The document describes how to organize the work with innovation, what to prioritize and how to define different types of innovation. Moreover, it points out the significance of aiming for different types of innovation and how the weight between these should be divided. What is believed to be missing in the innovation strategy document is metrics to measure the innovation progress, which is seen as a future goal to develop.

Performance measurement

When it comes to performance measurement the company does not have an innovation measurement system. There have been efforts to develop metrics for their innovation process on several occasions but due to the difficulty of finding relevant metrics and conflicts of interest, it has not led to a sustainable routine.

> "The main reason for not having metrics is the difficulty developing these metrics, and in addition it is difficult on so many levels."

When an initiative has been taken to create metrics, it has been highly dependent on the background and interests of the initiator. When the individual raising the question had a technical background for instance, the result was technology-focused metrics, and with individuals from the human resources department, the result was too focused on soft values.

4.1.4 ABC Industries

Background

ABC Industries is a multinational company that develops, produces and markets consumer goods and sells products in more than 100 countries. The interviewee has worked at the company for several years, and is now employed as a fellow scientist within innovation and knowledge management. A lot of work has been spent on innovation culture and the creation of a new innovation framework for the company. Moreover, the interviewee has played a large part in introducing open innovation and other innovation initiatives to the company. Apart from the role at ABC Industries, the interviewee also holds a role as adjunct professor at a Swedish university, which is reflected in some views of a more general nature, influenced by experience outside the case company.

Innovation

The innovation process at ABC Industries is structured around over fifty innovation teams with individuals that are cross functionally employed. A team consist of three to four members and the team has different focus areas with an incremental or radical nature. There exist a high degree of autonomy in the work process and the teams are part of the whole innovation process, from ideation to commercialization. A reason for this type of structure with autonomous teams was the identification of inefficiencies in the decision-making process:

> "When your idea needs to go through five or six different levels of management, and only one negative response is enough to terminate the projects, most projects will not reach the market."

Even though the projects are recognized to be different in nature, standardized ways of working is not explicitly stated within the organisation, as the organizational structure with autonomous innovation teams is fairly new. However in practice, radical projects follow a more iterative process while the majority of projects, which are incremental, follow a traditional stage-gate model.

Innovation strategy

ABC Industries has an established innovation strategy where for instance, the weight between exploratory and exploiting projects is established. As the strategy outlines the work process and expectations of the department, it is tailored for each department. Moreover, the strategy reflects the company's external environment by increasing focus on core products and more incremental innovation in an economic downturn. Despite a shift in focus, radical innovation is never completely omitted. The capability to manage the mix between incremental and radical innovation implies an ambidextrous organization, which is an explicit goal for the company.

Performance measurement

ABC Industries recognizes that metrics used by the company should be a function of its external environment and stresses the importance of noting the direction metrics give a company. When finding metrics the interviewee states that a good way is to identify what is not working and then improve it by finding relevant metrics. Many companies use a standard set of metrics with most of them relating to core products, thus neglecting other possibilities. Being able to find what actually leads to breakthrough innovation is hard, so to find and implement these metrics requires a strong leader. Today most metrics used by companies are lagging, therefore trying to find indicative metrics that drive behaviour would be beneficial.

4.2 Experts

To gain objective information within the area of innovation and innovation measurement, interviews with experts have been conducted. All of the interviewees have several years of both theoretical and practical experience within the field of innovation. Since the expert interviews were more focused around what the interviewees have done and produced, the interviews were not structured in accordance to the three theoretic areas as above but had a broader scope.

4.2.1 Jan Sandqvist

Jan Sandqvist is a partner at Googol Business Navigator, a company focusing on innovation management. "Our work results in enhanced innovation management, new products and services, new collaborations, enhanced business models or new corporations based on existing assets". Sandqvist specializes in idea management where he often works with groups in creative workshops and has experience of all parts of the innovation process. In addition to this, Sandqvist has an interest in innovation measurement where he has extensive experience and he is co-author to the *Book of Metrics* (Källman & Sandqvist, 2012), a text focusing on innovation measurement.

Innovation measurement

As a collaborative initiative, Googol is part of Innovation Pioneers, which is a network founded by innovation practitioners from various industries. Within this network, Sandqvist was part of a project with a goal to identify a set of metrics that could measure innovativeness within companies. However, during his years learning and practicing the topic he has concluded that since all companies are unique the task proved to be more difficult than first anticipated. Companies have different strategies; they are promoting different values; and they are working in different ways, all which affects what metrics that are needed to evaluate innovativeness within a specific company. As Sandqvist stated:

> "So far, we have not seen two companies wanting the same suite of metrics."

As innovation is a very complex subject, making it easy and universal is a very hard task. Instead of finding a generic perfect set of metrics, Sandqvist and Källman tried in *Book of Metrics* to produce a framework that identifies what dimensions to measure. They divide the innovation process into three sequential steps: input, throughput and output. Sandqvist suggests that there might be general metrics for the output step, but these are lagging indicators, which are not able to change or steer behaviour during the process, only afterwards.

> "The most interesting metrics, from an innovation perspective, is the steering ones."

To be able to identify a suitable set of metrics for a specific company, one must first think of what the metrics are supposed to achieve, and then work to find metrics to solve this. When the metrics have been identified, the definition of the metrics should be clarified and communicated to all stakeholders. Here it is

important to explain why the metrics have been chosen, and what the metrics are supposed to accomplish. Sandqvist said that these metrics need to be reworked and rewritten depending on changes in dynamics within the company or the external environment. Furthermore, pilot test should be conducted before rolling out the metrics suite within the rest of the organization to see what effects the metrics have.

4.2.2 Fredrik Nilsson

Fredrik Nilsson is a professor at Lund University at the faculty of packaging logistics. Fredrik has published several articles within the field of innovation and innovation measurement. Fredrik is one of the co-creators of the measurement framework MINT (Measuring Innovation Capability in Teams), a theoretical framework for how to develop a measurement system for innovation. Moreover, Fredrik works for the Vinnova financed Product Innovation Engineering program (PIEp) where he is involved in research on innovation measurement and assessment.

Innovation measurement

When working with innovation measurement and the MINT-framework, focus has been on a pragmatic team-level. According to his experience, measuring on a higher organizational level does not affect behaviour in the same way. Instead, it rather reflects the effects of actions from top management. Therefore, measurement needs to be conducted on a team-level to really make a difference.

During the research on innovation measurement at companies, Nilsson has focused on how the measuring really can produce results in a practical sense asking questions such as: ”What benefits can we receive by measuring and how do we best work with it?” and “How can we use innovation metrics to push innovation forward, instead of using lagging metrics that we cannot act upon?”

He explained that metrics could be used as a way to steer behaviour if implemented correctly. And by focusing on the weak part in an organization’s innovation process one can improve the overall process. For instance he mentioned an example where a company had a very high degree of idea accumulation, but no process for how to choose what ideas to progress with. To solve this, metrics were produced to make employees focusing on and discussing about what projects to continue with. This in turn improved the overall innovation process and let the employees focus their efforts on selected projects with better result.

4.2.3 Stefan Cedergren

Stefan Cedergren is an Associate Senior Lecturer at Mälardalen University. His research has focused on product development performance and lately, the creation of a framework measuring this area. Currently, Stefan is part of the project PD (Product Development) Watch, which is a project cooperation between The Swedish Institute of Computer Science (SICS) and researchers from the medical university Karolinska Institutet focused on product development.

Innovation measurement

In his research Cedergren came in contact with a health assessment tool for organizations called HealthWatch, which was developed at Karolinska Institutet. HealthWatch is a tool for continuously working proactively and giving feedback on employee's health by evaluating a short questionnaire filled in by the employees on a frequent basis. The tool gives instantaneous feedback to the employee and suggests actions that can be taken if any health value is below a certain threshold. Apart from the individual level it gives managers an easy way to assess overall employee health overtime and an indicator if corrective action has to be taken. Cedergren, in collaboration with Karolinska Institutet initiated a project to modify HealthWatch to fit a product development setting: PD Watch. With the help of this tool the project leader is able to identify problems before they escalate, and see where project members are least satisfied and act in a proactive way. The results can be benchmarked with older values to see if there has been any change in the measured areas.

Cedergren acknowledges that innovation is a complex area and this is the main reason why companies struggle to produce good measurements for it. According to Cedergren there exist, broadly defined, two types of companies in Sweden when it comes to measuring innovation: those who believes that it is positive to measure innovation and therefore measure everything, and those who only measure on a basic level. Companies that measure too much is not interested in drawing conclusions from their metrics because of the sheer amount of data and the ones that does not measure enough, is faced with the same problem but for the opposite reason.

> "Many managers and decision makers state that it is hard - sometimes impossible - to find good measurements for innovation. This attitude surely makes it hard to find relevant metrics."

Furthermore, when it is common for companies to state what they want to measure without really knowing why. A better way would be to first think of the

goals the company wants to achieve. Then work backwards to the metrics so that the metrics is directly linked with the goals of the company. This can be done e.g. by focusing on important success factors and criteria for being successful. By working this way instead, it is easier to understand the causal relationship of the metrics and behaviour.

Moreover, Cedergren referred to research which showed that a large majority of the company respondents that was part of the study were unsatisfied with their measuring systems. His own results from studies of Swedish companies confirmed this belief. One problem was that several of the metrics used was focused on the outcome instead of the on-going innovation process. As a result feedback from the process has a large time-lag. Furthermore, the metrics used sometimes caused problems that were not foreseen. Cedergren exemplifies with an actual company working with a stage-gate approach. One of the metrics that was used was the number of gates that was passed on time, and this was in turn connected to the bonus system. The metric led to focusing on finishing the projects on time to get the bonus even though the products did not have the desired standard, which in turn led to unsatisfactory products.

4.2.4 Tobias Larsson

Tobias Larsson is chaired professor at Blekinge Tekniska Högskola, and a consulting professor at Luleå University of Technology, within Mechanical Engineering with special emphasis on Product-Service System (PSS) Innovation. Within PSS Tobias focuses on developing methods and tools to support innovative development of sustainable product-service systems, where innovation performance metrics has been one field of interest in his research. Tobias has contributed with several articles within his field of research and was together with Fredrik Nilsson one of the co-creators of the measurement framework MINT.

Innovation measurement

Larsson believes that when working with innovation, it is important to recognize the differences between real life application and research theory. He himself adopts a pragmatic approach to measurement and feels that companies need to really think about the innovation process when selecting metrics to understand the effects of them. Ask straight forward questions like: "Will the number of meetings with external people lead to more company innovation?" If the answer is yes, then this is a behaviour that should be encouraged. Practitioners should ask themselves if they are doing all the things that will lead to an increased innovation capability as a way to help the pursuit of finding suitable metrics.

At companies today, there only exist a few company specific metrics that are unique between companies. Instead, the difference lies in how the same set of metrics are prioritized at different companies. This is a problem as Larsson states that metrics preferably should be unique and a result of a company-unique effort of selecting them. In the selection process it is important that the company employees are part of identifying and selecting the metrics through a dialog. It is important to get these metrics to work well with the overall company strategy as well as having the approval from the employees, so that the employees agree with what is measured and why. The number of metrics in use differs depending on what organizational level is in question as they ideally are cascaded down through the organization; two or three metrics on top management level are cascaded down and multiplies into five or ten metrics on a team level. But the amount of metrics should be taken into careful consideration as it is better to choose fewer metrics that are being regularly evaluated. As an example, having a hundred teams each with six metrics would lead to a sum of six hundred metrics, which is neither practical nor possible to follow.

Larsson believes that one of the greatest problems with innovation measurement is the poor understanding or complete lack of measurement. Some companies believe that they measure innovation just by measuring the number of patents. However, does the company with the largest amount of patents have the best innovations? The lack of dimensions in this kind of measurement with lagging indicators such as patents is a key problem. An individual in the organization should be able to understand how the metric is connected to his or her performance, and thereby be able to change the outcome, which can be argued to be impossible in the case of patent measuring. Another problematic area with innovation at companies is that few people really are working with it despite its perceived importance. Many people are stuck in old habits and are not taking the necessary steps towards a more innovative climate, as it is easier to work in the same way as before. This type of risk-averse traditionalist thinking makes the innovative effort biased towards incremental innovation, as it does not promote new ideas.

5 Analysis

This chapter presents the analysis of the studied material and consists of a synthesis of the theoretical and empirical findings. Guidelines for working with innovation measurement and a practical framework aimed at helping practitioners implementing these guidelines can be found at the end of the chapter.

The tentative analytical framework presented in section 3.4 was juxtaposed with the empirical findings to find similarities and discrepancies between theory and the information gained through the interviews. This evaluation led to a number of analytical themes of special interest that was further analyzed and the themes constitute the following subchapters. The findings from the analysis are synthesized into key takeaways presented as guidelines together with a framework outlining the general idea of how innovation measurement can be used to increase the overall innovativeness of an organization.

5.1 Innovation strategy

A factor that stands out when evaluating the interview topic innovation strategy is the discrepancy between theory and practice. Although several authors consider innovation strategy to be one of the most important factors in NDP (Kahn, et al. 2012; Nicholas, Ledwith & Perks, 2011), only Westcoast Inc. and ABC Industries have what can be considered to be an innovation strategy. Furthermore, of these two, only ABC Industries has an established and formalized strategy that is dictated by top-management. Both strategies are used to describe how innovation efforts within the organization should be structured, what to prioritize and how to define different innovation types. The strategies can be categorized as PNTL strategies, in accordance to Dávila, Epstein and Shelton (2006), with a higher focus on incremental innovation. However, both radical and incremental innovation is pursued.

Primatech did not have an innovation strategy, even though a distinction is made between incremental and radical innovation. Incremental innovation is seen as increasing the capabilities of existing products, while radical innovation is used to

gain a competitive edge. The prioritization and innovation focus is mostly dictated by deadlines and personal preference of managers, which led to an unstructured innovation process without real focus. A theme that emerged more than once during the interview was the discrepancy between theory and practice. There is a much greater focus on revenues in practice, and theory does not take personal interests that affect decision processes into account. These differences affect the decision process, so that decisions are not taken upon the basis on what is best for the company but instead reflects personal interests and incentives.

Water & Power Co. neither had an explicit and clearly communicated innovation strategy. The organization is despite this structured in a way to promote different innovation projects with a wide range of technical and business novelty. The variety is monitored with the help of an innovation portfolio, which is used to balance projects with short and long lead times, which in turn is a way to ensure competitiveness both today and in the future. The importance of structuring innovation in a portfolio composed of both incremental and radical projects frames have strong theoretical support (Adams, Bessant & Phelps, 2006; Goffin & Mitchell, 2010; Kahn, et al. 2012; Chan, Musso & Shankar, 2008). Although all companies do have a mix of innovation projects, the ratio between them are more or less intended. Without a strategy to clearly set the goals, project selection and termination is left to manager's subjective opinion. This way, happenstance takes a large part in planning a company's innovation effort, a fact probably few managers would be happy to support.

5.1.1 Bias towards incremental innovation

Down-prioritizing radical innovation is mentioned in the literature as a possible consequence of not having a well communicated and established innovation strategy. Although the prioritizing issue is a problem that several of the case study companies had experienced, other factors apart from the lack of an innovation strategy can be identified as the cause. One issue mentioned was the higher level of uncertainty in radical innovation projects which increases the risk and as current incentive systems reward risk aversion, employees were less inclined to champion radical projects. This was evident at both Primatech and Westcoast Inc. and has been identified in previous studies as well. Andrew, et al. (2010) found in their survey that executives identified a risk-averse culture to be one of the biggest factors restraining innovation effectiveness.

Another problem affecting the prioritization of radical innovation projects was the established project procedures within the organizations. All case companies predominantly follow a structured stage-gate model, which promotes a linear work

stream, more suitable for incremental innovation as suggested in section 3.2.4. As the linear model is highly embedded within the organizations, previous research such as Leonard-Barton (1992) suggests that the accustomed behaviour is very hard to transform. The bias towards incremental innovation is not only true for the case companies studied as other authors also describe that most established companies have developed a work structure which is more suited for incremental innovation (Dávila, Epstein & Shelton, 2006; Adams, Bessant & Phelps, 2006). Although, this was the case for both Westcoast Inc. and ABC Industries, an effort was made to introduce alternative ways of working in radical projects with an intention of outlining them in the innovation strategy. For instance, ABC Industries structured the innovation process around smaller teams, where teams working with radical innovation used an iterative process whilst in the incremental innovation teams they had a more linear structure. Hence can the company-wide innovation strategy be decomposed into smaller components, each with its own adoption of PTW or PTNL strategy. Although Westcoast Inc. has outlined different ways of working in the preliminary innovation strategy, the company still had some practical problems with changing embedded work patterns of the employees. Even though both companies are working towards a structure supporting both innovation types, it has proved difficult. These difficulties is also found in previous research which underlines the organizational and structural difficulties caused by the dichotomy between radical and incremental innovation (e.g. Dávila, Epstein & Shelton, 2006; Adams, Bessant & Phelps, 2006; Nilsson, et al. 2012).

5.2 Performance measurement

Primatech have a large set of metrics in use but there were examples of the metrics' goals being achieved without any actual innovative improvements, which might indicate a poor connection between what is measured and the intended outcome. So even though a suite of metrics is in place, poor understanding of the causality within the innovation process means that the metrics does not work as a way to drive innovation forward. Instead it works as way for management to follow-up behaviour and base bonuses, which is in clear contrast to what has been suggested by both theory and the expert interviews.

At the other case companies on the other hand, none or very few innovation metrics were in use at all, but for different reasons, which can be attributed to the big discrepancy between the types of innovation projects undertaken at these companies. Water & Power Co. has an innovation portfolio existing predominantly of longer projects where new technology is acquired and projects

are rather evaluated as investments than as an internal development process. This view can contribute to innovation metrics being seen as redundant and investment models are used for evaluation instead. Here, it seems to be a question of suitability to the existing way of conducting business at the organization. Westcoast Inc. has on several occasions tried to implement an innovation measurement system, but due to conflicts of interest and the perceived difficulty and complexity of finding the right set of metrics, it has consistently failed. Due to recent efforts to "innovate the innovation process" at ABC Industries, its innovation measurement system is still in development. Just as with Westcoast Inc., there seems to be a larger degree of enlightened ignorance regarding the difficulties of measuring innovation. Even though attempts have been made to implement measuring, it has been cancelled when it has been seen as unsatisfactory instead of keeping it just for the sake of keeping it.

5.2.1 The question of an accurate maturity level

It became clear through the interviews with both company representatives and experts that many companies have not properly defined their own innovation measurement maturity. This unawareness leads to having a measurement system that might not be at a level that is suitable, which is of high importance according to Eckerson (2009). As in the case of Westcoast Inc., trying to implement a full system that encompasses all aspects and parts of the innovation process at the organization has been futile. Despite the intrinsic value of innovation measurement as suggested by Carayannis and Provance (2007), this leads to misdirected efforts and inefficiencies when not properly connected to an innovation strategy. Seen from a maturity perspective, the first step for an organization would be to define the goals of measuring, but this has evidently been overlooked in the eagerness of implementing a measurement system such as with Primatech. Companies seem to envisage that an innovation measurement system will give full insight into the innovation process from the start instead of starting small. Both Westcoast Inc. and ABC Industries is in the process of defining and communicating a formal innovation strategy and the next step according both to the interviews and theory, is to identify relevant metrics that support the strategy.

Källman and Sandqvist (2012) have a similar view to Eckerson (2009) on the need for aligning measurement and maturity but recommend using 21 metrics for a mature company. To keep supervision of over twenty metrics is more than most authors (e.g. Norton & Kaplan, 1992) propose and together with metrics from the company's other processes it will likely be overwhelming. Both Tobias Larsson and Stefan Cedergren stress the importance of not measuring too much and it is implied in the MINT framework. The interviewee at Primatech indicated that the

company's set of metrics was far from parsimonious and the organization would probably do better with fewer metrics. It is hard to empirically evaluate what would be the right amount of metrics but when implementing a measurement system for innovation it can thus be concluded that it should not be complete and all-encompassing to out start with, but should be seen as a pilot project as suggested by Jan Sandqvist. Also, as Meyer (2002) states will metrics deplete over time and there is a need to replenish them, which further calls for dynamism in the measurement system and makes measurement a continuous process.

5.2.2 Measurement as a tool for changed behavior

Recent research such as Atkinson, Waterhouse & Wells (1997), proposes that a performance measurement system should be used as a way to influence behaviour in a desirable way. This is acknowledged explicitly in the expert interviews by stressing the need for not using only lagging metrics. This can be related to Kaplan and Norton's (1992) view of a measurement system, which points to the importance of understanding underlying causality. Though not stated explicitly, their view was the beginning of what can be seen as the second generation of performance measurement. Synthesizing the consensus view from the company interviews on the other hand, suggests that performance measurement is still used as a way to follow up and control. This type of first generation measurement effort misses the point that measurement in itself contributes to changes in the measurement results by adding focus to the metrics used. When selecting metrics, this should be taken into account, as it most definitely will constitute a large part of the results as proposed by the MINT framework (Nilsson, et al. 2010:p24):

> "Nonetheless, different tools should be used with carefulness. This is because focus often moves from the goals to their measurement when tools are introduced. Moreover, when it comes to complex issues such as innovation, making sense and understanding of the purpose of measuring in order to increase innovation capabilities are prerequisites."

Instead of using innovation measurement as a way to track the innovation progress, it should be used as a way to steer behaviour to correct errors and strengthen the weakest link of the innovation process. This is in contrast to the approach labelled the *inclusive approach* in section 3.3.3, where not much attention is given to the purpose of single metrics but instead to their function or categorization within a predefined framework. A standard framework used in this approach divides the innovation process into an x by x matrix and every metric in each cell is then made sure to keep balance in the metric portfolio. This leads to a very atomistic view of innovation which neglects the importance of acknowledging

the sheer complexity of the process itself, as discussed in theory section 3.1. So even though these frameworks incorporate leading indicators to be able to predict future outcome, they omit the human factor in the metrics themselves. This way, not much focus is given to the behavioural perspective as the framework promotes measuring for follow-up and prediction rather than grass root changes in behaviour. It has been suggested in both the literature and expert interviews, that there is a need to understand what a metric does for behaviour and results, but a tool for evaluating metrics in this way is still to be found. As metrics are a result of behavior, instead of trying to find metrics that measures behavior, practitioners should try to find metrics that will steer behavior to give a desired result.

5.2.3 Innovation measurement as a dynamic learning process

Not knowing what metrics to use has been the most prevalent reason for not implementing a measurement system as found in both empirical studies (Chan, Musso & Shankar, 2008; Andrew, et al. 2008) as well as explicitly in the interview with Westcoast Inc. The sheer complexity of innovation and its measurement has been evident through both the literature review and interviews with experts and company representatives which might deter many efforts to start measuring. But as an extension to the discussion in section 3.3 on performance measurement, Carayannis and Provance (2007) point to the benefits of using the innovation process as an opportunity for learning. Furthermore, Andrew, et al. (2008) concludes their survey by stating that the first step a company should take is to actually start measuring. Innovation measurement brings about positive feedback that further strengthens the innovation system and contributes to existing knowledge within the firm (Bohn, 1994). This is valid also for when selecting metrics and the uncertainty should be embraced instead of trying to figure out the whole picture before a measurement system is implemented. Just starting a discussion on the selection of innovation metrics will most definitely lead to a better understanding of the concept. The important role of knowledge in the innovation process is further suggested by Roper, Du and Love (2008:p961):

> "Knowledge, of different types and from different sources, is the unifying factor providing the main operational link between the different elements of the innovation value chain."

To continuously learn after implementation as well, metrics should be used actively and not in passive follow-up fashion. To counteract this and add dynamism to the measurement system, an increased use of double-loop learning as suggested by Argyris and Schön (1974) would include all stakeholders in the evolution and replenishment of metrics, so they keep producing valid feedback. If

innovation is regarded as a learning process it can be contra productive to always look at deadlines and keep projects separate as it decreases the potential for learning and knowledge transfer. In radical projects that are exploratory in nature, innovation can benefit from being seen as a process with uncertain outputs instead of a structured process leading to an intended output, often the case with incremental innovation. A very structured exploiting approach gives less room for serendipity and unintended outcomes.

In a longer perspective to gain full advantage of using a measurement system, formal evaluation such as knowledge workshops after each project are preferable. But during the company interviews it was evident that such evaluations were scarce as they are not a part of their current innovation model. This result was also found by Cedergren, et al. (2010), who in their study noted that it was uncommon for companies to use a formalized evaluation routine.

5.3 Guidelines for selecting metrics contingent on strategy

It has been argued throughout this thesis, both in theory and during the interviews, that all metrics should be company specific. Therefore instead of giving a comprehensive set of metrics that a company could choose from, something that several other authors have already done, the following subchapter will provide guidelines on important factors to take into consideration when selecting metrics and aligning them with strategy.

Guideline 1: Construct an innovation strategy, break it down to a team level and communicate it clearly throughout the organization.

Reason: Without an innovation strategy, neither the employees nor management knows what to accomplish or how to accomplish it. With the use of an innovation strategy, it becomes more manageable to steer behaviour in the intended direction. This is not a static document but should be updated continuously. Research outlined in the theoretical chapter, has shown that companies with a well-established innovation strategy reaches better innovation performance. By using an innovation strategy and communicate it clearly, the importance of strategy becomes more explicit and this in turn can increase the willingness to innovate amongst the employees. A simple strategy could state the weight of radical and incremental innovation and outline how to work with each.

Guideline 2: Use a portfolio management approach to the innovation projects and be ambidextrous in your innovation effort.

Reason: Companies working with portfolio management gets a holistic overview of all their current and future innovation projects. This allows for better understanding of the overall risk-level and how single projects contributes to it. The portfolio also provides a way for stocktaking the amount of projects with respect to timeframe and incremental or radical focus.

One way of becoming an ambidextrous organization is to divide all employees concerned with innovation into different project units. Define the radicalness of a team or project, and provide the environment relevant for the outcome. The incrementally focused projects would benefit from having a functional structure with formalized roles and responsibilities where the management encourage conformance to rules and to work according to procedures. The projects units with a more radical focus should instead utilize small entrepreneurial units with an exploratory culture, which encourages risk-taking and experimentation.

Guideline 3: Focus on identifying weaknesses and hindrances for innovation as well as facilitators.

Reason: Companies struggle when taking an all-inclusive approach to finding innovation metrics instead of keeping it simple. Starting by correcting weaknesses rather than trying to predict the future and set metrics based on those predictions is a more tangible way of working. In accordance to the 80/20 rule, companies can increase their innovativeness without having to make large changes to the whole innovation process. To start making improvements, it is a good idea to introduce measuring.

Guideline 4: Assign metrics that add attention to the problematic area and use different metrics for incremental or radical innovation.

Reason: When the weak areas of the innovation process have been found, the next step is to find metrics that help steer behaviour to address these areas. By not using metrics for follow-up but as a way to facilitate individual behavioural change, the subjectivity of what is seen as a good result is diminished. It is important to recognize that incremental and radical innovation needs different ways of working. Having the same metrics for both of the approaches will most definitely lead to unwanted results. An example metric is the number of accumulated ideas, which can be a good metric in a project focusing on incremental innovation where the ideation phase has stalled. However, in a project focusing on radical innovation

this metric could prove to be counterproductive by focusing attention on the number of ideas produced, instead of the radicalness of the same ideas.

Guideline 5: See innovation measurement as a learning process.

Reason: Innovation has potential to bring about a positive feedback loop, which contributes to the existing knowledge within the firm. When urged to select metrics and work with the innovation process, a deeper understanding of the area and how it is valuable for the firm is developed. By looking at innovation as a learning process, the first perceived struggle with doing everything right could be seen as something that contributes to the company instead of as a problem.

5.4 Practical contribution

Much focus of previous research on innovation measurement is put on areas of the innovation management process and important parts of the process are outlined. It furthermore focuses on designing new metrics instead of looking at the positives and negatives of the current system (Cedergren, et al. 2010). Frameworks and suggestions for increasing the innovation capability are plenty but practical contributions for taking the first steps are rare. Thus, practitioners are given the first piece of the puzzle but do not get any indication of how to continue. The important part of adaption, adoption and implementation is left to chance. Methods and supportive tools for evaluating crucial questions such as how the new measurement system will affect the actual behaviour within the organization are still to be found. Hence, there is a gap between suggested metrics, the role they will play in the organization and how to actually choose them. With the use of the guidelines outlined above, a framework has been created which is intended to help practitioners to overcome the hurdle of understanding the implications of possible metrics and place them into a strategic context. The framework consists of an illustration of a suggested line of thought regarding how to improve the innovation effort through measuring (Figure 6) as well as a tool for evaluating metrics (Figure 7). When synthesizing the guidelines into a practical framework four distinct themes or activities can be identified which are presented below.

Strategy. Without an established and communicated firm-wide innovation strategy, an organization will struggle to set relevant goals. A first step should be to develop a suitable innovation strategy, which clearly outlines what goals that is intended and how to reach them. This includes mapping a portfolio of innovation projects and defining suitable ways of handling the mix of different projects, i.e. an ambidextrous structure.

Identify. Instead of creating an all-encompassing measurement system that includes all aspects of the innovation process, a more pragmatic approach is to start by identifying weaknesses and hindrances for innovation as well as facilitators. By focusing attention on the problematic areas, resources can be more effectively deployed.

Action. As suggested by both theory and expert interviews, should the selection and development of relevant metrics be a discussion between all stakeholders. A thorough evaluation of suitable metrics that could increase the likelihood of promoting the right behavior should be conducted.

Learn. During the activities of aligning the innovation strategy with suitable metrics, the organization needs to acknowledge the knowledge creation that takes place. By formally collecting the new skills and knowledge from the ongoing innovation process and make it available throughout the organization, the organization will increase the innovation performance further through a deeper understanding.

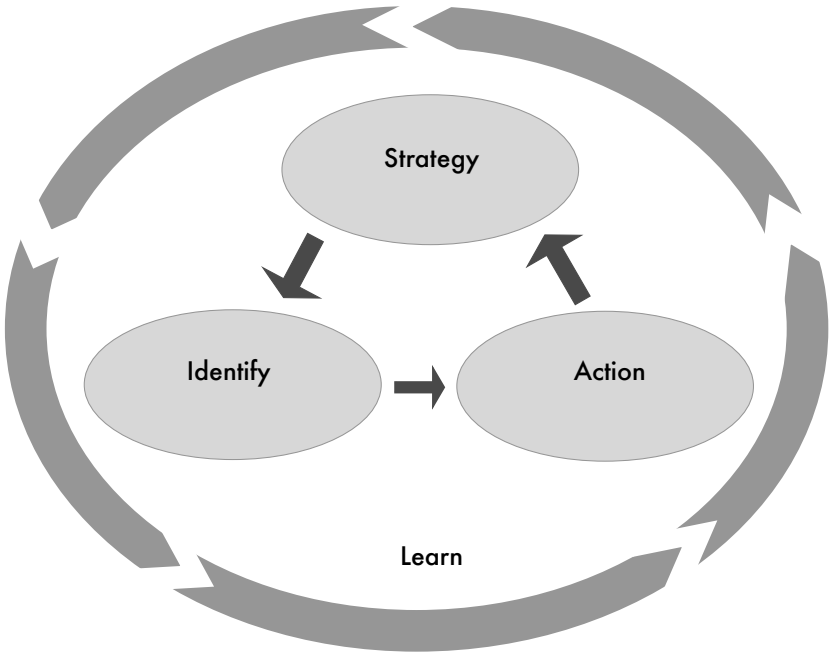

Figure 6. The framework works as an illustration for how to think about the link between innovation strategy, the use of metrics and the continuous learning process.

As it has become evident that it is hard to select metrics that will contribute to the organizational innovation effort in the way intended, a tool has been constructed to aid practitioners. Through the identification activity, weaknesses are identified and can be used as inputs into the tool for a comprehensive evaluation of potential metrics in the *action* activity. First, the problem is outlined and a primary search for potential metrics is done. The candidate metrics can then be scrutinized with help of the aspects found in the tool. Outlined in Figure 7 is the tool with an example problem and all fields filled out as an example and inspiration.

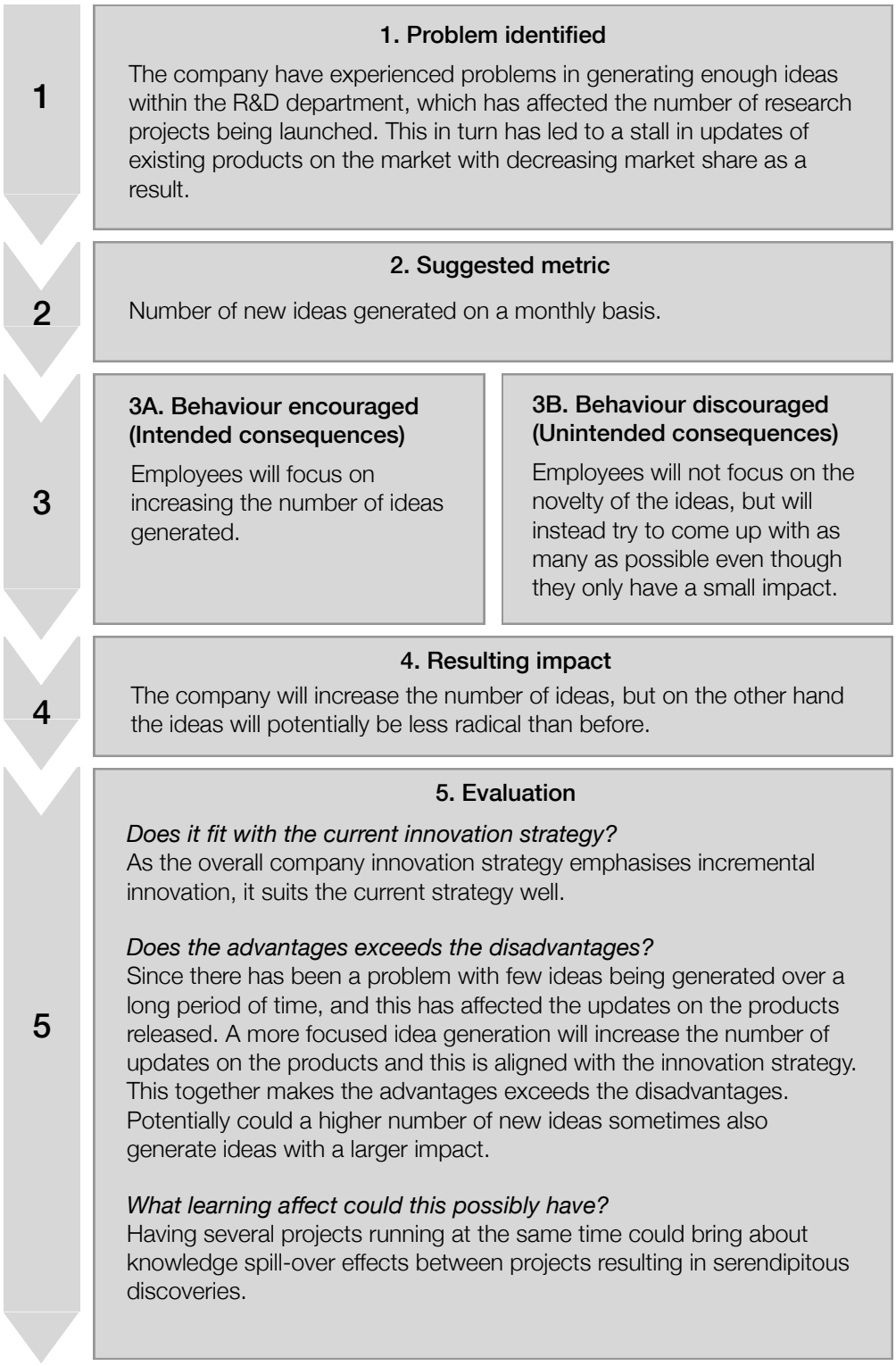

Figure 7. A tool for evaluating the suitability of metrics depending on the intended outcome.

6 Conclusion

6.1 Summary and reflections

Innovation in general is a very complex subject with several different possible perspectives and viewpoints. One of the first and biggest problems is the actual definition of the concept; as there does not exist a universal explanation of the term there is room for a lot of subjective interpretation. This in turn affects the whole subject and contributes to difficulties within all areas of innovation.

Innovation strategy is acknowledged as an important dimension of innovation in theory, however it does not seem to get the same attention in practice. One reason for this seems to be the general difficulty in creating a clear view of the concept. Companies find it hard to start working with questions relating to innovation, and even though discussions are held around the subject, there are few individuals who really work with it. Without an explicit strategy that is well communicated within the company, it is hard to grasp the perceived importance of the topic internally, which leads to risk-aversion and sticking to old routines. The use of innovation metrics in companies does not work in a satisfying way, and proposed best practice within innovation is not suitable for most companies. The company interviewees have found the process of selecting metrics difficult, and the experts further strengthen this view. Instead of working with finding a set of all-encompassing metrics to monitor the whole process, a more focused approach is proposed, where the focus should be on improving the weakest links and thereby improving the quality of the innovation process as a whole. This usage of measurement is not a way for companies to track their innovation effort progress but instead works as a way to improve it. There already exist a plethora of standard quantitative metrics that can work as a proxy to measure the progress.

With the proposed framework practitioners working with the innovation process can find support on how to address the problem of finding effective metrics. Relating measurement to innovation will create a learning environment around the innovation process that can increase the innovation performance. Previous research has proposed a range of metrics to choose from for different phases of the innovation process but this does not give any indication of what effects the

metric itself will have, or why a certain metric should be used. Moreover, this thesis has resulted in a tool for evaluating suitability of metrics with a focus on behaviour and strategy. It is hoped that it can provide some guidance for practitioners that want to start to, or change the way they measure and view innovation.

6.2 Discussion

In the report, the main intention of the gathered empirics was to get an understanding for how companies work with innovation, and their thoughts on working with the same. One idea expressed by all companies and further discussed with the experts was that companies find it hard to work with the innovation process in general, and innovation measurement specifically. Even though this is not a revolutionary finding in any way, it points out a somewhat overlooked problem with the innovation process as of today. The participating case companies represent only a fraction of the industries working with innovation, but the idea of finding innovation difficult could probably be generalized in different contexts irrespective of industry. This implies that the guidelines and the resulting framework are widely generalizable.

The framework presented in the previous section of the report, might seem like a very straightforward process, almost provokingly easy, as it does not take circumstances outside the innovation process into consideration. During the interviews it became apparent that cultural differences, personal conflicts and bureaucratic activities largely contributed to the difficulties in the innovation process. These aspects have not explicitly been included in the guidelines and framework despite the focus on changing behaviour to get better results. This is rather a matter of organizational complexity. So when evaluating what areas in the innovation process that is not working well, these factors should be raised to the surface. By explicitly including the above-mentioned issues in the framework it would increase the complexity of the framework, which is opposite to the intention of the thesis.

Relating to this, there are potential drawbacks of focusing on the weak areas of the innovation process instead of focusing on what is working well. For instance, if a specific department or even manager that is responsible for the problematic area, a resistance against change might take place. It is therefore important to always emphasize that working with problematic areas enhances the overall process and it needs to be as transparent as possible. Another risk factor is a negative culture where people search for problems instead of focusing on what is really working

well. When working with these questions management has an important role to promote a learning culture and to emphasize what is already working well so that too is highlighted.

There has not been any conclusion drawn between the company innovation process, the way of working with innovation strategy and performance measurement, and how it affects the company result. Empirical data supporting this could have strengthened the foundation on which the results are based. Instead the implied importance of having a structured innovation process is based upon earlier empirical research. This topic was discussed in the early phase of the thesis process, but is left for future research.

6.3 Theoretical and practical contribution

The theoretical contribution of the thesis is a compilation of the literature within the field of innovation measurement and innovation strategy, as well as a relation between the areas. The combination of these areas has not got much attention in previous research, so through this thesis a broader theoretical base has been created. Apart from this, the importance of the behavioral aspects of performance measurement has been highlighted.

The practical contribution of the thesis is the framework presented in the previous section. This way of working will hopefully help practitioners struggling with innovation measurement and by giving them a simpler hands-on approach. Previous contributions to the innovation measurement effort usually take a all-inclusive approach where a large number of different metrics are presented without any practical way of working with them. This is argued to increase the difficulties faced by most companies when working with these questions.

6.4 Further research

The area of innovation measurement is still largely unexplored and there are many aspects to learn more about. The general notion that a structured innovation process increases company performance is hard to empirically prove but would provide an interesting research question to answer. Furthermore, building on the results presented in this thesis, proposed future research could be to empirically evaluate different innovation measurement systems that have been implemented, e.g. one using an *inclusive* or a *focus* approach. Even though there is a strong connection between academia and the industry when it comes to innovation, the adoption of new practices in the industry governs what is validated within the area,

as theory never can be confirmed without an actual implementation. The next logical step would thus be to convey the findings from this thesis to companies, as the best way to test a theory is to implement it in practice.

7 References

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. International Journal of Management Reviews, 8(1), 21-47.

Adelman, D., & DeAnglis, K. (2007). Patent metrics: the mismeasure of innovation in the biotech patent debate. Texas Law Review. Jun 2007, Vol. 85 Issue 7, p1677-1744.

Andrew, J. P., DeRocco, E. S., & Taylor, A. (2009). The innovation imperative in manufacturing: How the United States can restore its edge. BCG Report: The Boston Consulting Group.

Andrew, J. P., Haanæs, K., Michael, D. C., Sirkin, H. L., & Taylor, A., (2008). Measuring Innovation 2008: Squandered Opportunities. BCG Report: The Boston Consulting Group.

Andrew, J. P., Haanæs, K., Michael, D. C., Sirkin, H. L., & Taylor, A. (2009). Measuring Innovation 2009: The Need for Action. BCG Report: The Boston Consulting Group.

Andrew, J. P., Manget, J., Michael, D. C., Taylor, A., & Zablit, H. (2010). Innovation 2010: A return to prominence - and the emergence of a new world order. BCG Report: The Boston Consulting Group.

Argyris, C. (1976). Single-loop and double-loop models in research on decision making. Administrative science quarterly, 363-375.

Argyris, C., & Schön, D. A. (1974). Theory In Practice: Increasing Professional Effectiveness. A Joint Publication in The Jossey-Bass Higher and Adult Education Series and the Jossey-Bass Management Series. Jossey-Bass Inc., Publishers, 350 Sansome Street, San Francisco, CA 94104.

Arundel, A., & O'Brien, K. (2009). Innovation metrics for Australia. In: Talbot, L., Toh, H., Balaguer, A., Achanfuo-Yeboah, B., & Colman, J. (eds.): Innovation metrics framework project. Consolidated report. Canberra: Australian Government, Department of innovation, industry, science and research.

Atkinson, A. A., Waterhouse, J. H., & Wells, R. B. (1997). A stakeholder approach to strategic performance measurement. Sloan management review, 38(3), 25-37.

Barnett, H. G. (1953). Innovation: The basis of cultural change. New York: McGraw-Hill.

Benner, M. (Ed.). (2005). Innovationer: dynamik och förnyelse i ekonomi och samhällsliv. Lund: Studentlitteratur.

Beugelsdijk, S. (2008). Strategic human resource practices and product innovation. Organization Studies, 29(6), 821-847.

Blau, P. M. (1955). The dynamics of bureaucracy: A study of interpersonal relations in two government agencies. University of Chicago Press.

Bohn, R. E. (1994). Measuring and managing technological knowledge. Sloan Management Review, 36, 61-61.

Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: catching the wave. Harvard Business Review, Jan-Feb 1995.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. Academy of management review, 343-378.

Bryman, A. & Bell, E. (2005). Företagsekonomiska forskningsmetoder. Malmö: Liber Ekonomi.

Burns, T., & Stalker, G. M. (1961). The management of innovation. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Carayannis, E. G., & Provance, M. (2007). Measuring firm innovativeness: towards a composite innovation index built on firm innovative posture, propensity and performance attributes. International Journal of Innovation and Regional Development, 1(1), 90-107.

Catasús, B., Ersson, S., Gröjer, J. E., & Wallentin, F. Y. (2007). What gets measured gets… on indicating, mobilizing and acting. Accounting, Auditing & Accountability Journal, 20(4), 505-521.

Cedergren, S., Wall, A., & Norström, C. (2010). Evaluation of performance in a product development context. Business Horizons, 53(4), 359-369.

Chan, V., Musso, C., & Shankar, V. (2008). Assessing innovation metrics. McKinsey Quarterly Global Survey.

Chesbrough, H. (2007). Business model innovation: it's not just about technology anymore. Emerald 35

Christensen, C. M., Raynor, M. E., & Anthony, S. D. (2003). Six keys to creating new-growth businesses. Harvard Management Update, 8(1), 3.

Cooper, R. G. (1990). Stage-gate systems: a new tool for managing new products. Business Horizons, 33(3), 44-54.

Cooper, R. G., & Kleinschmidt, E. J. (2007). Winning businesses in product development: The critical success factors. Research-Technology Management, 50(3), 52-66.

Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2002). Improving new product development performance and practices. Consortium Learning Forum Best-Practice Report. Houston, TX: American Productivity and Quality Center.

Cordero, R. (1990). The measurement of innovation performance in the firm: an overview. Research Policy, 19(2), 185-192.

Corso, M., & Pellegrini, L. (2007). Continuous and discontinuous innovation: Overcoming the innovator dilemma. Creativity and Innovation Management,16(4), 333-347.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. Academy of management journal, 555-590.

Damanpour, F. (1996). Organizational complexity and innovation: developing and testing multiple contingency models. Management science, 42(5), 693-716.

Dávila, T. (2000). An empirical study on the drivers of management control systems' design in new product development. Accounting, organizations and society, 25(4), 383-409.

Dávila, T., Epstein, M., & Shelton, R. (2006). Making innovation work: How to manage it, measure it, and profit from it. Financial Times Press.

DTI (1998). An Audience With Innovation: Innovation in Management. London: Department of Trade and Industry.

Dubois, A. & Gadde, L. E. (2002), "Systematic combining: an abductive approach to case research", Journal of Business Research, Vol. 55, pp. 553-60.

Eccles, R. G. (1991). The performance measurement manifesto. Harvard business review, 69(1), 131-137.

Eckerson, W. (2009). Performance Management Stategies. TDWI Best Practises Report.

Eisenhart, K. M. (1989). Building Theories from Case Study Research, Academy of Management Review, Vol. 14, No. 4, pp. 532-550.

Ernst, H. (2003). Success factors of new product development: a review of the empirical literature. International Journal of Management Reviews, 4(1), 1-40.

Ettlie, J. E., Bridges, W. P., & O'Keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. Management science, 30(6), 682-695.

Fagerberg, J. (2006). Innovation: A guide to the litterature. In: Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.) The Oxford handbook of innovation. OUP Oxford. Chapter 1.

Franczek, C. E. (2007). Five mistakes companies make when measuring innovation. The innovation Practice. [Online] Available at: http://www.theinnovationpractice.com/pdf/5mistakes-FINAL.pdf [Accessed on 15 Apr 2013].

Frenken, K. (2006). Technological innovation and complexity theory. Economics of Innovation and New Technology, 15(2), 137-155.

Goffin, K., & Mitchell, R. (2010). Innovation management. 2nd edition. Palgrave Macmillan.

Hage, J. T. (1999). Organizational innovation and organizational change. Annual Review of Sociology, 597-622.

Hagedoorn, J., & Cloodt, M. (2003). Measuring innovative performance: is there an advantage in using multiple indicators?. Research policy, 32(8), 1365-1379.

Halachmi, A. (2002). Performance measurement: a look at some possible dysfunctions. Work study, 51(5), 230-239.

Hamel, G., & LeBarre, P. (2012). Help Us Innovate the Innovation Process. HBR Blog Network [Online] Available at: http://blogs.hbr.org/cs/2012/10/how_can_we_innovate_the_innova.html [Accessed on 24 Jan 2013]

Hansen, M. T., & Birkinshaw, J. (2007). The innovation value chain. Harvard business review, 85(6), 121.

Harkema, S. (2003). A complex adaptive perspective on learning within innovation projects. Learning Organization, The, 10(6), 340-346.

Hayes, R. H., & Abernathy, W. J. (1981). Managing our way to economic decline. Mckinsey Quarterly, (1), 2-23.

Henderson, R. (1993). Underinvestment and incompetence as responses to radical innovation: Evidence from the photolithographic alignment equipment industry. The RAND Journal of Economics, 248-270.

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative science quarterly, 9-30.

Herzberg, F., Mausner, B., & Snyderman, B. B. (1959). Motivation to work. Transaction Publishers.

Höst, M., Regnell, B., & Runeson, P. (2006). Att genomföra examensarbete. Lund: Studentlitteratur AB

Jalonen, H. (2011). The uncertainty of innovation: a systematic review of the literature. Journal of Management Research, 4(1).

Johnson, H. T., & Kaplan, R. S. (1991). Relevance lost: The rise and fall of management accounting. Harvard Business Press.

Kahn, K. B., Barczak, G., Nicholas, J., Ledwith, A., & Perks, H. (2012). An examination of new product development best practice. Journal of Product Innovation Management, 29(2), 180-192.

Kahneman, D. (1973). Attention and effort. Englewood Cliffs, New Jersey: Prentice-Hall.

Källman, K., & Sandqvist, J. (2012). Book of Metrics, Edition 2012. Innovation Pioneers.

Kanigel, R. (2007). The one best way: Frederick Winslow Taylor and the enigma of efficiency. MIT Press Books, 1.

Kaplan, R., & Norton, D. (1992). The balanced scorecard - Measures that drive performance. Harvard Business Review (Jan-Feb): 71-79.

Kaplan, R., & Norton, D. P. (1996). The balanced scorecard: translating strategy into action (Vol. 4). Boston: Harvard Business school press.

Kerr, S. (1975). On the Folly of Rewarding A, While Hoping for B. Academy of Management Journal, 18(4), 769-783.

Kilroy, D. B. (1999). Creating the future: how creativity and innovation drive shareholder wealth. Management Decision, 37(4), 363-374.

Kline, S. J., & Rosenberg, N. (1986). An overview of innovation. The positive sum strategy: Harnessing technology for economic growth, 14, 640.

Kondo, Y. (2000). Innovation versus standardization. The TQM Magazine, 12(1), 6-10.

Kovács, G., & Spens, K. (2005). Abductive reasoning in logistics research. International Journal of Physical Distribution & Logistics Management, 35, 132-144.

Kuczmarski, T. D. (2001). Five fatal flaws of innovation metrics. Marketing Management, 10(1), 34-39.

Kuczmarski, T. D. (2003). What is innovation? And why aren't companies doing more of it?. Journal of consumer marketing, 20(6), 536-541.

Kwoh, L. (2012). You Call That Innovation? The Wall Street Journal [Online] Available at: http://online.wsj.com/article/SB10001424052702304791704577418250902309914.html#articleTabs%3Darticle [Accessed on 22 Jan 2013]

Lam, A. (2006). Organizational innovation. In: Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.) The Oxford handbook of innovation. OUP Oxford. Chapter 5.

Lawson, B., & Samson, D. (2001). Developing innovation capability in organisations: a dynamic capabilities approach. International Journal of Innovation Management, 5(03), 377-400.

Leifer, R., O'Connor, G. C., & Rice, M. (2001). Implementing radical innovation in mature firms: The role of hubs. The Academy of Management Executive, 15(3), 102-113.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. Strategic management journal, 13(S1), 111-125.

Lindvall, J. (2001). Verksamhetsstyrning. Från traditionell ekonomistyrning till modern verksamhetsstyrning. Lund, Sweden: Studentlitteratur.

Martin, R. L. (2009). The design of business: why design thinking is the next competitive advantage. Harvard Business School Press.

Martins, E. C., & Terblanche, F. (2003). Building organisational culture that stimulates creativity and innovation. European Journal of Innovation Management, 6(1), 64-74.

McCarthy, I. P., Tsinopoulos, C., Allen, P., & Rose-Anderssen, C. (2006). New product development as a complex adaptive system of decisions. Journal of Product Innovation Management, 23(5), 437-456.

McDermott, C. M., & O'Connor, G. C. (2002). Managing radical innovation: an overview of emergent strategy issues. Journal of product innovation management, 19(6), 424-438.

McLaughlin, P., Bessant, J., & Smart, P. (2005). Developing an organizational culture that facilitates radical innovation in a mature small to medium sized company: emergent findings.

Mitchell, D., & Coles, C. (2003). The ultimate competitive advantage of continuing business model innovation. Journal of Business Strategy, 24(5), 15-21.

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

Nelson, R. (1993). National innovation systems: a comparative analysis. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Nicholas, J., Ledwith, A., & Perks, H. (2011). New product development best practice in SME and large organisations: theory vs practice. European Journal of Innovation Management, 14(2), 227-251.

Nilsson, F., Regnell, B., Larsson, T., & Ritzén, S. (2010). Measuring for Innovation – a guide for innovative teams. Applied Innovation Management.

Nilsson, S., Wallin, J., Benaim, A., Annosi, M. C., Berntsson, R., Ritzen, S., & Magnusson, M. (2012). Re-Thinking Innovation Measurement To Manage Innovation-Related Dichotomies In Practice.

O'Connor, G. C., & DeMartino, R. (2006). Organizing for radical innovation: an exploratory study of the structural aspects of RI management systems in large established firms. Journal of product innovation management, 23(6), 475-497.

OECD. (2005). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. 3rd Edition. The Organisation for Economic Co-operation and Development.

Ouchi, W. G. (1977). The relationship between organizational structure and organizational control. Administrative science quarterly, 95-113.

Peters, T., & Waterman, R. H. (1982). In Search of Excellence: Lessons from America's Best-Run Companies. Harper & Row: New York.

Ramberg, U. (1997). Utformning och användning av kommunala verksamhetsmått. Lund University Press.

Rao, J., Wilson, J., Watkinson, J. (2009). Culture Drives Innovation, Not Ideas! Innovation at work [Online] Available at: http://innovationatwork.wordpress.com/tag/managing-innovative-people/ [Accessed on 28 Jan 2013]

Ridgway, V. F. (1956). Dysfunctional consequences of performance measurements. Administrative Science Quarterly, 1(2), 240-247.

Robbins, S. P. (1996). Organizational Behavior: Concepts, Controversies, Applications. 7th ed. Prentice-Hall. Englewood Cliffs, NJ.

Robertson, T. S. (1967). The process of innovation and the diffusion of innovation. The Journal of Marketing, 14-19.

Roper, S., Du, J., & Love, J. H. (2008). Modelling the innovation value chain. Research Policy, 37(6), 961-977.

Rothwell, R. (1994). Towards the fifth-generation innovation process. International marketing review, 11(1), 7-31.

Sandkull, B., & Johansson, J. (2000). Från Taylor till Toyota: Betraktelser av den industriella produktionens organisation och ekonomi. Studentlitteratur.

Schroeder, R. G., Van de Ven,, A. H., Scudder, G. D. & Polley, D. (1989). The development of innovative ideas. In A. H. Van de Ven et al. (Eds), Research on the Management ofInnovation. New York: Harper & Row

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Simons, R., Dávila, A., & Kaplan, R. S. (2000). Performance measurement & control systems for implementing strategy: text & cases. Upper Saddle River, NJ: Prentice Hall.

Smith, K. (2006). Measuring innovation. In: Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.) The Oxford handbook of innovation. OUP Oxford. Chapter 6.

Thomond, P., & Lettice, F. (2002). Disruptive Innovation Explored. Concurrent Engineering Conference Proceedings July 2002.

Trott, P. (2012). Innovation management and new product development. Fifth edition. Prentice Hall.

Turrell, M., (2004). Show me the numbers: a look at innovation metrics, Imaginatik working paper, Available at: http://www.innovationmanagement.se/imtool-articles/show-me-the-numbers-a-look-at-innovation-metrics/ [Accessed on 9 Apr 2013]

Tushman, M. L., & O'Reilly III, C. A. (1996). Managing evolutionary and revolutionary change. California management review, 38(4), 8-28.

Verspagen, B. (2006). Innovation and economic growth. In: Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.) The Oxford handbook of innovation. OUP Oxford. Chapter 18.

Von Hippel, E. (1978). Successful industrial products from customer ideas. The Journal of Marketing, 39-49.

Voûte, J. H. (2000). Perspectives on innovation: A new TAO for business renewal and development. In Engineering Management Society, 2000. Proceedings of the 2000 IEEE (pp. 351-356). IEEE.

Weerawardena, J., O'Cass, A., & Julian, C. (2006). Does industry matter? Examining the role of industry structure and organizational learning in innovation and brand performance. Journal of Business Research, 59(1), 37-45.

Wettstein, T., & Kueng, P. (2002). A maturity model for performance measurement systems. Management information systems, 113-122.

Wolfe, R.A. (1994). Organisational innovation: Review, critique and suggested research directions. Journal of Management Studies, May, 31(3), 405–425

Xavier Molina-Morales, F., Teresa Martínez-Fernández, M., & Torlò, V. J. (2011). The dark side of trust: the benefits, costs and optimal levels of trust for innovation performance. Long Range Planning, 44(2), 118-133.