STOCKHOLM SCHOOL OF ECONOMICS
MASTER'S THESIS WITHIN INTERNATIONAL BUSINESS

Innovation Metrics – keys to increase competitiveness

Abstract

The quest and need for innovation have become ever more evident in today's corporate world. Western companies in particular are facing high competition due to the continuous globalization of the world. This calls for higher focus on making innovation more comprehensive and hence more tacit throughout the competitive organization, in order to effectively be able to manage and improve it. The purpose of this thesis has been to identify ways of using metrics as a way to improve innovation management and hence innovation performance.
The research is conducted around discussions on theories concerning innovation and innovation metrics, as well as by an illustration of the practical ways of working with innovation metrics in large-sized Swedish multinational companies. The empirical data is collected through both qualitative and quantitative interviews with employees working specifically with innovation, in some companies even called "Innovation Managers". An abductive research approach has lead to the construction of a 12-window matrix, based in theory but provoked by the corporate reality, in which the empirical results have been analyzed. Through this framework, similarities and dissimilarities between theory and practice have been analyzed, showing that practical ways of measuring innovation differ highly from the metrics suggested by theory, through highly unbalanced and seemingly random metrics of very simple character. The aim of the comparison and creation of a framework is to show that by in fact rather small changes of the metrics in use, improvements could be achieved rather easily. Finally, a clear structuring of innovation through the use of a metrics framework, opens up for common organizational understanding of the concept, and hereby more tacit reasoning for managerial decisions and allocation of resources.

Key words: *Innovation, innovation metrics, competitiveness, leadership*

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Contents

1. Innovation-situation of today

In this chapter, some current discussions around innovation will be dealt with. This insight will lead to the argument for innovation metrics as a useful and potentially crucial tool in order to manage innovation effectively. The chapter will go on to discuss the specific problem definition and the aim of answering to the formulated research questions. Successively a few limitations will be discussed, whereafter a chapter layout will present the structure of the thesis.

1.1 Innovation in the news

A simple definition of innovation is "the introduction of something new". In terms of business it can more vividly be explained as "the continuous process of developing ideas and business opportunities into commercially viable initiatives"[1]. To most established companies, innovation is what propels growth. In fact, this growth has become increasingly under pressure during the past decades, with the rapid change of the world's economic order. New market entrants, new technologies, shorter product life cycles, more empowered customers and a more globalized marketplace has posed new challenges, for all types of industries. The US' Council on Competitiveness has even declared that innovation will be the single most important factor in the 21st century in determining the success of the nation.[2] The European Union body for Enterprise & Industry Innovation has claimed that European companies cannot compete in the new global environment unless it becomes more innovative and responds more effectively to consumers' needs and preferences, a need which has become ever more apparent.[3] In fact, organizations today cannot expect to survive without innovation, and the only question is whether slow innovators will be overrun suddenly by competitors who come up with successful innovations or if they will slowly fall deeper as their competitors constantly push the competition.[4] Therefore, what is needed is not just innovation, but sustained innovation[5] – that is well balanced and long-term lasting. Companies need a stable flow of different types of innovations, over time.

Over the years, companies have indeed become increasingly aware of the need for innovation. Several have tried to tackle the issue by introducing innovation programs, innovation work flows, innovation processes and other structures in order to take control of an area which was previously through of as something "free-flowing" and "uncontrollable". In times of economical turmoil, it can be argued that one does not have the resources to focus on innovation initiatives. However, many argue that innovation, now more than ever, should be on top of the agenda. "Innovation (…) is particularly important right now in the current global and economic environment (…) because innovation is driven by the capture and implementation of ideas from across the organisation (…) that can be used to effectively generate ideas for new products and services (but also) for cost savings and improving efficiency in a downturn"[6].

Old management aphorisms such as "you can't manage what you don't measure" and "what gets measured gets done" imply that it is vital to also measure innovation in order to manage it. Only hereby can you diagnose the overall innovation performance over time. But innovation metrics are

[1] Googol Business Navigator AB on "Innovation". A further discussion of innovation definitions will take place in Chapter 3.1
[2] Council of Competitiveness 2004
[3] European Commission: Enterprise & Industry Innovation 2009
[4] See for instance: Davila et al. 2006, Dundon, Drucker (Innovation…)2007, Drucker (People…) 2007
[5] Muller et al. 2005
[6] Mackinnon 2004

not only important to in order to measure the current situation, but is also a vigorous tool for improving it. Only by measuring can management decide on strategic direction and identify where to allocate resources to innovation projects.[7] Well communicated metrics also steer behaviour through the inherent identification of important innovation areas. It can hence also play an important role in enhancing the long-run innovativeness, through having all employees on board.[8] On top of this, measurable numbers are an easy way of sending a credible signal of innovativeness to your shareholders. In fact, it has been claimed that as soon as a leading company can demonstrate the long-term advantage of its superior performance on innovation, this will change the rules on the market forever, and it is only a matter of time given the efforts to try to track and enhance non-primarily-fiscal-measures related to innovation.[9]

Still however, companies do not seem to know how or what to measure. In the companies where metrics actually exist, they vary considerably and remain highly rudimentary according to global studies, recently performed by two separate well known management consulting firms.[10] The same situation can be identified in Sweden where a study performed in 2006 on CEO's in 29 large-sized companies in Sweden concluded that a majority of the respondents felt they lacked adequate innovation metrics.[11]

One reason, according to one of the above consulting firms, is that companies are under the mistaken impression that innovation somehow is different from other business processes and that it cannot or should not be measured. "The potential cost of this error (…) is substantial."[12]. Another major reason may be that there exists no general and official suggestions for measuring firm-level innovation, leaving the companies without framework.

1.2 Problem definition and aim of thesis

Swedish as well as the international companies obviously struggle to find the right metrics and the right methods of measuring. The current situation has lead to the following problem definition:

Q: How can innovation metrics be used to strengthen the competitiveness of a company?

To help answer this main question, the following two research questions will be included:

(i) Which innovation metrics are developed and suggested by academia?

(ii) What are the ways of working with innovation metrics, in Swedish large-sized multinational corporations, and what actual metrics are being used today?

Through answers to these questions, this paper aims to contribute to an improved (and more transparent) relationship between conceptual and applied work in this area. Research question i) answers to a mapping of innovation metrics suggested by various international academic research, which will lead to a better understanding of what metrics are "potentially useful"[13] according to theory. Through research question ii) information will then be complemented with an understanding of the

[7] See for instance Muller et al. 2003, Goffin & Mitchell, 2005, Davila et al. 2006
[8] See for instance Regnell et al. 2008, Goffin & Mitchell, 2005, Davila et al. 2006
[9] Eccles 1991
[10] Chan et al. 2008
[11] Schleimann-Jensen & Sauraga 2006
[12] Andrew et al. 2008
[13] The "usefulness" implies that the theoretic metrics chosen should be generic in order to be useful for a broader selection of companies.

situation in practice, through a study on how and what metrics are in fact applied in large Swedish multinationals (limitations will be explained further in chapter 1.3.) combined which the actual experiences, challenges and requirements of innovation metrics. An analysis of this theoretical and practical current status aims to create better understanding of whether, and if so how, a more competitive use of innovation metrics could be applied. Although this study is performed on 26 of Sweden's largest multinationals, it aims to contribute to improved applicability of innovation metrics regardless of nationality of corporation, and to an increased general knowledge on the area of innovation metrics.

Finally, there is a global innovation metric for nations, called the Global Innovation Index (GII), which builds on a holistic framework including 5 input metrics and 3 output metrics (all calculated by a number of sub-metrics)[14]. This index ranks the worlds best and worst-performing economies in terms of innovation. It is the hope that this thesis will make a contribution by inspiring to what in the future might result in a Global *Corporate* Innovation Index, which could be used for internal management and improvement, but also for signaling towards investors and benchmarking against competitors.

1.3 Limitations

General innovation concepts will be discussed through four theoretical models and additional author's supporting comments only in order to ensure cohesion between the authors' and the readers' definition and understanding of innovation concepts and to lay a foundation for the arguments around innovation metrics. The thesis will however not discuss specifics of innovation management such as how to encourage innovation, how to organize innovation teams etc, other than on points specifically relevant to metrics.

Several specific theoretical as well as empirical metrics will be used in the thesis. Theoretical metrics will be chosen on the basis of certain important parameters, explained further in Chapter 4.4. Beyond that, it will be assumed that the applicability has already been considered before suggested. There will hence be no thorough investigation as to how, where, how often, by whom etc. the data for the metrics will be collected. Neither will any financial analysis be performed as to the cost-benefit or similar of the metrics. The display of specific metrics is only provided in order to support the different parts of the model, and should not be interpreted as an exhaustive list of possible metrics, neither a perfect one. Rather it should be seen as a source for inspiration, where modifications, definitions and applications will need further discussion.

In terms of evolution, the historical perspective, such as how innovation or innovation metrics has changed until today, will not be dealt with. Although it could give interesting inputs as to how and in which direction innovation metrics application is changing, it is not directly relevant to the problem definition of this thesis. For the same reason, no discussion around general performance metrics or indicators beyond those that relate to innovation will be brought up.

As mentioned in chapter 1.2 and chapter 2.1.2 neither nationality nor size will play a part in the conclusions, and the results will be assumed generally applicable in an international business context. However, in order to create limitation and a certain level of homogeneity, this limited sample has been chosen for the empirical part of the thesis. The sample consists of companies from many different industries, and no limitation in terms of industry, type of product, product life cycle etc.

[14] See Chapter 3.3 for a definition of input versus output

has been made, other than that the companies are all for-profit, registered corporations. Based on previous studies of innovation and innovation metrics, the tendency has showed that structuring of innovation metrics is still under testing or even un-tested in the corporate world, wherefore comparisons would be difficult, and probably not even constructive to make.

The study will in addition focus only on middle managers as respondents. A confirmation of their responses from both top management as well as lower level employees would have been both interesting and valuable, however not possible within the timeframe of this thesis.

1.4 Chapter layout

The below exploratory design has the purpose of describing the course in which the thesis has been structured, and hereby to create a holistic picture of the structure and progression of the work. This will be illustrated by a short description of the contents of each chapter:

To give an understanding of the methodological approach of the thesis, **chapter 2** describes the theoretical and empirical approaches, as well as different techniques in terms of interviews and analysis of the data. This is followed by an evaluation of reliability and validity of the work. **Chapter 3** includes an understanding of the term "innovation", and identifies four main theoretical approaches to innovation, that are discussed and compared, at the same time as being complemented with other theories and sources. This is then followed by **chapter 4**, where three horizontal phases and four vertical levels are identified based on the theoretical discussion, in order to create a common framework that the empirical data in **chapter 5** will be built upon. Furthermore, chapter 5 gives an understanding of the included companies' attitudes towards innovation, as well as their approaches to measuring innovation today. This chapter is rounded off with several challenges and issues that they have identified. Chapter 3 - 5 therefore lays the foundation for the analysis in **chapter 6**. Here, the findings are analysed in comparison to the suggested framework from chapter 4, thereby resulting in a conclusion to how the main question of this thesis is answered. A conclusion of the findings will be presented in **chapter 7**, followed by future research suggestions, literature overview and appendix in **chapter 8, 9 and 10** respectively.

2. Methodology

The following part of the paper has the purpose of explaining the methodology of the thesis.
It will start out with a description of how the research process has evolved over time. Then, a description of the theoretical as well as empirical approach will be presented, followed by a discussion of the reliability and validity of the theories and the empirical data.

2.1 Research methodology

When conducting social sciences research, two different main methods can be followed to connect theory with empirical findings: *deductive* and *inductive methods*. The former method includes formulating one or more hypothesis based on existing theory, and testing these against collected empirical data. When following the latter method, the researcher starts out with collection of empirical data, which then functions as a basis for formulating relevant theory.[15] In between these extremes, a third method can be found - the *abductive method*[16]. This method entails taking part of existing theories during the collection of the empirical data. This can be explained as a circular analytical approach, where a natural cause of doing research will raise new questions and further understanding.[17]

When, as has been done in this thesis, creating fusions and extensions of previous theories, conclusions should be derived from both existing theories and empirical data, alternating between inductive and deductive methods. In this thesis, the *abductive*, or circular, approach has therefore been judged the most appropriate method as theories around innovation metrics are scarce. The existing theories on the subject were studied before collecting empirical data, in order to understand the specific research area. The design of the interviews was thereby based on theoretical knowledge, which represents a deductive approach. The interviews have then allowed for situation-adaptation in order to ensure the collection of further important business context parameters, which represents an inductive approach.

In this thesis, a *mixed method study* has also been used, which entails a combination of qualitative and quantitative data collection and analysis.[18] The approach, also labelled multi-method, methodological mix, combined method, integrated mix, multiple methods and triangulation, may offer several benefits and increase the value added of a study.[19] The field of international business's special character of increasing complexity and high speed of change within organizations and business due to globalization, poses higher pressure for change to existing theories. Therefore, it is argued that the solution to these problems requires a more holistic, multidisciplinary and multi-method approach in research.[20] In this thesis, the initial reading on literature created an understanding on recommendations around metrics. During the initial interviews however, is very soon became clear that no answer, or even line of thinking around metrics, was similar to the next, and hence the decision was made to focus on creating a more extensive and thorough model of innovation metrics, than has so far been provided in theory. In this, the quantitative approach of mapping various metrics used was judged important in order to create an understanding for the current business approach

[15] Bryman 2006, Patel & Davidson 2003, Rienecker & Jörgensen 2002
[16] Alvesson & Sköldberg 2008
[17] Andersen 2005
[18] Creswell et al. 2003
[19] See for instance Jick 1979, Creswell 1994, Wolstenholme 1999, Tashakkori & Teddlie 2003, Hurmerinta-Peltomaki & Nummela 2006
[20] Hurmerinta-Peltomaki &Nummela 2006

to innovation metrics. A simultaneous qualitative approach would then be crucial for reaching a deeper and fuller understanding of what was actually lacking with the companies in terms of innovation metrics. [21] The qualitative approach would here also be useful for analysing existing but limited theory.[22]

2.1.1 Theoretical approach

As of today, there is no single book dealing exclusively with innovation metrics.[23] Many innovation management books however have specific chapters on metrics which, together with a number of papers on the subject, has constituted the theoretical foundation for this thesis. Four very recent (from between 2005 to 2008), non-industry specific and rather holistic models of general innovation management, accompanied by specific suggestions for metrics, have been chosen to constitute the basis for the later developed model of innovation metrics. The novelty of the four models has been judged highly important as the concept of working structured with innovation is rather new, as well as the fact that the increasing popularity of it leads to a strong stream of general articles on updated views on innovation. Again, in terms of subjects relating to international business, this is increasingly important.[24] To support the models and the reasoning for the structuring of the framework, they have however been complemented with comments from other sources. These sources stem from both old as well as more up to date articles and books on innovation. No further validation of these specific sources will be done, as they are only used to back up the statements throughout the thesis.

The holistic and non-industry specific character of the four models has also been judged important, as the thesis is based on cross-industrial empirics. This due to the later developed argument that the modern definitions of innovation are multifaceted and non-industry specific and covers several areas of an organization (see chapter 3.1). In connection to specificity, the literature research has found other holistic innovation management models either too specific or simply outdated due to the previously mentioned continuous evolution of the field of International Business.[25]

Note that the word “theoretic” will be used throughout the thesis, denoting concepts or comments of the above described theoretical sources, all originating from publications in recognized magazines or academically approved or printed books.[26]

2.1.2 Empirical approach

Although this thesis aims for broad application of results, companies participating in the study were to possess all of the below attributes in order to create a comparable sample of study object:

(i) Must be defined as a Swedish organization

Swedish origin or identity was chosen as a parameter only to limit the study, and will therefore not lead to any Sweden specific discussions or analyses. Due to the increasing difficulties of and widespread discussions on determining the nationality of globally present multinational companies[27] (see

[21] Holme & Solvang 1997
[22] Eisenhardt 1989
[23] Based on search in Scandinavian libraries as well as on www.amazon.com which is America’s largest online retailer and one of the most comprehensive search engines for books.
[24] Hurmerinta-Peltomaki &Nummela 2006
[25] Hurmerinta-Peltomaki &Nummela 2006
[26] This will be understood as ”theory”. No further development of this understanding will be performed.
[27] See for Reich 1990, Jones & Wilson 2005

point iii), for this thesis, the nationality will be based on country of naissance, country of headquarters, country of majority of stakeholders or similar, with the only purpose to create a limitation.

(ii) Must be of considerable size

A report on innovation metrics claims that "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."[28] Hence, it has been judged that larger companies have a relatively stronger need for rigorous structures for monitoring and managing, including a need for innovation metrics. Headcounts have been used to determine the size of companies, and approximately 2000 employees or more has been judged to be a considerable size.

(iii) Must have multinational operation or presence

Multinationality can also be defined in many different ways, however for this study the simple definition that "an MNC is a corporate entity that is involved in operations in a number of countries" has been used.[29] The reason for adding this parameter is that companies with international business also have a relatively stronger need, than solely nationally operating companies, of rigorous structures for monitoring and managing the different parts of the organization, including innovation metrics. In addition, it has been assumed that respondents from companies of considerable size and multinational character will have better established notion of, and relation to, innovation metrics. In addition it has been assumed that they therefore also have a larger interest in contributing to and attaining results of a study on the subject.

2.1.2.1 Choice of corporate representatives

Based on the three criteria for the empirical sample, a list of 34 suitable organizations was created. When looking for general patterns rather than specific issues of a certain organization, studies on multiple objects are preferred.[30] Therefore it was decided that the study was to be performed on 20-25 organizations, in order to ensure reasonable scope. A lower number would decrease the ability of drawing generalizing conclusions of the results whereas a too high number would on the other hand not be manageable within the timeframe of the thesis. In the end 26 companies provided information, which is considered a high feedback percentage.

To attain a representative picture of application of innovation metrics in the corporations, *middle managers* were the focus of the empirical study, as their position indicates awareness of what is communicated both upwards and downwards. The sought after position was "Innovation Manager", "Innovation Director" or similar. In the cases where this position did not exist, a "Business Development Manager" or similar was contacted. In the few cases where also this did not exist, a "Product Development Manager", "R&D Manager" or similar person was complemented with a product/portfolio/customer-related or similar manager from a different part of the organization in order to attain as full a spectra of information as possible. In terms of location in an organizational structure, all of these positions were in this content defined as middle managers. A valuation of the quality of the respondents' answers was made in the latter cases, based on the areas of innovation they talk about (narrow or broad) and the amount of general insight to metrics they seemed to possess. The valuation lead to the decision on whether or not to find a complementing respondent from the same company. In two instances, an additional person was contacted and agreed to participate but did not or could not provide information within the timeframe of the thesis. In these two cases, the

[28] Andrew et al. 2009
[29] O'Connell & Cooper 2009
[30] Eisenhardt 1991

answers from the first person contacted have been used, in combination with the insight that innovation metrics were very difficult to track in these companies – an answer in itself. The situation does however decrease the reliability as well as the validity of these two respondents (see further discussion on validity and reliability in chapter 2.1.2.4.1 and 2.1.2.4.2).

2.1.2.2 Interview technique

All suitable persons[31] were initially contacted via telephone in order to ensure an understanding of the thesis purpose as well as to create a personal contact and trust and to allow for the respondent to ask any questions or discuss any hesitations to participating. In all interviews the focus rested on three specific areas:

(i) Definition of innovation on corporate level (quantitative)
(ii) Potentially used innovation metrics within the organization (on what level measured, how measured, how often measured, how communicated) (quantitative)
(iii) Challenges faced/issues considered important based on experience with/considerations of innovation metrics (qualitative)

In some cases the whole interview was held via telephone, either immediately when reached or at a later booked time. In other cases, the respondent preferred to have an email sent to them, with the questions clearly explained. Finally, a limited number wanted to book physical interviews. In order to give all 26 respondents equal focus, and since an answer by email would not be comparable to a physical interview, all interviews in the end were held via email and/or phone.

The few respondents who were handled mainly over *email* received the three specific questions, in addition to an excel sheet to fill in different parameters of the metrics used (mentioned in parenthesis on (ii) above) in order to attain clear and unambiguous information of the metrics used. Oral interviews can be divided into two types, *information discussions* and *scheduled interviews*. When searching for appropriate persons within the companies, in the early stages of the research, some of these contact initiations in the end turned into informal discussions. This was at a point where the structure and knowledge base of the thesis was still forming, but where information was considered to answer research questions it was included as a statement from the company. As for the scheduled interviews, the three broad questions mentioned above as well as the excel sheet for metrics were sent beforehand, so that the respondents were able to prepare the necessary data.

The interviews were semi-structured with open-ended questions in order to keep the interviews comparable, but to enable the best results given that an abductive and mixed method approach was chosen. Interviews were generally held between 30 minutes to one hour in Swedish or English. The language was chosen by the interviewee, in order to ensure his or her comfortableness, again in order to create more reliable responses.

2.1.2.3 Data analysis

As the method of this thesis is circular, and the level of information is a combination of qualitative as well as quantitative, the analysis of theory has been influenced by both qualitative and quantitative empirical finding, and the analysis of the quantitative as well as qualitative empirics of course also has been influenced by theoretical findings. The initial theoretical reading, resulted in a basic understanding for areas which were of importance when structuring innovation metrics. Based on this reading, an initial division of three main and MECE (mutually exclusive and collectively exhaustive) phases of innovation was created; *input*, *throughput* and *process*. Once the empirical patterns

[31] With one exception due to the difficulties in reaching this person over telephone.

were identified however, a true value of additional layers was identified. Based in theory, but provoked by reality, this lead to a further crystallization of the framework four different and MECE levels of metrics; related to *task*, *organization*, *finance* and *market*. Again, looking at the often wide range of metrics in theory on these four additional levels, and also realizing the important directions in which metrics should steer behavior, an additional division of the metrics based on the type of indicators was made. This finally resulted in four additional layers; *amount*, *balance*, *efficiency* and *effectiveness*. In essence, all levels can be based on and found in theory, but the heavy decomposition is a result of the empirical reality.

In this thesis, the underlying circular approach does not fully come to its right due to the necessity of presenting the information structurally. Therefore, the analysis has been divided into two parts, one on theory, which enables the presentation of the empirical data in a more structured way, and a later analysis of the patterns and dissimilarities between the theoretical analysis (the framework) and the empirical data. This partial analysis of theory, allows for a more value-added presentation of the quantitative data through a cross-company analysis. [32] A within-case analysis of the data would have been interesting as it could have created a rich familiarity with each case, and allowed for company unique patterns. However, the number of cases was judged too high to make this sort of reporting of empiric data interesting. Instead, the quantitative data has been presented in an overview, complemented with qualitative features in the form of quotes organized on different themes, providing interesting nuances which became apparent during the study.

All information on metrics has been presented in tables in order to ensure comparison between theory and practice as well as in-between theoretics and companies.

2.1.2.4 Quality of empirical research

It is important to evaluate the quality of the research in order to establish credible results, at the same time as stabilizing the ground for future research. When evaluating the quality of the data collected, usual criteria are validity and reliability. The purpose of assessing ***reliability*** is to assure that later potential studies on the same subject with the same procedures would provide the same findings and conclusions, i.e. whether the produced data is independent of the context. This probability is higher if random errors and biases are minimized. The purpose of assessing ***validity*** is to test whether the evaluation technique actually measures what is supposed to be measured, i.e. if the produced data represents the truth.[33]

2.1.2.4.1 Reliability

In terms of the qualitative data collected, it is judged that the necessary precautions were taken in order to ensure the minimization of errors and biases, i.e. to increase the reliability. Here, detailed notes have been taken during the interviews and summarized straight after. Any uncertainties have however been cleared over phone or through additional mail correspondence in order to ensure a high reliability of the information. In the same way company-unique definitions, specifics of metrics and organizational structures important in order to understand, have been clarified during the interviews in order to understand the company's ways of working with innovation and innovation metrics. In addition, concerning qualitative data, investigations should preferably be based on research problems and specific potentially important variables with reference to existing literature in theory building research, but thinking about specific relationships should be avoided in order to

[32] Eisenhardt 1989
[33] See for instance Yin 2003, Gustavsson 2004

prevent predetermination which will bias and limit the findings.[34] This idea has been born in mind throughout the interviews as it was evident that the circular methodology would mean a theory-tinted interview format. Hence, it has been continuously ensured that the direction beyond the specific questions sought answered followed the respondent rather than the interviewer, in order to decrease the risk of biased interviewing.

In terms of the quantitative data, the majority of the respondents chose to use the provided excel sheet, where the description of the different parameters per metrics helped enabling a deeper understanding of the metrics. The parameters also ensured that the respondent understood the types of metrics and parameters sought after. In certain cases, respondents chose to report the metrics in ordinary email format, or orally during the interviews. In these cases the information has been noted in detail and definitions, application levels etc. have been clarified during or after the interview.

In terms of reliability, it must however also be noted that the fact that only one or few people at each company have been interviewed, increases the risk of a biased picture, not representative for the whole company. To the reliability on this matter however, precautions have been taken through the extensive search for suitable people to talk to. It should also be noted that there is a risk for errors in the quotes, in that the majority of the interviews were held, and summaries were written, in Swedish but quotes have been translated into English for the thesis. The translations have however been confirmed by an English/Swedish speaking person, in order to minimize this risk.

2.1.2.4.2 Validity

Validity consists of three components: *construct validity* (correct operational measures, for instance the use of multiple sources of evidence), *internal validity* (the extent to which research results correspond with reality) and *external validity* (extent to which a study's findings can be generalized beyond the case study conducted).[35]

In terms of construct and internal validity of the quantitative data, there is a possibility of the interviewed being unaware of certain metrics in use in parts of the organization, so that a non-complete picture of metrics has been reported. On the other hand, metrics which are not well communicated have little importance to the organization as they without communication cannot use them to steer behaviour (see chapter 3.3 for further explanation) More probable due to the positions of the respondents would be the situation of an "over-complete" picture of metrics, where the respondent might release metrics and ways of working with innovation that other parts of the organization are unaware of or that are not actually well used in reality. Over-reporting could come from a desire to give a good picture of the company, or ones own work on the area. This could have been minimized by having more respondents per company from various parts of the organization; however it has not been possible within the limited scope and timeframe of the thesis. Instead, focus has been laid on creation of trust and ensuring of confidentiality, which has been attained through the oral contact initiation, and oral interviews in most cases.

For the same reason, recording the interviews and writing exact transcriptions has been avoided. This also limits the risk of focusing on word-for-word analysis as the main objective has been to create an understanding for what is needed on the area of innovation metrics rather than specific answers to specific questions.

[34] Eisenhardt 1989
[35] See for instance Yin 2003, Gustavsson 2004

The respondent's perception of the interview as being comfortable and informal, has been judged more important than having post-interview access to word-for-word information. The large number of interviews in addition with the fact that the interviewer had previous notion of the subject through the initially deductive approach, further supported this choice. The approach also followed the focus of the qualitative data collection, where it was the respondent's mental construct of reality which was studied, wherefore the results do not have to purely reflect the objective reality but where the perception is more interesting than the truth itself.[36] However, in addition to add pieces of reality and strengthening the internal validity, a number of quotes have been included in the empirical data section.[37]

In terms of external validity, it is possible that the representatives of companies who have been contacted but who denied an interview, might to a lower extent find interest in innovation issues and innovation metrics specifically, and hence represent companies who do not see a problem with the status quo and who do not want to increase the focus on innovation metrics. The high number of responding companies, unrelated by industry, type of product, type of customer, product life cycle etc., on a subject which with a broad definitions is non-industry and non-product/service-related (see chapter 3.1 for further support) is however argued to give a very high external validity.[38]

[36] Taylor & Bogdan 1984
[37] Merriam 1994
[38] Yin 2003

3. Theoretical approaches to innovation metrics

In order to be able to understand the way in which innovation metrics are used in reality, and to be able to later identify improved structures, different theories on the topic will be presented in the following chapter. First, an overview of how innovation is generally defined in theory will be presented. Hereafter, four different authors' view on innovation will be presented, together with a description of their frameworks. To sum up this chapter, a discussion of the four authors will take place, combined with additional author's comments on measuring innovation will be presented.

3.1 Definition of innovation

Innovation as a field of study has been discussed at least since the 19th century, by economist such as Say, Smith, Schumpeter, Keynes and Friedman. At this time, the definition of innovation seems to have been rather simple, meaning "the introduction of something new" as derived from the Latin words "in" and "novare" which means to "make new".[39] Schumpeter was the most prevalent debater of innovation, publishing several articles on the subject up until his death in 1950. His definition of innovation could be divided into five different areas: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize businesses.[40] However, the output of other academic articles on innovation was few at this time, and most definitions of innovation were narrow and highly technologically centered.[41]

It was not until the 1960s that the topic really hit the masses. Since then a large amount of articles and academic material has been published, increasing especially rapidly during the past 10 years.[42] Today, we therefore see practically as many angles and definitions of innovation as there are authors on it. However, most have moved away from the technical, product development specific notion of innovation, and started including business model innovations, social innovation, national innovation, customer-driven innovation etc. Although impossible to here go through a thorough summary of innovation definitions, one of the most important distinctions include one between *invention* and innovation, where invention basically is an idea for a new product, process etc. whilst innovation is the attempt to carry it out into practice. A change or improvement is only an innovation when it is put into use and hence causes a social or commercial reorganization.[43] In addition, innovation is to be seen as the result of a *lengthy process* which involves many interrelated innovations, rather than as a single item.[44] According to Kuczmerski innovation "is a *mindset*"[45].

Beyond this, there are several different types of innovations on a firm-level. Some of them include:[46]

- Type of innovation: *Product/service, Process, Business model, Social, Market-driven, Experiential, Marketing, Structural, Disruptive, Technical vs. Non-technical etc.*
- Type of newness: *New to the world, New to the company, Line extensions, Improvements or revisions, Product/Service/repositioning, Cost reductions etc.*

[39] Sarkar 2007
[40] According to Fagerberg et al. 2005, Freeman 2008
[41] Edquist 1997
[42] Fagerberg & Verspagen 2008
[43] See for instance Goffin & Mitchell 2005, Fagerberg et al. 2005
[44] Fagerberg et al. 2005
[45] Kuczmarksi 2000
[46] Selection based on Moore, 2004, Davila et al. 2006, Goffin & Mitchell 2005, Kuczmarksi 2000

- Type of strategy behind: *Market penetration, Product development, Market development, Diversification etc.*

Whilst one the one hand, the high diversity in definitions probably has spurred the interest and production of much interdisciplinary work, it is also of value to create a harmonization of the concepts in order to be able to create further development on innovation related areas, [47] including innovation metrics. Although a harmonization is not the aim of the thesis, it is important to state that the following chapters of the thesis understands innovation from a broad, inclusive and "modern" (if you'll have it) meaning of innovation, where innovation can be performed by a number of people in a number of ways. However, no further breakdowns will made.

3.2 Identification of four theories for structuring innovation

In order to create metrics, and be confident in that the important areas are measured, innovation must be structured. A thorough study of the literature on general innovation management however showed that there are several authors discussing innovation management frameworks in general, but not linking performance measurements to it. On the other hand there are theoretics suggesting specific metrics or measurement levels, but not providing sufficient support for the chosen ones, in terms of holistic systems or models.

Building on a quote saying that "designing a measurement system for innovation relies on a clear model of how innovation is managed and how ideas are created, evaluated and selected, and transformed into value"[48], four groups of academics who recently (2005, 2005, 2006 and 2008 respectively)[49] have provided both models for innovation management as well as specific metrics suggestions, will be presented in this chapter. Four different ones have been chosen in order to create a fundamental understanding of the innovation process and the similarities and variation that the different authors provide. The areas important to innovation management would naturally correspond to the areas which are important to monitor and control. The reader will therefore through the *italic* words be able to follow areas of innovation management and measurement which are strongly suggested by the authors. This will also facilitate the connection to the summarizing table of metrics, which is a combination of the important areas and specific metrics suggested by the authors. Please refer to Appendix 1, for a full description of the specific metrics, suggested by each author.

It is important to note that none of the four authors deal very thoroughly with innovation metrics in terms of breaking the metrics down, making clear definitions or distinctions between parameters, identifying measurement levels, suggesting actual methods for data collection or backing up the metrics through empirical studies. However, all authors have a background of working closely with several organizations on innovation metrics, through teaching, consulting etc. Together, their overall arguments lay a foundation as to which areas of innovation are important, functioning as a reminder not to focus on one, but many elements of innovation management when looking to measure it.

[47] Archibugi 1999
[48] Davila et al. 2006, p. 148
[49] For instance, Kuczmarksi also uses an innovation model to draw conclusions of metrics from. However his paper dates back to 2000 and the four chosen theories all overlap his suggestions.

3.2.1 Davila et al.

In the first of the four theories, Davila et al.,[50] base their innovation management model on the balanced scorecard theories which stress the need for a range of measures in addition to only classical financial measures.[51] Though Davila et al. structure their model around balanced scorecards, they focus on developing one for innovation exclusively. They state that any metric is only as good as the underlying business model, which will describe how a company will be innovative and generate value from innovation. In turn, the underlying business model only is as good as the fundamental innovation strategy of the organization. Hence an innovation strategy must first be developed whereafter the innovation business model can be created. The authors point out the below framework, showing the underlying relationships of innovation, as important in creating an appropriate innovation strategy.

Figure 1: Davila et al.'s business model for innovation (source: Davila et al. 2006)

In the framework, the *inputs* are the resources devoted to the innovation effort; The *process* combines the inputs and transforms them; *Outputs* are the results of the innovation effort, in terms of quality, quantity and timeliness; *Outcomes* also describe the actual results of the innovation effort, but in terms of value created. In this overall framework, several important areas need to be kept track of, suggest the authors:

- **Inputs** worth examining include *tangible* (capital, time, software, physical infrastructure) and *intangible resources* (talent, motivation, culture, knowledge, brands), *innovation structure* (interest groups, corporate venture capital) *innovation strategy*, (innovation platforms, positioning) *external network* (partners, lead customers, key suppliers) and *innovation systems* (systems for recruiting, training, continuous learning, execution, value creation)
- According to the authors, **process** measures are critical during the execution as they "can signal the need to change course or alter the execution". Measurement levels include *creative process* (quality of ideas, ability to explore them, conversion rate into projects and value), *project execution* (evolution of projects in terms of time, cost, technology performance, estimated value generated), *integrated execution* (aggregate performance of all projects), *balanced innovation portfolio* (mix of projects and alignment with strategy).
- **Outputs** can be measured through *technology leadership* (number of patents, cites, seminars, technology licenses, technology adoption in the business model), *project completion* (executions metrics vis-à-vis expectations or competitors) *new product introduction* (number of successful products, acceptance compared to competitors, market share, sales), *business process improvements, market leadership* (customer acquisitions, customer share, customer loyalty).
- The authors state that accurately measuring value, or **outcomes**, is controversial but some methods include *project profitability* (estimation of value generated during its life cycle compared to expectations and comparable projects), *customers and product profitability* (estimation of overall value of innovation from a market and product perspective), *return on investments* (estimation of current profitability of the organization), *long-term value captured* (estimation of value captured through the life of the product or product family).

[50] Davila et al. 2006
[51] Kaplan & Norton 1996

Change in valuation of share prices could be another measurement but it relies on the assumption of efficient markets, claim the authors. In addition it can of course only be used by public companies.

3.2.2 Goffin & Mitchell

The second group of theoreticians, Goffin & Mitchell,[52] uses a framework combining five key elements, all being crucial to innovation management. Their framework, the Pentathlon Framework, is probably the most thorough and holistic model of the four, and is based on the classical idea development funnel,[53] similar to phase mentioned by Davila et al. However, the model includes innovation strategy and HR management as additional key elements.

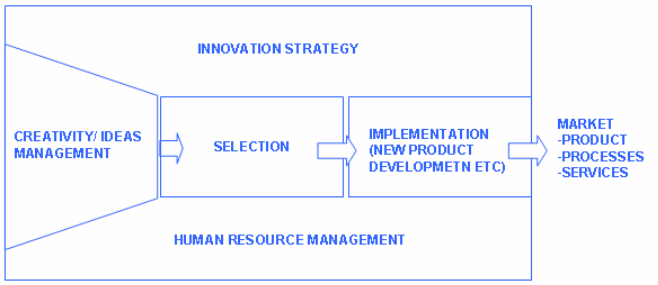

Figure 2: Key elements of innovation management according to Goffin & Mitchell (source: Goffin & Mitchell 2005)

- Concerning **creativity/idea management**, the authors reject the myth that innovation only concerns development of completely new ideas, that it only takes place in one part of the organization and that it results from a flash of inspiration. Instead the importance of *managers* looking for effective ways to stimulate constant creativity through the *exchange of information and knowledge* and encouraging employees to *reserve time to innovate* is stressed. In addition, similar to Davila et al., they claim that the potential of *customers and users* in generating innovative ideas should not be overlooked.
- A large MNC normally has several large projects running at the same time, hence the issue of **prioritization** arises. Distributing resources for projects is challenging, and even more challenging when it comes to innovation projects which normally encompass higher levels of uncertainty. In addition, innovation projects continuously change and develop as they process and as a result some may be pushed forward, some delayed and some stopped altogether. Hence, *continuous review of the project and decisions previously taken* is necessary in order to ensure optimized resource allocation, why an adequate portfolio management progress with identified and *measured phase-gates* is recommended. The authors also specifically stress the importance of *balance in a portfolio.* Balance in terms of *time of the projects* is needed to make effective use of resources, especially if projects share the same resources, but also in order to spread the deliver dates as a company normally has a limit for how much change it can handle at one time. Here, the general rule of thumb is that the more innovative the project, the more work needs to go into it. Although difficult to estimate, balance in terms of *risk* should also be ensured.
- When **implementing** the idea, turning it into a project, good *project management* must be ensured, with clear and verifiable deliverables. Here the authors mainly discuss techniques for plotting an *efficient* course, including project definition, task analysis, priority management, resource allocation and progress monitoring. Commercialization is the last phase of the implementation.

[52] Goffin & Mitchell 2005
[53] See for instance Majaro 1988, Weelwright 1992

- Similar to Davila et al., Goffin & Mitchell also stress the importance of the **innovation strategy** which is part of the overall strategy and has the role to indicate what new ideas are needed, which in practise is not often done. As many people can come up with solutions when faced with specific problems, but few are successful in producing new ideas spontaneously, *direction from above* regarding what areas of the organization/products are in need of new inventions, is crucial in order to direct people efficiently. In addition, Goffin & Mitchell focus on the need for *balance in the innovation portfolio*, claiming that innovation strategy plays an important role in clearly indicating a certain level of newness required in the new innovations, in order to avoid that the company is being supported only on innovations of the current business model, which may be inaccurate a few years later.
- The **human resource management** element, stresses the strategic importance of the management of human resources in three levels: organizational, innovation project team and employee level. Here, the authors mainly discuss how to create *innovative environments*, *innovative teams* and how to *motivate* people on an individual level, but also suggests some metrics of innovative performance on employee level.

Goffin & Mitchell argue that input, process and output measures in relation to their five parameters should be applied when measuring an organizations' level of innovation. It should however be noted that there is a substantial lack of connection between the model and their suggested metrics. See Appendix 1B for all full description.

3.2.3 Muller et al.

Compared to the previous two theoreticians, Muller et al.[54] take on a more structural perspective, discussing innovation from a *capability*, *resource* and *leadership* view. The arguments behind this framework is less worked through and less extensive than the previous two, but it provides interesting alternative perspectives.

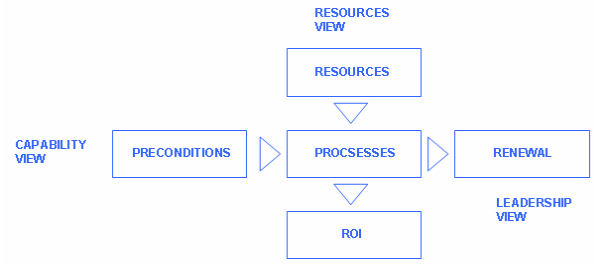

Figure 3: Muller et al.'s capability, resource and leadership view.(source: Muller et al. 2005)

- The **resource view** addresses the balance in allocation of resources between tactical investment in the existing business and strategic investment in new businesses and innovations. The authors focus on inputs such as *capital, labor and time*, and output such as *return on investment in strategic innovation.*
- The **capability view** assesses how well the company's competencies, culture and conditions support the conversion of the innovation resources above into opportunities for business renewal. Here, the authors look at the *preconditions* for innovation, meaning how well the company's skills, tools, culture, and values are adapted to innovation. An example of input could be *if the company evaluates past demonstrations of innovativeness when selecting new*

[54] Muller et al. 2005

recruits. An output could be the *development of new skills and knowledge areas* that generates innovation or opportunities.

- The **leadership view** illustrates how the company's leadership *supports* innovation. This is done by evaluating *leaders' involvement in innovation activities*, the *establishment of formal processes* to promote innovation, and *dissemination of innovation goals*.

The three views are in the framework linked together through the **processes,** constituting an additional element to the framework. Processes are here understood as *organizational structures* such as incubators, innovation markets, venture funds, and innovation incentives.

3.2.4 Regnell et al.

Regnell et al. are a group of 26 Swedish researchers from various Swedish academic institutions who, through their experience with and studies of innovation, have created an innovation management framework called MINT (short for "mätinspiration för innovativa team" which translates into "measurement inspiration for innovative teams"). This framework is less holistic compared to the previous three, covering mainly the sourcing of innovation in a company.

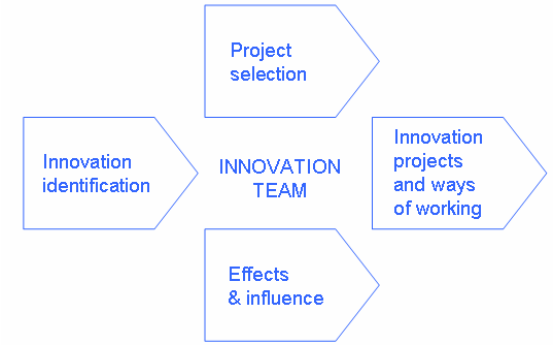

Figure 4: Innovation management according to Regnell et al. – the MINT Framework (source: Regnell et al., 2008)

Regnell et al.'s framework identifies four measurement areas:

- **Innovation identification** which focuses on the sourcing, treatment and encouragement of initial ideas. The importance of a combination of *internal and external sourcing* of ideas is stressed, as well as a *passive and active sourcing*.
- **Project selection** where ideas are selected based on identified criterion with focus on a *balanced portfolio* of projects, referring to balance in terms of *timing* of projects and launches, *risk*, *size* and estimation of *value generation*.
- **Innovation projects and ways of working** which focuses on the "innovative team" and their ways of transforming the idea into reality. *Incentives* and *competence* of the team are stressed as important factors to look into.
- **Effects and influence** which is the stage at which the "innovative team" hands over the idea to the development team. *Interaction* with the rest of the organization, *level of trust* as well as previous development of organizational *praxis and standards* are stressed as important measurement levels.

3.3 Perspectives on the four theories

Chapter 3.2 has presented the ideas and frameworks of four different theoreticians, all covering innovation management and suggesting specific metrics (Again, see Appendix 1). As they all have

individual focuses, clear discrepancies as well as similarities are found in several areas. A more thorough comparison will be done in the following, combined with comments from additional authors, in order to create a broader framework covering several measurement levels. Initially, figure 5, gives an overview of the most emphasized keywords of the different frameworks:

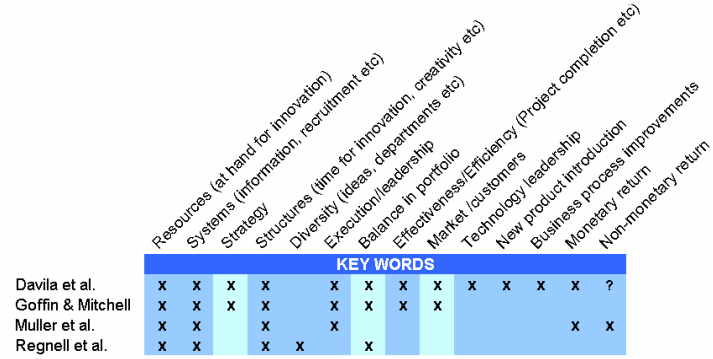

Figure 5: Most emphasized key words as discussed by the four different groups of authors[55]*. (source: own construction)*

Where similar expressions have been used by the authors, these have been merged in order to compare them. The authors cluster around certain issues such as sufficient and qualitative resources, both tangible and intangible, facilitating structures, supporting systems as well as effective leadership and balance in the portfolio of ideas. In addition, half of them bring up the importance of strategy, effectiveness and efficiency, market-orientation as well as returns. Regnell et al. in addition has a strong focus on the importance of diversity and balance to the discussion, whilst Davila et al. adds more of a technology focus. His two specific focuses will be merged with new product introduction, and process improvements, monetary- and non-monetary returns and discussed together(labeled returns) in order to create a more generic focus. Other areas with similar touch points, such as resources and systems (labeled resources) as well as structures, diversity and leadership/execution (labeled structures) will be discussed collectively. The seven resulting main areas which the authors cluster around, and the importance of focusing on these, will be backed up by other additional sources in the following.

Resources: All authors stress the importance of resources and systems, which therefore shows the tendency of being one of the most natural focus area. Goffin & Mitchell in this context put specific emphasis on human resource management which is strongly supported by famous innovation author Kuzmarski, who argues that the best conceived innovation purposes and most thoroughly developed innovation processes cannot succeed without appropriate human resources to execute them.[56] Moore, on the subject of what types of innovations to focus on, stress the importance of picking the things you are best at and focusing your financial resources accordingly. [57] Hence, one can claim that you need to know your non-financial resources in order to better locate your financial resources.

Strategy: The importance of an innovation strategy, addressed by both Davila and Goffin & Mitchell, is again supported by authors such as Drucker, often called the world's most influential business guru[58] and one of the most well-known writers on innovation, and Majaro, a well-known

[55] The question mark on Davila et al. regarding non-monetary return comes from that their "value" is not specifically defined.
[56] Kuczmarski 2000
[57] Moore 2004
[58] Sullivan 2005

marketing strategist. They both discuss the importance of clear and specific innovation strategies to help integrate the organization's diverse activities so that the overall goal of innovation can be supported. According to Majaro, the innovation strategy must be clearly communicated on all levels of the organization in order to be effective and gain this support.[59]

Structures: The need for organizational praxis and standards is in addition supported by Drucker. He argues that everybody in the organization always knows that the need (for process innovation and improvements) exists, yet usually no one does anything about it.[60] The importance of the management here is further supported by Hamel, the world's most influential business thinker according to the Wall Street Journal[61], who however takes the perspective even further by discussing the necessity of strong *management innovation*, which means innovating around new ways to organize, lead, coordinate and motivate. Hamel claims that management innovations are what create long-lasting advantages, rather than technology and product innovation which are low-calibre innovations, having impact only in the short-term.[62] Kuczmarski similarly states that each company has its own identity and challenges, and works in a different competitive environments, but that it however is the top management, particularly the CEO, who makes or breaks the spirit of innovation. Hence, innovation cannot be delegated, and will succeed only if senior management develops the right altitude.[63] Cooper et al. further stresses the importance of looking into structures, through his focus on the cross-functional teams. They state that leading organizations greatly rely on cross-functional teams throughout the NPD process, which should be possible to equal with innovation. Based on the same study, Cooper et al specifically comments on the structural and managerial matter which concerns time allowed for innovation, claiming that managers must take a hard look at the percentage of time truly available for NPD and that their commitment must be spelled out quantitatively.[64] Barczak in addition presents data supporting that the leading organizations rely greatly on cross-functional teams throughout the NPD process.[65] As a part of this, the exchange of information and knowledge, is further supported by Drucker who claims that it requires knowledge.[66] Knowledge, and specifically communication of knowledge, is supported by several other sources.[67]

Balance: The pre-calculation and monitoring of balance in terms of risk, particularly stressed by Regnell, is strongly supported by Drucker who says that successful innovators are and have to be conservative.[68] Kuczmarski also supports the mix of projects in the portfolio and brings up the types of innovations, previously discussed in chapter 3.1. A tracking of the balance of different types of innovations, he argues, gives a broader picture of the types of innovations that the company is dealing with.[69]

Effectiveness and efficiency: The importance of a focus on efficiency and effectiveness are particularly stressed by Davila et. al. and Goffin & Mitchell. Davila et al. does however stress the importance of not focusing *too* much on efficiency, as this may inhibit creativity, but later also ac-

[59] Majaro 1984, Drucker (People…) 2007
[60] Drucker (Innovation…) 2007
[61] White 2008
[62] Hamel 2006
[63] Kuczmarski 2000
[64] Cooper et al. 2004
[65] Barczak 2006
[66] Drucker (Innovation…) 2007
[67] See for instance Dooley & Sullivan 2007, Kuczmarksi 2001
[68] Drucker (Innovation…) 2007
[69] Kuczmarski 2000

knowledges that a "right way" of structuring can enhance creativity[70]. In a very recent study, Sarkees & Hulland[71] argues that relatively few firms are able to balance efficiency and innovation due to battles for resources. Their cross-industry study on publicly-traded U.S. firms however shows that companies which are successful at combining these two focuses outperform those which overemphasize either. Effectiveness concerns the importance of focusing on the right types of innovations which is naturally important, and also covered by several authors including Drucker.[72]

Market-orientation: Only two of the groups of the authors mention the importance of some kind of market-orientation, although one would instinctively argue that an innovation can have no success without it being useful to, and required by the customer. Drucker supports this by claiming that an innovative strategy needs to deliver what is "value" to the customer rather than what is "product" to the manufacturer and that the entrepreneurial strategy has a larger chance of success the more it starts out with the users.[73] He further claims that the test of an innovation always is what it does for the user, and that entrepreneurship always needs to be market-focused and market-driven. The importance of market-orientation is further supported by Majaro, who states that innovation can be derived from several influential factors, but if they are derived solely from people without influence from the market, there is a risk that the level of innovation will be fairly low.[74] Leadbeater, a strong supporter of consumer innovation, confirmingly states that consumers and markets need to be just as highly involved in innovation as scientists and laboratories and that this is the only way for both companies and nations to survive in the long run. [75]

Returns: Neither Goffin & Mitchell nor Regnell et al. cover the outputs of innovation. Goffin & Mitchell however includes it in their specific suggestions for metrics, and it is emphasized by both Davila et al. and Muller et al. In addition, to Davila et al.'s long-term value focus and Muller et al.'s focus on more softer outputs, Drucker comments on the risk of having too static and only short-term focus on innovation output such as goals of 5 percent growth in profits every year, since normally innovations do not result in profits until much later, after its introduction.[76] As the inherent reason for innovation is returns, this is argued to be enough supported.

Beyond these seven areas, there are several voices commenting on the **actual set of metrics**. It needs of course be ensured that the *cost of locating the data does not exceed the benefit of knowing the data*. This is closely related to the *number of metrics* where it is important not to have too many metrics, but at the same time not limiting the number too much. Too many in a complex measurement system creates prioritization difficulties, whilst few metrics in a clear system can give an overview just as good.[77] Measuring the right thing is crucial, as *metrics steer the behaviour* in the organization. Common mistakes are that the metrics are too focused on outcome and cutting costs (sub-optimal if you want to encourage risk-taking and thinking outside of the box), historical performance (meaning that people will see it as that happened then) too difficult to interpret (that people do not react to it), too difficult to impact (only measuring R&D investments gives little incentive for employees to act) and not customer focused (sub-optimal if you're looking for the innova-

[70] Davila et al. 2006
[71] Sarkees & Hulland 2009
[72] Drucker (People) 2007
[73] Drucker (Innovation…) 2007
[74] Majaro 1984
[75] Leadbeater 2006
[76] Drucker (People…) 2007
[77] For instance Goffin & Mitchell 2005, Kuczmarski 2000, Rae 2006, Muller et al. 2005

tions to be customer-driven)[78] Finally, and similarly, there is a risk that organizations put too much efforts on metrics without reflecting on whether or not the metrics are *value creating*, if they tell something about the business impact, or if they are linked to the business strategy.[79]

[78] For instance Regnell et al. 2008, Kuczmarski 2001, Muller et al. 2005, Goffin & Mitchell, 2005, Dooley & O'Sullivan 2007

[79] For instance Rae 2006, Goffin & Mitchell 2005, Dooley & Sullivan 2007, Kuczmarski 2001

4 Analysis of theoretical framework

In chapter 3, the contents and suggestions of the four theoretical frameworks were presented one by one, followed by an identification of common views on important metric areas. These resulting areas, were further backed up by other literature and sources on innovation. All the resulting areas described in chapter 3.3 can therefore be argued as being important for a company's success on innovation. A deeper analysis of these areas will be conceived in the following section, with the purpose of merging them into a common applicable framework for further analysis of the empirical data.

4.1 Three horizontal phases of metrics

The theoretical models presented in the previous chapter, all suggest underlying systems for the metrics. By looking at the broad common strokes and the individual definitions of the authors' respective main areas of metrics application, as well as specifically suggested metrics[80], a pattern of three common underlying phases for the innovation process can be identified. The pattern consists of **Inputs** (Davila et al., Goffin & Mitchell, Muller et al, Regnell et al.), **Throughput** (Davila et al., Goffin & Mitchell, Muller et al., Regnell et al.,) and **Output** (Davila et al., Goffin & Mitchell, Muller et al.), see figure 6 below.

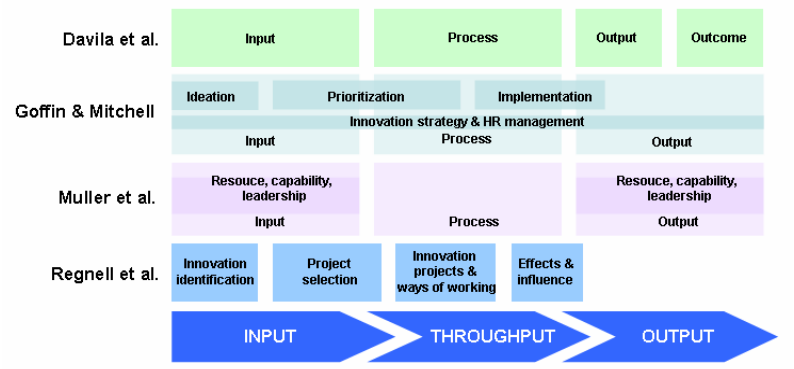

Figure 6: Overview of underlying phases for the innovation process. (source: own construction)

The term "throughput" is simply a renaming of Davila et al.'s, Goffin & Mitchell's and Muller et al.'s and Regnell et al.'s term "process", in order not to confuse the innovation process with general processes of an organization. The term "throughput" has been taken from Hamel who speaks of innovation pipeline throughput [81]. Similarly, Davila's definition of outcome, which is the purely financial outputs in terms of value, has been merged with his concept of output, since the same financial outputs are discussed simply as "outputs" by Muller et al. and Goffin & Mitchell. Goffin & Mitchell's "innovation strategy" (which is also stressed as a separate input area by Davila) lies outside of these three phases of innovation, but is in essence communicated as well as monitored through a selection of successfully balanced metrics.

[80] Again, refer to Appendix 1A, B and C for a full description of the authors suggested metrics to be applied to their models.
[81] Hamel 2006

4.2 Four vertical drivers of metrics

As mentioned, there is little coherence between how the authors present their suggestions of metrics, other than that they all use their own version of the three phases shown in figure 6. However, by combining the authors' various definitions, elements and specific additional metrics suggested (see again Appendix 1), in combination with the additional authors stressed factors, a pattern of four central levels can be distinguished: task-, organization-, finance- and market-related metrics, illustrated in figure 7 below.

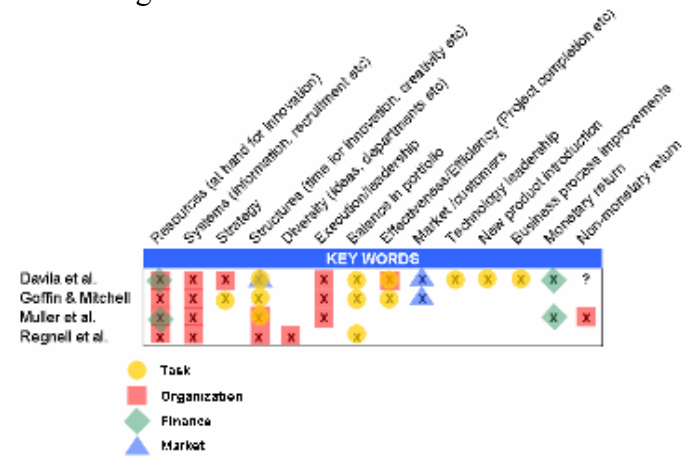

Figure 7: Crystallization of the four vertical levels, based on key words of authors. (source: own construction)

Task related metrics would be defined as metrics relating to the product/service/process specific ideas which potentially turn into projects, which later expectantly become realized products/services/processes. I.e. the level would describe the capacity, efficiency and performance of taking the actual idea to the market.
Organization related metrics would include those looking at the status quo of non-financial innovation-related resources and investments made to strengthen these, the efficiency at which these resources are handled throughout the projects, and what non-financial and organizationally related returns the organization experiences in the end. In essence, it concern the ways by which a company organizes in order to generate, handle and commercialise their innovations. This includes employee, managerial and structure related issues. The structural element here refers to general "ways-of-working", cultural-impacting issues as well as organizational issues such as how the company is organized in terms of departments etc.
Financial related metrics would cover those metrics that relate to purely financial numbers, from the monetary inputs to support the innovation work, the efficiency by which these investments are handled during the throughput, and finally the financial returns that may be reaped.
Market related metrics would cover the organizations ability to include the market/customer/competitors and even suppliers in first phases of the innovations, how efficiently these inputs are used throughout the process, and what the actual benefits are in the end in terms of customer and in comparison to competitors.

These four vertical levels, with clear definitions, are like the three horizontal phases argued to be MECE.

4.3 Four indicators of metrics

As discussed in the introduction chapter 1, there are numerous applications for metrics, primarily internal as companies look to improve innovation by managing resources and steering behaviour in

directions which will improve the innovativeness of the company. The metrics suggested by the authors will therefore further be divided into four types, depending on their type of behaviour they steer – named "indications". Several types of indications have been assessed, which resulted in four observable and for innovation essential types of indicators covering the metrics suggested in theory; Amount, balance, efficiency and effectiveness; **Amount** shows how much of something is done. These types of metrics play an important role in understanding the absolute figures that a company is working with, especially as it allows for the company to compare changes over time, but also for potential benchmarking against competitors. **Balance** indicates the balance of what is being done. The importance of balance is discussed heavily in theory, and is crucial for any company looking for long-term, stable innovation. **Efficiency** indicates if things are being done correctly. Efficiency will therefore be crucial to any company acting in a competitive market, making sure that their innovations hit the market, or become implemented internally as early as possible. **Effectiveness** indicates whether or not the right things are being done. A company can create all the ideas and innovation is want, but will never be successful with it, if in the end it does not develops the most valuable ideas.[82]

The support for the three latter areas comes from figure 5, whereas amount is a natural basic and often used metrics.

4.4 Proposed framework with accompanied metrics

In summarizing, a framework has emerged measuring on several levels.

Amount / Balance / Efficiency / Effectiveness	Input	Throughput	Output
Task			
Organization			
Finance			
Market			

Table 1: Framework emerged from the previous discussion. (source: own construction)

In table 1, the theoretical metrics suggestions of the various authors are structured in accordance with the three horizontal phases, the four vertical phases, and the four types of indicators. The metrics presented represent only a selection of the metrics suggested by the four authors, a selection based on evaluation of generic applicability (i.e. relevant to all industries), easiness to interpret, easiness to trace and immediate relevance to innovation.[83] In this content, it is noteworthy that some of the authors' metrics have been modified in order to fit the format of the proposed common framework. These modifications however only constitute minor adjustments such as shortenings of sentences etc. and do not affect the content. Also, in some cases the authors disagree, or are not specific enough on what innovation phase a certain metric belongs to. In this case, the selection is based on the final definition of the three horizontal phases of innovation, as well as on the various authors' arguments.

[82] In few cases a metrics will indicate both efficiency and effectiveness, for instance in the case of post-reviews of projects. In the occurrence of these types of metrics, a label called Efficiency & Effectiveness has been used.
[83] Please again refer to the initial sources for complete list of suggested metrics.

	INPUT		THROUGHPUT		OUTPUT	
TASK	**Balance**		**Balance**		**Balance**	
	Internal/external, active/passive sourcing;	R, G	Balance of portfolio: type, risk, time, size, value generation, strategy alignment, compared to total portfolio	G, D, R	Number of introduced products/ services/process	D, G, M, R
	Number of ideas generated per process/product/service resp.	G	**Effectiveness**		**Effectiveness**	D, G, R
	Effectiveness		Number of projects killed too late;	G, R, D	Cost, price, perception of new prod./ services offered from innovation;	
	Considered/selected ideas out of total number of suggestions	D, G	Number of projects proving to be of no use	R	Improvement of output quality	G
	Efficiency		Percentage of projects entering and ultimately considered commercial success	G	**Efficiency**	
	Time between project suggestion and response	R	**Efficiency**		Execution vs. Expectations	D
			Efficiency of exploring ideas/converting projects into value;	D, G		
			Aggregate performance/phase-gate continuous reviews	D, G		
ORGANIZATION	**Amount**		**Balance**		**Amount**	
	Number of innovaiton tools and methodologies avaliable;	M	Time spent on administrative/ support tasks compared to value	R, G	Number of new strategic options (opportunities for business renewal)	M
	Amount of time dedicated to	D	Percentage of workforce time that is currenctly dedicated to innovation	M	**Effectiveness & Efficiency**	
	Number of management	H	Percent of total workforce involved in innovation projects	G	Percent of projects where post-project reviews are conducted;	M
	Balance		**Efficiency**		Staff satisfaction	G
	Percentage of initiatives being functional;	D	Reduction in NPD time;	D	**Effectiveness**	
	Level of innovation integration business units and functions	D, G	Percentage of workforce actively contributing to innovation projects;	G	Number of new competencies (Distinctive skills and knowledge domains that spawn innovation;	M
	Efficiency		**Effectiveness**			
	Number of suggestions from who were previously rejected;	R	Number of experienced/competent innovation team members;	D, R		
	Effectiveness		Level of estabilished structures and for hand-over of projects;	R		
	Level of innovation experience/ dedication of individuals;	M, G	Level of strength of project magement, leadership guidance/involvement;	M		
	Quality and easiness of access information of innovation;	D	Level of alignment between strategy and allocation	D		
	Number of previous the company;	M				
	Frequency of lack of HR for	G				
FINANCE	**Amount**		**Amount**		**Amount**	
	Investment in innovation activities and efforts	M, D	Average project cost;	G	Percentage of sales from new products;	G, D, M
	Balance		Within target sales/profits	D	Percentage of cost/revenues from process innovations	G
	Revenues invested in product/service/process R&D	G	**Efficiency**		**Balance**	
			Reduction in NPD cost;	D	Return on innovation investments;	G
			Time to break-even;	G	Percentage of sales from product/service/process;	G
			Estimated value generated	D	Projected sales growth long/short term	D
			Effectiveness		**Effectiveness & Efficiency**	
			Percentage of projects delayed or cancelled due to lack of funds	G	Estimation of value generated throughout lifecycle	D
MARKET	**Amount**		**Efficiency**		**Amount**	
	Number of strategic alliances	D	Time to market	G, K	Number of new markets entered in past year	M
	Balance		**Effectiveness**		**Balance**	
	Mix of innovation sources	G, D	Number of projects with customer relevance;	R	Number of new products/services compared to competitors;	G
			Number of projects with user relevance	R	Share of wealth;	M
			Percent mix of projects by their external drivers (meeting customers to competition)	G	Percent of mix of first-to-market, fast follower and me-too products;	G
					Market share growth due to new products/services/-enhancements	G
					Efficiency	
					Percent of orders delivered on time	G
					Effectiveness	
					Perception of new products/services offered from innovation projects;	D
					Frequency of repeat customers	D
					Number of existing customers who buy new products/services;	D
					Number of new customers of new products/services who go on to buy existing products/services;	D
					customer satisfaction indicies;	G

Table 2: Framework with specific metrics suggested for each of the area. Letters representing the respective author. (source: own construction)

We can see that **task** related metrics in theory particularly stress a balance of tasks, in addition to a check of quality (effectiveness, efficiency) of the actual tasks performed. Based on Regnell's and Goffin & Mitchell's definitions of project selection and prioritization respectively, the importance of a balancing portfolio will be accounted the throughput phase. Attempts to ensure that inputs are balanced can be made, however it is in fact not until the project is part of a portfolio, and i.e. is in the throughput, that it can in fact be measured/estimated. Additionally, "type" in "balance of portfolio" refers to process/product/service for instance, as defined by Goffin & Mitchell. Chapter 3.1 on definition of innovation, identifies some of these types, which can all be considered important in order to maintain long-term innovativeness.

The **organizational** level evidently includes a lot of "soft" metrics, however as can be seen in the table above, also several highly quantitative metric are recommended on this level. Belonging to this level are for instance all metrics involving time, as this concern the efficiency of the employees, managers and structures.[84] With good project management and project plans, time should be rather easily traceable, although, or course, should not be overemphasized, as noted by for instance Davila et al. Regarding some specific metrics, it can be seen in the table, "Innovation experience" is labelled an indicator of effectiveness of the input. Innovation experience of employees, does not necessarily equal effective performance, however, experience of innovation work would indicate a tendency to have a more "innovative" mind-set, and hence being able to create more effective inputs. "Lack of human resources" is similarly reported as a measurement of effectiveness, as the lack means that the company does not do the right things, what they want, because they are hindered by this. "Number of new strategic options" is labelled "amount" as the measurement lacks a value-related element of the actual outcome – i.e. whether or not the options are actually used for improving purposes.

Financial measures are possibly the most straight-forward, with the exception of "value generated". Due to the general difficulty of estimating it, value generation should be re-estimated continuously and has therefore been brought up as a metric in both throughput and output.

The importance of **market**-related metrics is one of the areas most heavily stressed in theory (See chapter 3.3). Through this structuring of the metrics, we can see that mainly output metrics are to be found in theory, although the few mentioned in input and throughput above are just as important although few. Note that the output-balance metric "share of wealth" is by Muller explained as the change in the company's market value during the past year divided by the change in the total industry's market value during the same period.

[84] One exception is the "balance of portfolio in terms of time" (previously mentioned under task related) as this is an estimation of the specific product features.

5 Empirical approaches to innovation metrics

The past introduction to, and discussion of models for innovation metrics, resulted in a more extensive and thorough framework than has previous been suggested in theory. As this is a theoretical and in one way ideal approach to measuring innovation, the more practical realities of working with innovation, will therefore be sought answered in the following. By doing this, it will create the basis for further analysis, which will be done in chapter 6. This following chapter will introduce qualitative data in the form of general views and structural issues of innovation, followed by the quantitative data on metrics used by the companies. In the end of the chapter the focus will return to qualitative data in the form of the most important issues and challenges that the companies report facing when working with innovation metrics.

5.1 General attitudes

Out of the initial list of 34 companies, one single company decided not to join the study due to company policies not to participate in student researches. Finding the "right" people within the other contacted companies however proved generally difficult, as also discussed in chapter 2.1.2. In one company, it took two calls to the operator to finally be directed to a product developer for a specific type of products. This person in turn explained that

> *"We have no innovation terminology, and most probably no one in the organization has a cross-company insight on this matter."*[85]

The same person claimed that the only way to find out would be through the press responsible, who in turn had no idea, but were willing to find out and reply by email. This email was never received. In a second company, the search for a suitable person went through four different people and took 22 days, with a comment that

> *"I've worked on several projects called "innovative projects", but I've never heard of someone with a cross-company insight into innovation or innovation metrics…which I can find strange since innovation has been a buzz-word with us for at least 10 years."*[86]

In a third company, a person involved in R&D could provide part of the story, but referred to a second person with better overview of their innovations. This person was contacted and offered to help, but 15 days and two reminders later replied that he had talked to various relevant people in the organization, but that neither of them had any good answers;

> *"I wish I could help you, but we don't have the definitions you are looking for."*[87]

With some companies, contact with a suitable person was never attained. Five companies in addition agreed to participate, but never followed through due to lack of time or inability to locate relevant people or information on the matter. Finally however, data from 26 companies was collected, companies who all but two demonstrated a great interest in understanding more about innovation metrics. One single out of the 26 companies required the signing of a confidentiality agreement, which shows a very high interest in contributing to transparency and better knowledge on this area.

[85] Company 23, 14 April, Resp A
[86] Company 5, 7 April, Resp A
[87] Company 20, 2 April, Resp B

31% of the respondents also explicitly repeated the interest in taking part of the final analysis of the thesis, which again shows a high interest in developing in the area. Several of the companies also reported ongoing projects to create better ways of working with innovation as well as innovation metrics. The participating companies, and the respondents' titles have been listed in table 3 below. (See chapter 2.1.2.1 for further arguments for selection of respondents);

ABB	IKEA
Alfa Laval	Perstorp Group
Arla	Sandvik
AssaAbloy	SCA
AstraZeneca	Scania
Atria Scandinavia	SEB
DeLaval International	Skanska
Duni	Sony Ericsson Mobile Communications
Elekta	Spendrups
Electrolux	SSAB
Ericsson	StoraEnso
Fritidsresor /TUI Nordic	Swedish Match
Husqvarna	Tetrapak

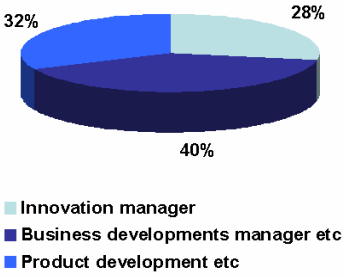

Table 3: Companies participating in the study, with allocation of respondents titles

The titles will to some extent be used in quotes, in order to add an interesting perspective to the quote useful for interpreting the answers, but will not be analyzed more than has been in chapter 2.1.2.1.

5.2 Identification of innovation metrics

The difficulty for the representatives of "finding out" what metrics were being used was shown widespread. Less than half of the companies, 46%, could give rather immediate answers. The remaining companies needed time to "look around in the company" to find out what metrics were being used. To give an understanding of the general responses concerning the companies' innovation metrics, some quotes have been included:

"Depending on what you mean by innovation metrics, my answer will be sort of different." [88]
- Global head of innovation

"Yeah, that's a bit difficult you see, we haven't really concretised it (innovation metrics). But sure, I could try to figure that out for you.
- Global head of key drivers and idea management[89]

"It's not that easy, it's not like we have a list or something"
- Global head of innovation and new business development[90]

"I doubt that we measure on a group level. And we don't really have a development department…anymore… and that of course is interesting from your perspective… I mean, top management should have an idea of where we are

[88] Company 19, 16 April
[89] Company 26, 14 April
[90] Company 11, 7 April

positioned (reg. innovativeness)…"
- Head of product development, specific product[91]

"That is very difficult to take over the phone, we need to sit down and talk. We have nothing written down.
- Global head of research, innovation and development[92]

The reason for these difficulties can have several explanations, but three clear issues have been identified: definition-, transparency and historically related ones, which will be described in the following subchapter.

5.2.1 Definition of innovation

Asking for non-product or non-financially related metrics as well as those covering the actual process of innovation, posed the largest difficulties for the respondents. Numerous companies report that these types of metrics do not concern them due to their business model, alternatively they do not have a previous notion of these types of metrics, and hence a difficulty in grasping the concept of these metrics.

"We are product and technique focused when measuring innovation. We don't measure business innovation."[93]
- High-tech

"Portfolio planning and R&D are the two parts of the organization which work with innovation, and this is where it is most relevant. Innovation is of course relevant to the whole organization, but I cannot see how one would work with innovation in the economy or sourcing departments for instance."[94]
- Consumer goods

It is clear that some companies have a rather narrow definition of innovation, where innovation concerns only certain parts of the organization. Two other companies[95] explicitly argue that the incoherent definitions around innovation are what make it difficult to identify and deal with metrics. 35% of the companies had no clear definition on a corporate level, although some of these had broad descriptions or concept which they were working around. In some cases, this was also the result of internal re-defining and re-structuring of innovation.

"Our company consists of very many small units. (...) Regarding definition you can express something on group level, but there will always be people out in the organization with their own definition."[96]

"I wish I could help you, but this is a question that we are discussing right this moment; what is innovation to us? [97]

[91] Company 23, Resp. B, 16 April
[92] Company 20, 14 April
[93] Company 10
[94] Company 21, 29 April, Resp B
[95] Company 9, 7 April, Company 21, 16 April
[96] Company 24, 17 April

Out of those with official definitions, key words in the definitions were compared to the definitions of the three horizontal phases and the four vertical levels of innovation, recommended in theory.

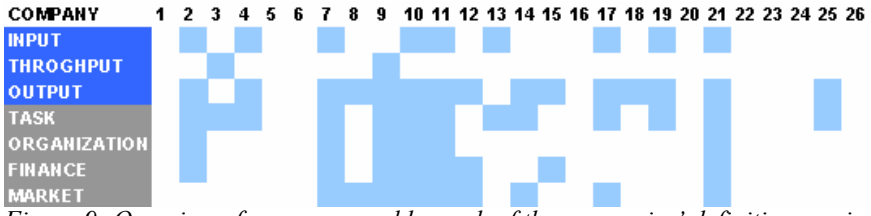

Figure 9: Overview of areas covered by each of the companies' definitions on innovation (source: own construction)

Figure 9 shows that 4% of the companies had a definition relying solely on input, 4% relied solely on throughput whereas 19% were relying solely on output. 35% had a definition which combined two of the three phases, with input/output representing 31 %, and throughput/output the remaining 4%. Consequently, none of the companies had a definition covering all three phases. When looking at the four vertical levels the same figure 9 shows that, out of the companies with an official definition, 50% had a definition which includes innovation around the specific task. For 19%, this task-related innovation was the only focus in their definition. 26% include an organizational focus, mainly including the importance of the employee. 31% through their definition point to the importance of a financial focus, normally monetary output, of their innovations. 35% have, through their definition, a focus on market or customers when describing innovations. 23% focus on one single vertical level in their definition where, as mentioned above, the 19% is represented by companies having solely a task focus, and the other 4% having only a financial focus. On the other hand, the same total percentage (23%) focus on three or more vertical levels through their definitions.

5.2.2 Organizational transparency

12 % of the respondents explicitly from the start mentioned the huge difficulties in finding out what metrics were being used on a group/cross-divisional level. One respondent still gave it a try, but came back virtually empty-handed after weeks of search. In all of these companies, there was also a huge difficulty of finding the right person, i.e. there was no innovation manager or similar, and the people contacted had difficulties in referring to other suitable contact persons:

> *"We are much decentralized when it comes to innovation. (...) Each division basically minds their own business in this area".*[98]

> *"We have some metrics here and there, but everyone works very differently as we consist of many different companies. (...) We have had several internal projects looking at this and coming up with the conclusion that we are missing a lot, including what should be done (...) However, quite honestly, we are rather bad at following up these kinds of things."*[99]

However, the title does not always imply a detailed overview of the situation. In one company[100], the Innovation Manager claimed to know the metrics used only on a group level, but having no information about what was measured on a divisional level. Another company on the other hand, had recently initiated a project of considerable size to homogenize definitions, management, reporting

[97] Company 22, 29 April
[98] Company 5, 14 April
[99] Company 24, 17 April
[100] Company 11, 7 April

and specific metrics. They had previously experienced huge problems of innovation transparency and cooperation across the divisions. The project was implemented during this year and they were already starting to see results:

"We found that all parts of the company were working very differently with innovation, and had to merge our views. Since we are a company based on acquisitions, it has been very important to ensure that all have a say. (...) The local companies are highly independent in their innovation choices, but must follow the global innovation process framework. Therefore we put stronger emphasis on some process related issues such as that they use Voice of the customer as base for development decisions."[101]

Furthermore, in connection with the organizational transparency of innovation, 23 % of the companies[102] reported that they are just about to, or have just initiated innovation projects of larger size, including improved structures for innovation transparency and collaboration, and establishment of new or improved innovation metrics.

5.2.3 Historical legacies

15 % of the companies explicitly referred to the historical lack of measuring as a problem,[103] whereas several other companies showed general inexperience with the concept of innovation metrics. In these cases, the companies' metrics were all very simple and few:

"Innovation and innovation processes are concepts that haven't existed naturally in X but have been an implicit part of the business development (...) We don't really have an innovation terminology. (...) I saw the need and said that we need this, and I will call myself Innovation Manager and start working with this."[104]

On the other hand, one company[105] which only 3 years ago started a huge effort of structuring the "free flow of innovation" today has one of the broadest definitions and applications of innovation of the companies in this study, as will be shown in chapter 6.

5.3 Metrics actually reported

Each company was asked to define which innovation metrics were used within the company, with additional information describing specifics around the metrics in order to ensure understanding of the metrics – measurement technique, measurement frequency, level of post-measurement communication and additional comments. Several companies chose to inform on all parameters, however many of them only to gave a broad overview of the metrics used. Due to the variation of depth in responses, the reported metrics in the following will be presented on a fundamental level, in order to ensure comparability. Overall, the companies in total reported 97 somewhat overlapping but at the same time very varying, metrics.

COMPANY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
TOTAL	8	12	3	5	2	2	13	4	2	3	3	4	1	4	6	6	0	3	1	1	1	2	0	5	5	1	**97**

Table 4: Total number of metrics, used by each of the companies.

[101] Company 4, 7 April
[102] Company 4, 6, 10, 14, 19 and 23
[103] Company 19, 20,21 and 23
[104] Company 17, 23 April
[105] Company 7, 7 April

To facilitate comparison with theory, the quantitative metrics found through the empirical study, will be presented in the structure that emerged from the theoretical findings in chapter 4.4 (table 2) – with the three horizontal phases of the innovation flow, the four vertical levels of specific areas, and the four types of indicators. The metrics reported by each company have been connected to the appropriate level in the matrix. A further analysis on the results will be conducted in chapter 6.

	INPUT		THROUGHPUT		OUTPUT	
TASK	**Amount**		**Amount**		**Amount**	
	Number of ideas resp. invention applications generated	1,7,10,14,15, 18,20,21,24,25	Number of projects running	1,4,7,14,16,25	Number of new products/launches /line extenstions etc	1,6,7,22
	Number of ideas approved	1,2,14,15,18,24	**Balance**		**Balance**	
	Balance		Balance of portfolio: time, cost	1,8,10	Number of launches, re-launches vs. line extenstions	22
	Number of challenge-driven ideas, as opposed to spontaneous	12	**Effectiveness**		Average age of products on market	1
	Effectiveness		Number of projects stopped in certain stage;	8	**Effectiveness**	
	Valuations of ideas: risk, potential size, technique parameter of idea;	1,15,16,24	Percent of ideas/projects resulting in commercial success/proving themselves	8, 24,25	Extent to which new offerings cannibalize on existing offerings;	2
	Valuation of ideas approved;	15	**Efficiency**			
	Number of patents;	2,5,7,10,11,13,18	Number of projects passing stages at right time, in right shape;	12,25,26		
			Phase-gate metrics	16		
ORGANIZATION	**Amount**		**Efficiency**		**Efficiency & Effectiveness**	
	Number of management trainings	12	Planning hours/actual hours for a project;	7	Competence developed;	7
	Time reported for innovation	7	Average development time per projects;	2	Organizational learning	7
	Efficiency		New developed product divided by number of engineers	7		
	Creative/innovative environment	11,12	**Effectiveness**			
			Time spent on R&D vs. total time	4		
FINANCE	**Amount**		**Amount**		**Amount**	
	R&D Investments (as % of);	2,3,5,9,11, 15,16,19	Projected sales and contribution per projects	4	Organic growth;	4
					Share of sales from new products	2,3,4,6,8, 9,15,25
	Money spent on innovation;	14	**Efficiency**		**Balance**	
	Value of project suggestion	16,24	Time to break-even	2	Return on innovation/R&D investment	2,7
					New product/service/offering sales;	1
					Cost of product maintenance &	2
					Efficiency	
					Projected vs. actual profits & revenue	2
MARKET	**Quality**		**Efficiency**		**Balance**	
	Quality of innovation based on customers notions	7	Time to market	2,3,16	Market share with new investments	7
			Time to volume	2	**Effectiveness**	
					Framgång på marknad, successrate	7

Table 5: Framework developed in theoretical section, matched with actual metrics used in practice. Figures representing the participating companies, with coding.[106] *(source: own construction)*

5.4 Challenges/important issues

In addition to the metrics that were reported to be in use today, several challenges, issues and important areas of measurement were brought up by the companies. These will be mentioned in short, divided into general issues as well as the more specific issues. These issues will be kept in mind when conducting the analysis, and be brought up where applicable.

General issues: Beyond the definitions of innovation, organizational structures and historical legacies mentioned previously, the companies report several issues of innovation metrics, on a general level.

[106] "Quality of innovation" is by the company using it defined as "customers' expectation of performance and satisfaction of the solutions according to specific functions and quality".

A: The difficulty of finding *relevant* metrics.[107]
B: The general *lack of standards* to lean towards.[108]
C: Finding *concrete, absolute metrics*.[109]
D: Finding *qualitative metrics*.[110]
E: Two representatives stress the issue of *too few, versus too many metrics*.[111]
F: The same companies argue that the balance must be found by metrics that are *easy to understand*.[112]
G: Metrics that the *staff can actually influence*.[113]
H: Metrics that are *easily traceable*.[114]
I: Another representative sees *communication* as both difficult and important, where another respondent adds the importance of communication through that is creates a buzz around innovation, and puts innovation on the map.[115]
J: Furthermore, one representative brings up the *volatility* of ”innovation focus” where resources are easier to set aside in good times, but at the same time the need for innovation is less. In more difficult times on the other hand, the surge and need for innovations are greater, however it is also more difficult to get resources in terms of both people and money.[116]
K: One company sees large challenges with even just *describing the innovation process* (”which probably differs from the product development process”) and measuring being even more difficult.[117]
L: One company stresses the difficulties in measuring *without focusing on results*, as capability creation in reality is the most important.[118]
M: Several companies bring up the measurement of *value creation* as the biggest issue.
N: Another one stresses that the *real added values* of innovation are hard to really translate into money.”[119]
O: Two others mention specifically the difficulties with *time perspectives* in terms of output, with regards to long life cycles.[120]

Specific issues: Beyond these general issues for metrics, the companies report several specific concerns and/or suggestions:
P: Two representatives claim a desire to create better metrics for *patents*; for instance number of new patents in new products or efficiency of patent portfolio.[121]
Q: Some companies stress the specific difficulties in measuring *quality of ideas*,[122]
R: Others would like a measurement better supporting the generation of more *radical innovations*.[123]

[107] Company 26, 8 April
[108] Company 7, 2 April
[109] Company 7, 2 April
[110] Company 9, 7 April
[111] Company 21, 29 April, Resp B
[112] Company 21, 29 April, Resp B
[113] Company 21, 29 April, Resp B
[114] Company 21, 29 April, Resp B
[115] Company 11, 29 April, Company 18, 24 April
[116] Company 24, 17 April
[117] Company 18, 24 April
[118] Company 21, 29 April, Resp B
[119] Company 12, 16 April
[120] Company 26, 14 April, Company 4, 7 April
[121] Company 10, 27 April, Resp B, Company 13, 7 April
[122] Company 11, 29 April

S: One company stresses the interest in knowing how to *separate large innovations from incremental innovations*, but still being able to measure both.[124]
T: Another company claims that it is the *innovation efficiency* which is the most important – what they actually manage to perform with their ideas.[125]
U: Two representatives wish they could measure "*return on innovation*" and brings up the early value estimations as the largest issue.[126]
V: Another company stresses the need for focusing more on *learning* and how experience is leveraged.[127]
X: Several bring up organization related issues on a broader level. Issues such as *better understanding and monitoring of the culture*, *influencing factors*, *creativity* and being able to *translate it into absolute value*.[128]

[123] Company 13, 14 April
[124] Company 21, 29 April, Resp B
[125] Company 11, 29 April
[126] Company 3, 22 April, Company 15, 2 April
[127] Company 4, 7 April
[128] Company 1, 24 April, Company 18, 24 April, Company 12, 16 April

6 Analysis

Given the theory analysis in chapter 4, this analysis will focus on the patterns that appear when merging theory with the empirics from chapter 5. The challenges and important tasks concerning innovation metrics will be integrated into the analysis, under the area in which it belongs to.

6.1 Ways of working

It is obvious that the majority of companies studied are struggling to find relevant and well-based innovation metrics. Even those that do have a rather broad selection of metrics, as well as generally well-structured ways of working with metrics, report the need for better metrics in order to gain management support and thereby allocate resources more efficiently.

6.1.1 Legacies, transparency, terminology, communication and responsibility

Historical legacies do seem to play a part in this, as many companies have a history of not knowing how to approach innovation metrics. On the other hand, the findings showed an example where a company had been able to build up a structure for innovation metrics in only a few years time, although the structure seemed rather rigid. *Organizational transparency* similarly posed difficulties for the companies, where large and highly decentralized companies made transparency and cross-cooperation around innovation and innovation metrics more difficult. On the other hand one example brought up where a company very recently took a strong grip on harmonizing the various parts of the company, but still taking the voices of the departments into consideration.

Historical legacies can not be affected, and organizational transparency is neither easy to change nor rational to change only to attain a better overview of innovation. Are which were identified as challenging areas, but still should be alterable however, include the lack of *innovation terminology, clear innovation communication* and *people with an overview responsibility for innovation*. Although these issues overlap, the lack of innovation terminology became clear in many companies due to the general difficulties in discussing innovation in broad terms, without falling into product development, patents and R&D. The lack of innovation communication is based on the huge efforts put into collecting the data from the various companies, as well as the huge efforts put in by some of the respondents, who sometimes also came back empty handed or with very limited and incomplete information. The lack of people with an overview responsibility for innovation is based on the, in many companies, difficulty of finding the correct person to talk.

An established and inclusive innovation terminology, a clear communication around innovation which thereby steers behaviour as requested, and a person with true responsibility and insight on an overview level (indeed, several people with “innovation manager” title or similar struggled to find the information) would allow for higher probability of value-added use of innovation metrics, whereas a lack in one of more of these areas indicates that the company does not have a clear base to build innovation upon, nonetheless useful metrics.

A lack of this kind was identified in many of the companies, indicating that there is room for significant improvement of basic fundamentals which can increase the probability of working successfully with innovation.

6.1.2 Definition of innovation

Another closely related issue concerns the *definition of innovation* as a part of the organization's way of working structurally with innovation. A huge disparity amongst the companies as well as compared to the metrics in use, can be seen here. When structuring the empirical reality around the companies' definitions of innovation, as in figure 10, the disparity is clearly shown.

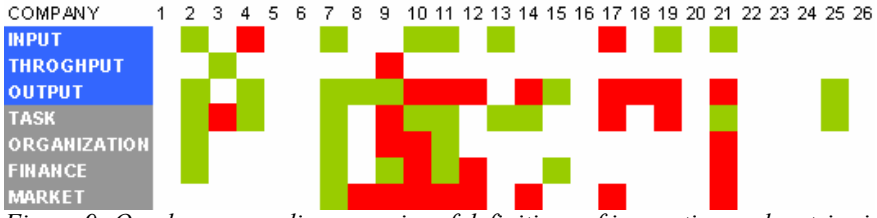

Figure 9: Overlap versus discrepancies of definitions of innovation and metrics in fact used with each of the companies.

The basis for this figure 9 is figure 8 which with blue boxes showed what areas the companies' definitions cover. Here the blue boxes have been replaced by green and red boxes. The 33 green boxes represent areas where the definition is coherent with what is being measured, whereas the 29 red boxes illustrate the areas which the companies find important when defining innovation but are not followed up via metrics. As previously explained, 35% of the companies have no official definition of innovation, resulting in blank fields. The illustration above however clearly shows that also where there is a definition, there is confusion between what a company defines as important aspects of innovation, and what they in fact focus on when measuring. A large discrepancy is to be found on the market-level. 31% of the companies through their definition explicitly stress the importance of market-driven innovation, but have no metrics to follow up how well they perform in this area. The same percentage (31%) use some sort of output variable in their definition, but have no metrics for output.

The lack of a clear and well-grounded definition, furthermore underlines the lack of base to build upon when working with innovation metrics. A clear definition itself does not ensure the use of high-quality metrics, nor the accessibility of the data, or value-added use of it, however it helps when creating an innovation terminology. In addition it facilitates the innovation communication whereby it helps sending a clearer message towards the employees regarding what is actually meant by innovation, i.e. what is sought after or even required from them. With the current situation there are most likely gaps between the management's and employees' definition. This means that whenever management uses the term "innovation", every single employee may have an individual interpretation of what is said. In the worst case scenario, the employee interprets "innovation" as something that does not concern him or her, but that it is something which the R&D department or similar should take care of. In addition a company-level definition is a basic foundations for innovation management, which clearly identifies the important parameters of innovation and which thereby can function as a structures for the creation of well-motivated, strongly supported and clearly identified metrics. As a bonus, it may help the companies identify metrics which were not previously labeled innovation-related but could well be.

The fact that 35 % of the companies lack a company level definition, and that 47 % of what the rest of the companies are trying to attain with their innovations (given by their official definitions), is not actually monitored in reality indicates that there is room for significant improvement of basic fundamentals which can increase the probability of working successfully with innovation.

6.2 Metrics

The framework which was created based on the theoretical findings, resulted in a framework of 12 squares of importance and four types of indicators, where each of the companies' metrics were allocated (see table 5). An analysis of these results will be conducted in the following, where the challenges and important areas, as reported by the companies, will be incorporated in the analysis. This, to be able to clarify certain patterns and deficiencies between the frameworks' suggestions on where and what to measure, and how it is actually being measured in the companies.

6.2.1 Broad picture

COMPANY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
TOTAL	8	12	3	5	2	2	13	4	2	3	3	4	1	4	6	6	0	3	1	1	1	2	0	5	5	1	97

Table 6: Number of metrics used by each of the companies. (source: table as table 4, but showed again here for better illustration of the analysis)

When looking at the broad picture of metrics reported, the picture appears highly scattered. Table 6 shows that the numbers of metrics in each company vary from 0 to 13, with 8 % of the companies using no innovation metrics at all. 19 % of the companies rely on one single measurement of innovation. In total, 65% of the companies use five or less metrics, whereas 12% of the companies form a group with a relatively high number of metrics, tracking 8, 12 and 13 innovation metrics respectively. The number of metrics does not necessarily give an indication as to the quality of the metrics, and there is no "golden number of metrics" reported in theory. However, in the cases where a very small number of metrics are being used for communication within the company, it indicates a lack of focus on innovation, and most probably gives an incomplete, and possibly even harmful, picture of the company's innovativeness.

In essence, it can be stated that the 42% which use two or less metrics could change their approach to working with metrics to a significantly more value adding approach, through creating a richer portfolio of metrics.

6.2.2 The three horizontal phases

COMPANY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
INPUT	3	3	1		2		4		1	2	3	3	1	3	5	3		3	1	1	1			4	1		45
THROGHPUT	2	4	1	3			3	3		1		1		1		3								1	3	1	27
OUTPUT	3	5	1	2		2	6	1	1						1							2			1		25

Table 7: Number of metrics used by each of the companies, in each of the three horizontal phases recommended by theory.

Taking this total amount of metrics to the next step, illustrating them in the three horizontal phases of the framework, table 7 shows that 73 % of the companies track innovation input, illustrating that this is the most important area to most of the companies. However, 27 % of the companies rely solely on this stage of measuring. 50 % use some variation of a throughput metric, which in every of these companies, with the exception of one, is combined with measuring in one or more phases. 42 % track output with one or more metric, and for more than a fifth of these, this is the only phase in which they measure. A mere 19 % have metrics that follow the innovations throughout all three phases, which based on the frameworks' suggestions to do so, can be argued to be a very low number. When focusing on the number of metrics used in each phase, table 7 furthermore shows that the companies with a large number of metrics, also to a larger extent are tracking all three phases, supporting the concluding remark in chapter 6.2.1.

The fact that a majority of the companies lack metrics throughout all three innovation phases, although the phases fundamental in theory, indicates that companies either have a general weak trust or knowledge of what phases of innovation that are recommended to track. The 46% of companies which track none or one of the phases, can therefore be argued to know exceptionally little about their actual innovativeness. Based on previous discussions, the 35% that track two phases, either have indications of what goes in and how well they take care of it, but have no idea what their output is; or of how well their process functions and what comes out of it, but not why they are actually good or bad in these two phases because they do not know what their input factors are. It could also be the case, that they know their input factors, and what in the end comes out of it, but have no idea whether or not they could make the process faster, more balanced or more effective. Again, when using these metrics for communication within the company or towards top management, it gives a highly incomplete picture. In cases where the gaps are not observed, stressed in the communication, and where the information therefore is taken as a true signal for innovation, this incompleteness may even be harmful to the company. With additional efforts, a large majority of the companies could rather easily attain a more balanced understanding of how they perform in terms of generation, efficiency/effectiveness as well as commercialization – as argued all equally important in order to be "innovative".

In essence, the information shows that 81% of the companies lack measures that follow innovation from generation to commercialization. This indicates that the information at hand for the company is often incomplete and of little use for understanding the total innovativeness of the company but also that there are huge rooms for improvement in terms of structuring innovation metrics on this level and thereby creating more added value of the metrics used.

6.2.3 The four vertical levels

COMPANY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
TASK	7	3		1	1	1	4	3		3	1	2	1	3	4	3		3		1	1	2		4	4	1	53
ORGANIZATION		1		1			5				1	2															10
FINANCE	1	6	2	3	1	1	1	1	2		1			1	2	2			1					1	1		27
MARKET		2	1				3									1											7

Table 8: Number of metrics used by each of the companies, in each of the four vertical levels recommended by theory.

When illustrating the metrics used in terms of the four vertical levels of the framework, table 8 shows the resulting allocation. These four levels were in chapter 4 argued to be equally important, meaning that metrics ideally should be used in on all levels. However, the empirical results show a clear tendency that the majority of the companies focus exclusively on task- and financially-related metrics. 81% of the interviewed companies measure on a task-level, with about half of them sticking to this as their only level of measuring. 62% of all companies use financially related metrics, where the majority combined these metrics with one ore more of the other levels. 81% of the companies today lack organizationally related metrics, and 85% lack metrics that include a market perspective. In fact, only 9 different organizational related metrics and 5 different market related metrics are in use, showing a great lack of creativity in this area, especially as the theories discussed, collectively came up with 40 different ones. Again, the number of metrics in itself says nothing about the quality of the metrics, but it does provide a pool for inspiration for creation of useful metrics.

58% of the companies measure on two or more of these vertical levels, of which most of them cover the task and financial levels. Noteworthy is that although using several metrics, company 1 has only task-related metrics apart from one task realted. This again, shows that even though a company uses

a high amount of metrics, this can be of little value if the metrics are not allocated wisely. Company 2 and 7, which also have reported several metrics in use, on the other hand cover all four phases and although no conclusions regarding the quality of these metrics will be drawn, it does indicate that these companies have a more developed and inclusive concept of innovation metrics and its applicability.

Again, when using incomplete metrics for internal communication, they provide an inaccurate picture of the company's innovativeness. In cases where the deficiencies are not observed or stressed in the communication, and where the information therefore is taken for a true signal of innovation, this incompleteness may give a wrong picture of the company's long-term innovativeness. Most probably, it is the organizational and market levels which are crucial for long-term innovativeness, as high scores on suitable metrics in these areas indicate strong innovative culture and, arguably vital for a high competitiveness; a high customer-focus on all innovations. The task and financial levels have been proved important as well, but due to the limited lifecycles of products/services/process/business models, and the high spin on financial assets, these indicates a more short-term innovativeness. Hence, without a good balance between all of these levels, the company might get an inaccurate idea of where their long-term innovativeness really lies, and hence make strategically harmful decisions and inaccurate investments thereafter.

In essence, we can see that 71% of the companies measure on only two, one or even no level, meaning that the innovation information at hand for the company is highly biased and of little use to understand the total innovativeness of the company. However the provided framework also suggests a structure whereby these companies could create more balanced and thereby higher value added application of metrics.

6.2.4 Specific metrics and the four types of indicators

Now that an overall picture of the tendencies of innovation have been shown, in order to get a comprehensive and more detailed understanding of more specific innovation metrics, it is necessary to look deeper into patterns and deficiencies of the specific metrics used in practice and suggested in theory. Again, in order to create a natural categorization and thereby facilitate the analysis, the framework previously developed will be used.

6.2.4.1 Task-related metrics

Looking more into details on the task level, although a total of 11 generic task-related metrics are suggested in theory, covering all three horizontal phases, the majority of the measuring in practice takes place in the input and throughput section, with 46% of the companies measuring task-input in one way or another, 38% measuring task-throughput and only 19 % measuring task-output (see table 5 in the presentation of the empirical data). Through the empirical data it can also be seen that there is a strong tilt towards "amount" metrics, which is not even suggested in theory on this level. This indicates an initial sign that innovation metrics are under-developed in most of the companies. Absolute numbers will rarely give a good indication unless turned into an interesting ratio, beyond what is already assumed to be the practice in the companies (for example a comparison to the total or previous year). Through instead using "balance" metrics for instance, the opportunity to separate for instance large innovations from incremental ones, but still measuring both, becomes clear (Specific issue S). Again, a balance measure must be accompanied with good definitions.

Overall, there is a large cluster around the number of ideas/invention applications generated in the input phase, with 42% of the companies using this metric. For one company, this measurement is

their one and only innovation measure. Only about one third of the companies using this metric, however make a valuation of the initial ideas. These same companies also take information further by tracking the number of approved ideas. In addition, one company tracks only "ideas approved", without measuring "ideas generated", hereby loosing an important comparison figure. As brought up in chapter 5.4, several companies stress the specific difficulties in measuring the quality of ideas (Specific issue Q). However, one can make a rather simple judgment of quality of ideas, through a straightforward comparison between number of ideas generated and ideas approved. This is obviously not taken advantage of in practice. By using effectiveness metrics on the throughput side, it can also quite easily become clear whether or not the ideas selected are succeeding, which functions as a guideline for whether or not good ideas are chosen.

Another company would like a measurement which better supports the generation of more radical innovations (Specific issue R). On this note, theory rather heavily argues for balance metrics in general, and for task-input suggests measuring (and thereby stressing the importance of) balance of different types of ideas - also measured rather simply given clear definitions. Through a balance measure of this type, accompanied with clear definitions, the difference between different types of innovations is not only measured but also stressed and visible. Another company in practice measured only the number of ideas with a particular character only, again missing the opportunity to create an interesting balance-metric instead.

27% of the companies track patents. Almost a third of these use this patent metric as one out of a portfolio of maximum three metrics. It is true that for some industries and companies, tracking patents might make sense. However, following the general characteristics of an innovation in chapter 3.1, the patent lacks a commercialization component in that it does not indicate the actual success of the patent, and therefore cannot be seen as a successful output. If anything, patent compared to number of initial ideas give an indication of the general qualities of ideas, potentially useful for patent-oriented companies. But only one company using patent as a metric makes this comparison. A patent metric could also be complemented with a measurement for "number of patents that are a success on the market" or "% of sales from patents….", which is not used by any of the companies. On the other hand, these kinds of metrics create separate measurements for patents, rather than for innovation on the whole, and still needs to be complemented on the other areas. In addition, patent is a highly non-generic metric, and as the aim of this thesis is to find a pattern of generic metrics that could be used cross-industrially, this metric, although used by 27% of the respondents, must be judged as of little use in the bigger picture. For the two companies that mention patent metrics as something they want to continue to refine (Specific issue P); Combining the fact that this was their only real area of concern mentioned with the above analysis of innovation definition and vertical levels covered by metric, it can be concluded that these two companies would need a more inclusive and non-primarily-product oriented view on innovation. However, looking on the whole, these are not the only companies who would benefit from this.

Regarding task-throughput, it was mentioned that 38% had a metric in this area, however 20% of these fail to actually make a judgment of this throughput in terms of quality, balance, effectiveness or efficiency, meaning that they miss to create a value-based metric. One of the companies stress that task related innovation efficiency is what is most important to measure, meaning what they actually manage to perform with their ideas (Specific Issue T). This is a typical problem which could be solved with throughput measures, which the company currently does not use. Both theory and practise here suggests several metrics.

Concerning task-output, a surprising 85% lack a simple innovation metric concerning the number of new products/services/processes introduced. Of the companies that do use this metric, 50% neglect the importance of making some sort of valuation of this output, in terms of cannibalization, age, balance etc.

In summing up; on a task-related level, several generic and useful metrics have been suggested in theory. However the companies cluster around number of ideas generated and patents attained. In addition, 85% of companies lack an output metric related to the number of new innovations that are being commercialized. It was also shown that some of the areas considered as the most important issues for the companies, can be solved rather simply by applying theoretically suggested metrics, or theoretically suggested removals of metrics.

6.2.4.2 Organizational level

When analyzing the organizational metrics, first of all the theory have several suggestions. Among these are suggestions in terms of employee, management/strategy and structure related metrics as well as ones which indicate "amount", "balance", "quality", "efficiency" as well as "effectiveness" plenty, at least concerning input and throughput. However, the results of the practical application shows a clear lack of both specific metrics as well as measurement throughout the innovation phases. 12% of all companies measure input in terms of training, time or environment, 12% measure throughput in terms of time mainly and 4 % make an attempt to estimate organizational learning and competence developed. One company specifically stresses the need to focus more on learning and how experience is leveraged (Specific issue V), where this latter figure shows that at least one company is doing just that at the moment (although mainly through surveys). There are also some theoretical suggestions for how to go about it, where primarily the post-project review is an indicator of organizational learning and leveraging.

One single company, measures the organizational level in all three horizontal phases with several measures in each phase, whilst the rest of the companies measure in only one of the two first phases, input or throughput. The implications of the immense lack on this level can be that the actual "resources" or innovations in terms of the people, management and structures which will create the ideas, is not at all tracked and followed up by the majority the companies. The few companies that do track, but in only either of the three phases, will based on the discussions on allocating the metrics; i) Either track the basic innovative environment of the company, or the investments made into creating it, but not how this "initial innovativeness" is taken advantage of or what output they actually get from it or; ii) Alternatively measure how good they are at transforming innovativeness into value, throughput, but neither what has gone into the system in terms of investments or inherent capabilities of the employees etc, or what actual output they get from it. All in all, neither of it provides sufficient information to make investments on this organizational level.

Numerous of the companies bring up the difficulties of better understanding and monitoring the culture, influencing factors, creativity and being able to translate it into absolute value (Specific issue X). The use of well-grounded metrics in all phases on the organizational level has been argued to help in getting a better understanding, in combination with the other three levels of metrics, as value should concern output on all four vertical levels.

In summing up; on an organizationally related level, the abundance of generic metrics suggested in theory is evident. However 81% of the companies lack metrics on this level, although one company covers all phases. It has also been shown that some issues considered as most important

for the companies, can be solved rather easily by adding organizationally related metric throughout the three horizontal phases, and using theoretical inspiration particularly concerning the final phase.

6.2.4.3 Financial level

Remarkably, 38% of all the companies lack financial metrics for innovation, whilst one company in fact has as many as six different ones for this level. By the nature of the financial level, "amount" metrics are used in both theory and practice. However, for instance theory again suggests the inclusion of "balance" measures to ensure a stable and long-term portfolio of projects. One single company uses a balance metric, and this is first in the finance-output square. Neither effectiveness nor efficiency is very well monitored in practise.

Although R&D in theory has been discussed as a rather unfitted measurement for innovation, it can in addition be seen that 31% use R&D investments as a metric for innovation, normally in relation to revenues or similar. For more than a third of the companies with R&D metrics, this is one metric out of a total portfolio of maximum three metrics. This gives a picture of a strong lack of more "creative measures" and further support that companies tend to measure what is easy to measure. R&D does give some indication as to how much the company is focusing on the financial area, but as discussed in theory, the metric can be replaced by better metrics which target what you are actually trying to monitor. In addition, R&D is not very generic, as it is mainly applicable to manufacturing industries. Therefore it would be better fitting, from an innovation perspective, to use a metric such as "investments in innovation activities and efforts" instead, as suggested by theory. Although this requires clear definitions of innovation activities and efforts, these figures lie somewhere in the financial statements. This type of metrics *is* used by one company, which however does neither track these investments throughout the throughput nor the output. Again, an insight of the like, which however is not completely followed through, has been seen several times. This situation may have a number of explanations; however it does again clearly support the case for the need of a basic structure for innovation metrics.

Two single companies track financial throughput through "time to breakeven", the actual efficiency of the money invested. In the eyes of the investors, this is a highly surprising figure. Most companies would follow average costs/sales/profits of projects; however, no company reports this as a metrics being used to track the path of the investments made in innovation. In addition there are a number of potentially useful metrics provided in theory. Quite remarkably, only 27% track the "sales from new products" as a measure of innovation output. This would again be a measure that most companies track, and therefore not difficult to communicate as a metric of innovation. Of the balance and efficiency metrics in the empirical data, all but one belong to the company with six different metrics, showing a great need but also prospect for improvement in this area. In fact there are also two companies, including this one, which already measure "return on innovation", in financial terms, something discussed as a difficulty by two companies (Specific issue U).

In summing up: on a financially related level, a number of generic metrics are again suggested in theory. Still, 38% of the companies lack metrics on this level, although one company has as many as six metrics. The reality of this company, in addition with the suggestions from theory, suggests that these 38% could measure financial related innovation in a more value added way. It has also been shown that one specific issue reported by two companies, is already solved by one company.

6.2.4.4 Market level

The largest discrepancy between theory and practice shows when looking closer into the market-related metrics, where only 15% of all companies integrate market-parameters into their metrics. One single company represents the market-related metrics on input and output, whereas the throughput metrics are represented by only three other individual companies.

Especially concerning market-output, theory again suggests several metrics, but only one companies has metrics in use here. The lack of metrics on the market-level indicates that not only are companies lacking a good internal communication of innovation, but they are even worse at communicating the relevance and the value of innovation to the market. Again this should be contrasted to the high number of companies which through their definitions state the importance of market/customer-relevance to their innovations. After all, if it is not of interest to the market, it can be argued that there would be no use of being innovative in the first place.

In summing up; a massive 85% of all the companies neglect the inclusion of market and/or customer relevance when measuring their innovativeness, although specific metrics suggestions are plenty in theory, and innovations should initially be driven by the needs of the market. Hence, there is a huge room for improvement in practice, in order to create more value adding metrics on this level.

6.3 Perspective on the analysis

The analysis has until now shown that there is a great lack of metrics in the companies, and that a majority of the areas recommended in theory, are either randomly measured or not measured at all by the companies as can be seen in figure 11:

	Input (Amount, Balance, Efficiency, Effectiveness)	Throughput	Output
Task			LACK
Organization	HUGE LACK	HUGE LACK	HUGE LACK
Finance		HUGE LACK	
Market	HUGE LACK	HUGE LACK	HUGE LACK

Figure 11: Summarizing table of areas lacking cover in practice. (source: own construction)

The strong randomness of metrics may have several explanations but it does support the case for the need of a basic structure for innovation metrics. In fact, the previous parts of this chapter also showed that several if the specific issues brought up in chapter 5.4 by the companies as challenging or important, i) are true lacks coinciding with the important areas of the framework and ii) could have been covered through the use of a more structured approach to metrics, through the suggested framework.

In addition, the above indications i) and ii) can be further be supported by taking a complete grip of the framework. The framework in itself provides a standard, for the companies to lean towards (General issue B), it suggests or at least inspires towards metrics which are relevant, concrete and absolute as well as qualitative, easy to understand and easily traceable (General issues A, C, D, F,

H). The balance of different areas provided by the framework, ensure a focus not only on returns, but also capabilities (General issue L). In addition it, through the measuring of four different types of output, creates a more holistic way of measuring value of the innovations, with values that can be seen both long-term and short-term (General issue M, N, O). The framework also provides aggregation versus drilling opportunities, meaning that the chosen portfolio of metrics can consists of different number of metrics, to be used on different levels of the organization. The framework is also only a framework, suggesting a balance from where the company can pick the amount of metrics it finds suitable (General issue E). The levels of task, organization and market are generally easily influenced by the staff (General issue G). Using a structure like the one the framework provides, in addition to improving on the areas suggested in chapter 6.1 strongly facilitates the communication of innovation, and the innovation process, as it makes the matter more tangible (General issue I, K). In addition, this way of creating more tangible touch points for innovation in addition most probably would also help reducing the general volatility in innovation focus, as there are specific numbers and areas to point towards, as well as specific accomplishments and performances (General issue J).

Hence we can see that the framework, based on theory but provoked by practise (as described in chapter 2.1.2.3) does include the areas considered most important by the companies.

7 Conclusion

The aim of this thesis was to investigate how innovation metrics can be used to strengthen the competitiveness of a company. The motivation behind, came from the common notion of "innovation" as a highly non-tacit area of today's businesses, combined with the fact that companies are ever more affected by globalization which creates a need for continuous renewal and innovative thinking. Innovation metrics here shows up as a means by which this non-tacit area could be made more tacit, and potentially be a useful way for improving competitiveness.

To answer the main problem of the thesis, the research commenced with a study of literature concerning innovation and the metrics suggested in theory. After a thorough research on the subject, the result was a great lack of academically suggested structures for innovation metrics. Four rather holistic, non-industry specific and recent models were however found. All models had somewhat different focuses, but coherence in some areas was found after studying them further. Three general phases of innovation were identified; *input, throughput and output*, which all could be combined with specific theoretical suggestions for metrics. The literature research was conducted parallel to gathering empirical data from 26 large-sized Swedish multinationals on their ways of working with innovation. This resulted in an understanding that further crystallization of the three phases would add considerable value to the practical application of innovation metrics. Therefore, further patterns in theory were sought, where four vertical levels of innovation: *task, organizational, financial and market related* were identified, which better structured the specific theoretical suggestions for using metrics. Through a further understanding of the empirical reality through continuous interviews, it also became clear that very few of the metrics used in reality were in fact suitable for steering behavior, which is a main argument for using innovation metrics. Through a further analysis of theory, four types of indicators: *amount, balance, efficiency and effectiveness* were therefore identified, discussed, and incorporated in the framework. The work resulted in a matrix consisting of 12 windows, each linked with theoretical suggestions to specific ways of measuring. The matrix could thereby be used as the basis for analyzing the empirical data, and give a picture of the corporate reality of innovation metrics. During the interviewing of the 26 companies, general attitudes towards innovation metrics as well as challenges and important issues, were furthermore collected. This, together with specific metrics used in reality, resulted in a number of interesting findings in the analysis.

Firstly, a generally positive attitude towards innovation was stated. But even though most companies expressed willingness to increase their knowledge and development of this area, several obstacles within their companies were identified. The difficulty of finding people with an overview of innovation matters, the difficulties for these people in turn to locate the data and the general lack of an innovation terminology indicated a lack for some very basic fundamentals for working with innovation management, nonetheless innovation metrics.

Secondly, to be able to improve on something, a clear definition of what you want to improve is needed. It turned out that many of the companies did not have a clear corporate definition of innovation although applying different types of innovation metrics in the organization, or used a definition which had very little coherence with the metrics actually used. The clear structures and definitions for important areas, contrasted with the situation apparent in practice gives a rather obvious conclusion around fundaments. Where there is a lack of a clear definition which all parts of the organization can understand and which is communicated effectively throughout the company, it is

very difficult to create innovation metrics to steer the behavior of the employees. In addition, it shows even more difficult to create strategic decisions as the company does not have a common visual picture of what innovation is to them. In terms of innovation metrics, the lack of a visual picture similarly leaves it virtually impossible to create metrics which will reflect the needs and prioritizations of the company. To a large extent, the companies with a definition, did not reinforce it with actual action on innovation, i.e. use coherent metrics, which gives the definition limited credibility and applicability.

Thirdly, building on the argument of a need for a solid ground to build innovation metrics upon, extensive difficulties of choosing what metrics to use was both reported and identified. Concerning specific metrics, the companies generally clustered around metrics which in theory were described as highly ineffective and practically useless. 81% of the companies lacked measures that followed the innovativeness from generation to commercialization, and 71% of the companies measure on only two, one or even none of the four vertical levels. In fact, 85% of all companies neglected the inclusion of market and/or customer relevance when measuring their innovativeness, 38% had no financial metrics and 81% of the companies lacked metrics relating to an organizational level. This showed that although companies are aware of the importance of innovation and the value of measuring it, resources are placed in the wrong and highly unbalanced areas, with reference to the holistic framework identified through theory.

Fourthly, all areas reported by the companies as important or challenging, were covered by this inclusive structure for metrics. In addition, all specific theoretically suggested metrics as well as the metrics actually used in reality, were covered. The areas of the framework which in reality were only vaguely covered by the average company, we could also see that specific companies were putting a lot of effort into measuring in these areas, using a number of specific and traceable metrics. The conclusion to this, is that the framework *does* provide useful guidance for taking on the challenge to create a more structured and truly value-oriented (in that it covers more than financial value) way of working with innovation metrics. The matrix framework is presented as slightly ideal, but is a highly useful framework for benchmarking the current metrics in use, identifying areas where more resources should be focused, identifying areas where use of metrics maybe even should be toned down, in order to better steer behaviour and get better indications for management. As all theoretically related studies however, it is important that the company takes the time to discuss (with an innovation team if possible) the company's specific needs and requirements, relative to the overall tendencies and suggestions in this thesis. The framework may prove too extensive for some, wherefore the importance of a balanced set of metrics cannot be understated. A good balance increases the chances of a more value-added application of innovation metrics – in the long run.

Concluding, the analysis showed an abundance of suggestions around innovation metrics, in all areas, which shows that by making innovation more tangible through facilitating structures and clearly communicated definitions, there are no reasons why innovation metrics should not be successfully applied in "soft" as well as "hard" areas of the organization, adding value to strategic decisions and internal behaviour around innovation - with the aim to improve competitiveness.

8 Future research

Due to the novelty of the area of innovation metrics, the thesis can only cover so many areas, and hence leaves many interesting questions unanswered.

More details as to specific metrics and a comparison of the metrics within each of the squares of the framework is a highly interesting area for future research. Through this, the skeleton for innovation metrics presented in this thesis, could potentially turn into a specifically recommended set of metrics, evaluated and tested.

The current situation of high diffusion and little coherence between companies allowed for very limited specific conclusions to be drawn, regarding quantitative conclusions etc. For instance, tracking financial results, such as operational profit over a few years and comparing to companies different methods of measuring would be interesting once a more common ground has been laid concerning innovation metrics. Similarly, studying the impact or effect of specific metrics would be highly interesting. For instance, comparing chosen metrics with annual growth rates over time would have been an interesting way of seeing if some measures are more successful than others. Due to the fact that few companies have a rigid way of measuring innovation, and the coherencies again are very scarce, this has been left for future research.

Interesting would also be to follow companies' potential changes in accordance with the framework suggested, and monitor the impacts on long-term results.

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10. Appendix

Appendix 1:

A: Metrics suggested by Davila et al.

Input measures

Financial
- Per cent of revenues invested in product R&D
- Per cent of revenues invested in process R&D
- Per cent of revenues invested in technology acquisition
- Percent of projects delayed or cancelled due to lack of funding

Customer perspective
- Per cent mix of projects by their strategic drivers (f.ex. meeting customer needs, reactions to competition; technology-driven; based on internal ideas; etc.)

Resources
- Per cent of total employees involved in innovation projects
- Per cent of personnel trained in creativity and problem-solvin techniques
- Per cent of personnel who have worked in two or more functions
- Number of ideas per source (for example ideas from employees, ideas from customers)
- Number of ideas generated per year for development into bew products, services & processes
- Number of ideas considered per year for new products, services & processes
- Efficiency of links to external prganizations
- Per cent of projects delayed or cancelled because of lack of human resources

Process measures

Financial
- Average project costs
- Costs of/savings through outsourcing

Process efficiency
- Average break-even-time
- Average time-to-market
- Hours worked per project
- Average time for a specific task (for example, initial design)
- Per cent time spent on project-related tasks
- Per cent time spent on non-project tasks (administrative and support) tasks
- Number of patents received/number commercialized
- Per cent mix of product/process/service/business process innovation projects
- Per cent usage of appropriate tools and techniques (for example advanced market research projects; computer-aided design; computer-integrated manufacturing, and so on)
- Per cen tof projects that entered development and were ultimately considered commercial successes
- Per cent of projects killed too late (that is after significant expenditure)
- Per cent of emplpyees ectively contributing to innovation

Learning
- Per cent of projects where post-project reviews are conducted
- Number of improvements to innovation processes

Specific service measures
- Customer throughput time
- Complaints: number and type
- Staff satisfaction
- Efficiency of innovations in products and service augmentations
- Cost per customer
- Profit per customer
- Retention rates

Output measures

Financial
- Per cent of sales revenues from new products/enhancements
- Per cent of sales revenues from new services
- Per cent of cost savings/revenues from process innovation
- Quality improvements from process innovation
- Return on innovation investment
- Profitability of the new product programme
- Earnings from patent licensing

Customer Perspective

Innovation rate (number of new products compared to total nuber of product in the portfolio)
Number of new products compared to competitors
Number of new services compared to competitors
Number of encancements to service augmentations
Number of process innovations (number of innovations per year compared
to the total number of major processes used in operations)
Per cent mix of first-to-,arket, afast follower, and me-too projects
Market share growth due to new products/enhangements
Market share growth due to new services
Strike rate (ratio of orders to enquiries or quotations)
Per cent of orders delivered on time
Customer satisfaction indices

B: Metrics suggested by Goffin & Mitchell

Objective	Measures
Outputs	
Long-term corporate profitability	Stock price
	Projected residual income
Short-term comporate profitability	Residual income growth
	Sales growth
	Return on equity
	Percentage of sales from new products
Outcomes	
Customer acquisition	New customers gaines throygh innovation
	Number of customers through existing products/s services who buy new products/service
	Number of new customers of new products/services who go on to buy existing products/services
	Market share
Customer loyalty	Frequency of repeat customers
	Average Annual sales per customer
	Customer satisfaction with innovation activities
	Percentage of customer attrition
	Ratio of new visitors to repeat visitors
Value capture	Margin of product and services offered to customers
	Average of prices paid by customers
	Number of new product and service lines introduces
	Profitability of innovation operations
	Revenues generated through innovation efforts (total revenue, innovation revenue, revenue per innovation customer)
	Customer profitability
Process	
Portfolio	Percentage of innovation efforts devoted to radical, semi-radical, and incremental innovation
	Portfolio balances over time, returns, risk and technoloties
	Alignment between innovation strategy and ressource allocation
Execution	Product platform effectiveness
	Reduction in new product/process development time/cost
	Within terget sales/profits
	Projected within time, budget, product performance targets
	R&D productivity
	Number of new patents granted each year
	Number of gateway resurns
	Rate and quality of experimentation
	Cost, development time, delivery time, quantity, and price of products and services offered
	Product and process quality score
Inputs	
Commitment and focus on innovation	Time dedicated to innovation
	Budget percent allocated to innovatoin efforts
	Performance-based compensation linkes to innovation success
	Success of ideas passing through selection and execution processes
	Investment in training
Balanced innovatoin of networks inside and outside of organization	Level of innovation integration across business units and functions
	Mix of innovation sources

	Percentage ofinnovation projects outsourced
	Number of strategic alliances
	Number of experienced innovation team members
	Assessment of supplier capabilities
Coherent and aligned innovation strategy	Number, cost, price, and perception of new products offered from innovation projects
	Number, cost, price, and perception of new servies offered from innovation projects
	Perception of brand
	Profitability of innovation poerations
	Objectives for innovation efforts clearly communicated to senior managers and employees
	Competitive position within industry
	Number, complexity and size of competitors, customers, partners and suppliers
Appropriate management infrastructure for effective innovatoin implementation	Percentage of performance measures and rewards aligned to and linked to innovation activities
	Quality of IT infrastructure
	Quality of information for innovation
	Market and technology research resources
	Amount and quality of customer data acquired related to innovation
	Dollars of resources available for innovation
	Free time allowances for R&D emplooyees
	Geographic diversity of production and sales
	Level of empowerment to Strategic Business Unit (SBU) and functional managers
	Cross-functional initiatives

C: Metrics suggested by Muller et al.

Resource view

Inputs (capital, talent, time):

- Percentage of capital that is invested ininnovation activities such as submitting and reviewing ideas for new products and servies and developing ideas through an innovation pipeline
- Number of entrepreneurs in the company, i.e. individuals who have previously started a business, either within the company or before joining the company
- Percentage of workforce time that is currently dedicated to innovation projects

Output (return on investment):

- Number of new products, services, and busineses launched in the past year
- Percentage of revenue from products or services introduced in the past three years
- Share of wealth, i.e., the change inthe company's market value during the past year divided by the change in the total industry's market value during the same period

Capability view

Inputs (preconditions):

- Percentage of employees for whom innovation is a key performance goal
- Percentage of employees who have received training in innovation - for example, instruction in estimating market potentian of an idea
- Number of innovation tools and methodologies available to employees

Output (renewal)

- Number of new competancies (i.e. distinctive skills and knowledge domains that spawn innovation) measures as a simple sount among a threshold proportion of employees
- Number of strategic options (i.e. newly created opportunities to significantly advance an existing business)
- Number of new markets enterd in past year

Leadership view

- Percentage of executives' time spent on strategic innovation rather than day-to-day operations
- Percentage of managers with training in the concepts an tools of innovation
- Number of times during the past 5, 10, and 20 years in which senior management has redefines the company's core business

Processes

- Number of ideas submitted by employees in th epast three, six, and twelve months
- Ratio of successful ideas to ideas submitted
- Number of ongoing experiments and ventures
- Average time from idea submission to commercial launch

D: Metrics suggested by Regnell et al.

Factors	Measuring-inspiration
Innovation identification	
Internal collection	Number of ideas coming from different sources
	Number of patents that have been analysed in existing portfolio of patents
	Time between cooperation activities and the patentdepartment in the company
External collection	Number and time between collectionactivities that focus on specific external stakeholders (userns, customers, competitors, owners, etc.)
	Number of visited events (conferences, courses, fairs, etc.)
	Amount of researching of other companies (potention threats, suppliers, mergers, etc.)
	Number of developed patents or prototypes that build upon existing portfolio of patents
Internal generation	Number and time between activities for presentations on a teams work
	Number of activities for systematic generation of ideas
	Change over time, of number of suggestions to the team (for example examination of whether or not the number of suggestions rise after a presentation)
External generation	Number of observation studies conducted by users
	Number of projects based on ideas from external stakeholders
	Number of customer meeting about future needs
Reversion	Number of suggestions from people who previously have had their suggestions rejected (it is important that people continue to come up with suggestions even though their previous suggestion have not been turned into projects)
	Time between suggestions and reversion on the suggestion
	Number of hours set aside to reversion
Project selection	
Timing	Appreciated time to implementation of the results of a project
	Number of short-term projects compared to long-term projects
	Appreciated leadtime for the results of the project to be received by internal stakeholders
Risk	Subjective valuation of risk of project (applicability, technical uncertainty)
	Number of parallel examination of alternatives (by uncertainties concerning future choice of technique)
	Number of projects that turn out to be non value-adding (some risk must be taken in connection with innovation, which means that not all projects will not be successful)
Size	Appreciated access to resources per project
	Allocation of projectsizes in the project portfolio
	Change over time, of number of suggestions to the team (for example examination of whether or not the number of suggestions rise after a presentation)
Internal stakeholders	Allocation of projects between differen types of internal stakeholders
	Number of projects that challenge current business models
	Number of projects that focus on stepwise improvements of existing product attributes (if only these types of projects are implemented, the level of innovation is probably too low)
External stakeholders	Number of projects based on radical future scenarios
	Number of projects with user relevance
	Number of projects with customer relevance
Return on investment	Appreciated return on investment per project
	Alternative costs if a project is not implemented (analysis of worst case scenario)
	Number of directions of decisions from management, about what innovation projects to be prioritized
Innovation project and ways of working	
Process	Subjective valuation of the efficiency of the way of working
	Amount of time laid down on actual value-creating work, compared to for example administration
	Subjective evaluation of how well the method of evaluating the innovationresults actually work
	Number of projects that change status from innovationprojects directly to productdevelopmentprojects
	Remaining investmentcosts until the product is finished
	Amount of the innovationteams' developmentground that can be reused directly in product development
Climate	Amount of coherent non-booked time in the calendar of each employee
	Amount of time suited for working with own ideas
	Time between delivery-deadlines for each employee
	Subjective evaluations of the opportunities for open, constructive debates
	Subjective evaluations of the lack of personal conflicts and other negative factors (too much pressure, fear of being unsuccessful etc.)
Incentive	Economical compensation for reaching personal and team goals
	Economical compenstion for reporting of patents and new inventions
	Number of acknowledgements and distinctions for individuals and teams
Competence	Allocation based on the employees backgrounds, level of experience, age, gender, etc.
	Number of different areas of knowledge in the team

	Evaluation of how well the team covers strategic competences
	Prevalence of rotations between position
	Number of projects that each individual carry out, respective have been responsible of
Organization	Resources per project (man-hours, procurement budget, etc.)
	Total number of projects per year
	Average time to realization of projects
	Amount of the budget that are allocated to sub-suppliers
Improvements of the innovation process	Number of improvement suggestions on the way of working, coming from the members of the team
	Number of improvement suggestions on the way of working, based on reversion from the environment, on the results of the team
	Number of implemented process changes (changes in the ways of working)
	Subjective evaluations of how many improvement suggestions, that have actually affected the ways of working
	Number of process changes that are evaluated as giving clear improvements
	Subjective evaluations of the value of implemented process changes
Effects and influence	
Product attributes	Number of product attributes affected by the work of the team
	Number of other projects affected by the work of the team
	Number of objects in the change process of the product development which are based on the results from the work of the team
	Number of end-users that are affected by the product attributes that the work of the team has affected
	Number of results from the innovationproject's team, that are accepted by the product planning department, or other internal stakeholders that manage the product development
	Subjective evaluations of the degree of the team's influence on the launched product, that are positive compared to neutral- or negative influence
Interaction	Number of people in the network of the team
	Number of stakeholders covered by the network of the team
	Number of resources dedicated to internal marketing
	Number of people attending presentations by the team
	Number of other employees that are aware of the work of the team
	Number of cooperations with people in the organization compared to external people
	Resources suited for preparations for passing on the idea, or integration and interaction with surroundings
	Resources dedicated to activities for internal marketing
Trust	Number of invitations for presentations, meetings, courses etc.
	The receivers subjective evaluation of the quality of the teamwork
	Number of accesses to documents and reports conducted by the team
	Results from surveys regarding the presentations from the team, among the participants of the presentations
	The surroundings subjective evaluations of the teams' trustworthyness and competences within strategic technical areas
Patent	Number of patent suggestions, patent applications, granted patents etc. (number per person and year etc.)
	Resources spent on patent suggestions and reporting of new inventions
	The teams' share of the company's allocation of patent bonuses
	The teams' share of the company's database of reported new inventions
Practice and standards	Number of organizations that conduct industry standards and practice where the team is participating (actively contributing or passively following)
	Number of occations where the work of the team is affected by practice and standards
	Share of standards that have really affected vs the total share of standards that desirably would have been affecting
	The ability to affect practice and standards compared to competitors
	Resources spent on affecting practice and standards