Innovation Capabilities – Measurement, Assessment and Development

Benaim, Andre

2015

Innovation Capabilities

Measurement, Assessment and Development

Andre Benaim

LUND
UNIVERSITY

LICENTIATE THESIS
by due permission of the Faculty of Engineering, Lund University, Sweden.

.

To be defended at Lilla Hörsalen, IKDC, Sölvegatan 26, Lund.

June 12, 2015 at 9.15am.

Faculty opponent

Minna Saunila, Lappeenranta University of Technology

Organization LUND UNIVERSITY	Document name: Licentiate thesis
Faculty of Engineering, Department of Design Sciences	Date of issue June 12, 2015
Author(s) Andre Benaim	Sponsoring organization

Title and subtitle: Innovation Capabilities – Measurement, Assessment and Development

Abstract: As organizations work to secure their innovativeness, they want to know whether their efforts are supporting the improvement of their innovation capabilities. The focus on outcomes and financial measures of current innovation measurement systems makes this challenging as those indicators often say little about capabilities. In addition, indicators are frequently focused at the organizational level, although often project teams are the ones ideating and developing new products. Lastly, in order to work not just for assessment, but for further improvement, measurement systems need to be made practical and context relevant. Given these challenges and the desire of organization to measure in relation to innovation capabilities, this thesis explores the implementation of a measurement system focused on innovation capabilities within teams.

The research is based on a single case study of a company, where an innovation measurement system was implemented guided by a previously-developed measurement framework (MINT). The research uses an action research inspired approach and follows the Design Research Methodology (DRM) structure. It studies the current reality of the case organization in terms of innovation capabilities and introduces the innovation measurement system to support the development of this capability followed by first reflections on impact and use.

The assessment revealed the common challenges related to innovation capability such as, time for innovation, feedback, continuity of initiatives and managers support. The indicator selection, MINT uses a bottom-up approach and the findings point to three approaches taken by participants towards metric selection: experimental, reflective, and certainty approach, with the first two being more successful in leading to practical indicators. Four metric uses were also identified: 1) To implement strategy by promoting a certain behaviour; 2) To diagnose and monitor trends; 3) To learn by experimenting with metric system; 4) To reflect on practice.

The findings describe the relation of the selected metrics to innovation capabilities and report challenges related to the implementation of the metrics system. The main implementation challenge was the change of measurement level and group in focus. Finally, the findings talk about the dynamics between organizational levels in relation to measurement and innovation capabilities.

The discussion reflects on the ways in which the implementation results are helping to create a functional innovation measurement system. For example: the measurement system focuses beyond output indicators and its use promote relevant action. The discussion also reflects on the main implications of the challenge related to change of measurement level. Specifically, it discusses the implication of the change in relation to the scope and extent of what is being measured. On the one hand, applying innovation measurement at an organizational level might influence the team level. On the other hand, it might miss how innovations are developed. The thesis suggests the need for delineating focus teams at the organizational level and re-integrating project team level perspective to the measurement system.

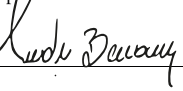
In conclusion, the measurement system implemented seems to direct the measure and activities related to innovation capabilities, but further research is needed to fully support this. In addition, measuring project team capabilities might require a faster and easy way to conduct the measuring in which reflection is more important than metric precision while higher level teams might work with more precision and longer cycles.

Key words innovation, capability, measurement system, teams

Classification system and/or index terms (if any)

Supplementary bibliographical information	Language: English
ISSN and key title	ISBN: 978-91-7623-387-0 978-91-7623-388-7 (Digital)
Recipient's notes	Number of pages 150 / Price
	Security classification

I, the undersigned, being the copyright owner of the abstract of the above-mentioned licentiate thesis, hereby grant to all reference sources permission to publish and disseminate the abstract of the above-mentioned licentiate thesis.

Signature  Date May 26, 2015

Innovation Capabilities

Measurement, Assessment and Development

Andre Benaim

LUND
UNIVERSITY

Lund University
Faculty of Engineering (LTH)
Department of Design Sciences
Innovation Engineering
Box 118
221 00 Lund
Sweden

ISBN 978-91-7623-387-0 (Print Version)
ISBN 978-91-7623-388-7 (Digital Version)
Printed in Sweden by Media-Tryck AB
Lund 2015

Acknowledgements

There are many people who made this work possible. To my advisors, I would like to acknowledge the support of my primary advisor, Andreas Larsson, who provided timely and precise suggestion, in addition to many stimulating readings from the courses he conducted. I would also like to acknowledge the support and initiative of my secondary advisor, Tobias Larsson, for providing me this opportunity and providing invaluable insight on the world of innovation and business.

I am very grateful for the conversations and openness of Jenny Elfsberg, Linn Andersson, and all the members of the iCoach group at Volvo Construction Equipment, who have been working hard to refine the innovation capacities within the company. I admire their stamina, passion and commitment to the initiative.

Also very important to me is to write a note of appreciation to all my friends and family that provided me with good conversations and reflections about innovation. Mainly a big thanks to Massimo Panarotto, Mikael Johnsson, Daniel Bogomoltz and Debora Benaim. In addition, Marilyn and Alexander Mehlmann, and the whole Global Action Plan network are a truly inspiration. My previous work with them facilitated a lot the interaction and reflections that I use within the context of measuring and developing innovation capabilities. More importantly, acknowledge the patience and support of my wife while I was developing and make sense of this work.

Last but not least, I would like to acknowledge the financial support of Volvo Construction Equipment, KK Foundation and company partners via the research profile “Model Driven Development and Decision Support”.

Sincerely and grateful,

Andre

List of appended papers

Paper A

Nilsson, S., Wallin, J., Benaim, A., Annosi, M.C., Svensson, R.B., 2012. Re-thinking innovation measurement to manage innovation-related dichotomies in practice, Proceedings of the 13th CINet Conference, September 16-18, 2012, Rome, Italy.

Paper B

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J., 2014b. Becoming an Innovative Company: Assessing an Organization's Innovation Capability from the perspective of a team. Proceedings of the 15th CINet Conference, September 7-9, 2014, Budapest, Hungary.

Paper C

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J., 2014a. Building a Pathway for Innovation: Lessons learned from developing an online platform. Proceedings of the 10th NordDesign Conference 2014, August 27-29, 2014, Espoo, Finland.

Paper D

Benaim, A., Elfsberg, J., Larsson, T.C. & Larsson, A., 2015. Implementing Innovation Metrics: A case study. Proceedings of the 20th International Conference on Engineering Design (ICED 15), July 27-30, 2015, Milan, Italy.

A note about terminology

The term innovation capability is used in singular form when used as a quality of the company. The plural form, innovation capabilities, is used to imply the skills and many elements that compose such capability. In the end both terms are used in an interchangeable way, following what would make sense or feel adequate in the sentence structure.

The term organization is used quite often in the introduction and theory section, because the general theory is not limited to companies. The term company is used when talking about the case study.

List of figures and tables

Table of Contents

1. Introduction

Innovation is a central point on the agenda of many organizations in order to stay competitive, and thus ensure that they have future offerings and can stay on the market (Nagji & Tuff 2012). In this quest, organizations rely on core competencies that give them the possibility to achieve this innovation. A key concern is therefore how to continuously develop existing, as well as new, competencies in this regard.

The capacity to develop new competencies can be understood as an innovation capability. It is a capacity of acting upon opportunities, and organizing assets that allow for the development of current and future offerings (Björkdahl & Börjesson 2012; Teece et al 1996). One of the main challenges of becoming an innovative organization is to innovate continuously; to explore new avenues for products and markets through a flexible strategy, as well as to be able to exploit new and current offerings though operational excellence (Boer et al 2001; Jacoby & Rodriguez 2007). The capability to do so is also known as organizational ambidexterity or the capacity to simultaneously work with radical and incremental innovations (Kim & Mauborgne 2004; Nagji & Tuff 2012).

To work with an organization's innovation capabilities one has to consider its innovation process and structure, as well as its innovation climate. Moreover, different aspects of innovation capabilities can be associated with different units of analysis: the individual, team and organizational level. For example, climate (Hackman 1998), creativity and motivation (Amabile 2012), as well as the innovation process, can be explored through any of those levels. This research focuses mainly on the team level.

As an organization works to secure their innovation capabilities questions such as "How do we know that we are making progress?" and "Are we really becoming more innovative?" are common, implying a need for a system to measure innovation performance. In addition, measurement can support the development of innovation capabilities not only by diagnosing its status and progress, but also by supporting learning and implementation of new working

routines (Saunila 2014; Chiesa et al 2009; Godener & Söderquist 2004). Finally, organizations are often set up for exploitation and are limited by a strong focus on short-term objectives and risk-avoidance within a bureaucratic culture that prevents more radical innovation (Assink 2001). A systematic innovation measurement system is one path to raise awareness, drive and monitor progress, and promote behaviours that support both incremental and radical innovation.

Despite its relevance, it is uncommon to find articles about the implementation and challenges of measuring innovation (Bourne et al 2003). Furthermore, there is little research about the development of innovation capabilities in practice (Börjesson & Elmquist 2011; Anderson et al 2014). Hence, the research project, which this licentiate is a part of, aims to contribute to the research by exploring the development of innovation capabilities through the design, deployment and use of an Innovation Measuring System in a case study setting.

1.1. (In)adequacy of innovation capability measurement systems

Many organizations are unsatisfied with their performance innovation system (Dewangan & Godse 2014). Davila et al (2006) mention a study in which more than half of the respondents graded their innovation performance measurement system as poor or inadequate (Davila et al 2006; DeCustatis 2008; Frigo 2002). Such inadequacy and consequent dissatisfaction derive from the challenges an organization faces when developing and implementing innovation measurement systems.

1.1.1. Heavy focus on output and outcomes

Current indicators tend to focus on financial input and returns, or the degree of innovativeness that outputs and outcomes have (Nilsson et al 2010; Adams et al 2006). However, it is challenging to measure innovation through outputs and outcomes within industries that have long innovation cycles. Due to the amount of time (and money) spent in those cycles, it is not fruitful to wait for the launch or market test of a new product in order to evaluate whether the company has

been working innovatively. In addition, in cases such as heavy manufacturing companies, beta products are not as accepted as they are in the software industry, because even if a product is discontinued, maintenance and spare parts usually need to be available for 10-15 years.

Another problem of measuring solely outcomes is that innovation is an iterative process in which failure and learning are part of the way towards success (Elmquist & Masson 2009; Sarasvathy 2001). Therefore, an innovation measuring system for innovation capabilities needs to also focus on process and activities that are likely to send the organization in an innovative direction.

1.1.2. The need for context-relevant measurement

Furthermore, a common challenge is how to make innovation measurement systems practical for employees to easily work with (Nilsson et al 2012; Smith 2005). Innovation measurements depend on the context because exploration and exploitation require specific mind-sets and activities that in turn require different indicators and expected targets (Langdon 2008; March 1991; O'Connor 2008). For example, an innovation process that is trying to find costumer need has outputs that are less related to feasibility and costs, than a project that is approaching a decision gate to be approved for production. The same is true for innovation climate, where Bain et al (2001) find it important to differentiate between research and development teams. He finds that innovation climate factors have different correlation with innovation depending on the type of team in focus; for instance, climate for innovation has a strong correlation with research teams who are trying to create knew knowledge, in particular innovation support. Meanwhile, development teams, due to their focus on development of the products, have a strong relationship with factors like clear and attainable objectives. Although context is important "contextual measurements are difficult to quantify, though, and it is difficult to manage what you can't effectively measure" (DeCusatis 2008, p.157).

Another challenge connected to contextual relevance and practical use relates to the level at which measurement occurs. Often measurement systems are directed at managers and focus on the organizational level. However, individuals and teams also require feedback and support to conduct their activities towards becoming more innovative. More importantly, these are at the levels that actually design and develop products. Hence the quality of their activities is essential for innovative outcomes.

1.1.3. Difficulties deciding what to measure

Even though outcomes, context and actions related to exploration and exploitation provide an idea about where to focus the measurement, a challenge when developing innovation measurement systems is to decide what to measure (Nilsson & Ritzén 2014; Smith 2005; Adams et al 2006). There are a myriad of relevant aspects (Fagerberg, 2005; Steiber & Alänge 2013; Baregheh et al 2009), such as leadership, strategy, learning, knowledge, asset organization, and input and output (Teece 2005; Bessant 2005; Müller et al 2001). The underlying questions are "what should one measure in order to assess innovation capabilities?" and "how many aspects should be measured?". The challenges include finding adequate aspects to measure and deciding the relevant pool of measurements to be used, as well as finding adequate indicators for aspects that are intangibles, such as human capital and information capital (Nilsson et al 2012).

1.1.4. The need to move beyond diagnose

As mentioned above, a measuring system can be used not only to diagnose status and progress, but also to support learning and implementation of new working routines (Saunila 2014; Chiesa et al 2009; Godener & Söderquist 2004). However, one needs to be careful. Originally, performance systems derive from control system and can be used as such. However, trying to control action and process in knowledge related jobs have shown not to lead to innovation performance (McLean 2005). Therefore, a measuring system that promotes innovation capabilities should be a motivating system, not a controlling one and needs to be designed as such.

In synthesis, the general challenges of making innovation capability measurement systems adequate relate to creating measurement systems that:

- Move beyond outcomes and focus on activities
- Consider both exploration and exploitation
- Determine the relevant areas and aspects to be measured
- Consider the contextual factors
- Provide practical support for teams, not only managers; and

- Act as motivation and a learning system

1.2. Empirical setting - the need for innovation metrics

This thesis is based on a case study with a multinational company producing heavy machinery. This section explores the need, rationale and history that moved the case company towards working with innovation measurement systems.

As the study that described the current reality confirmed (Benaim et al 2014b), the indicators that were in place within the company did not lead to innovation. For this reason the search for innovation measurements started within the company. They started by looking at how they could know whether they were more innovative than their competitors. After a number of internal investigations and benchmark reports the company decided to pilot an innovation measuring system. Such a system should touch upon the essential factors for leveraging innovation capability, and would be implemented in increments that would be developed according to the results of each assessment. The initiative started in 2009 and two assessments were implemented in 2014.

One of the reasons that directed the company towards the path for securing and measuring innovation capability was the understanding of the innovative potential of each employee. The dedication to "skunk works" demonstrated that passionate individuals and teams can develop promising ideas; for this reason the company decided it was time to promote such collaborative work within an "official process" in addition to the current portfolio.

The company had already started to experiment with ways to nurture and harvest such potential (Benaim et al 2014a). They then decided to nurture innovation by supporting the development of an online platform. One of the triggers for the development of the platform was a new organization set-up within the company. In the past, the company was site-oriented, meaning that the whole production of a machine was present at a site; today, the different functions such as engine, cabin, roller and product assembly are distributed across different sites around the world, and the same is true for working teams. Therefore, one aim of such a platform was to create a space for exchange and development of ideas - a kind of social network for the employees' activities, interests and ideas. Another aim of the platform was to leverage the innovation

climate by increasing the number of interactions between employees and spark creativity that could potentially lead to new projects. For this reason, one of the core purposes of the tool was to become the main place for ideation, where new projects were documented and discussed. The vision was to create a clean and fast formal pathway and procedure to develop ideas into becoming innovations, in addition and complementary to traditional R&D and the current portfolio.

Still, while developing such ways of working the company was wondering whether or not the conditions for being innovative were actually being created. Hence, there was a need for assessing and following up on innovation capabilities.

For these reasons the company decided to implement an innovation measuring system which would permit monitoring and provide solid ground for taking actions towards the development of the company's innovative capability.

1.3. Research questions

Given that there are few studies about the development and challenges of implementing innovation measurement systems, this thesis aims to explore how to secure such development through the use of an innovation measuring system. Hence, the research is based on the following questions:

RQ1- How can innovation capability be measured?

RQ1.1- What is the current reality of the firm's innovation capabilities?

RQ1.2- What are the challenges with the use of the measurement system?

RQ1.3- What are the impacts of implementing the innovation measurement system?

In addition, this thesis also reflects on the unit of analysis in which the innovation measurement is implemented. As will be explained later, the original approach focuses on teams; however a few assumptions come into play: The first assumption was that the results of teams can be aggregated in order to build part of the organization view of the capabilities. The second assumption was that the organization environment influences the team performance. For this reason the following question is also considered:

RQ2- What is the relationship between organization and group activities to support innovation processes?

2. Methodology and Methods

2.1. Ontology

The research takes a perspective of constructivism and critical theory. This perspective states that social structures, their meanings and related behaviours are continuously created through the interaction of the actors (Bryan 2008). In this sense it is not about studying an independent object and its intrinsic immutable properties; instead, it is about researching the meanings and actions that give the studied phenomena its current properties, having in mind that such properties change depending on the relation and interpretation that people establish in practice.

Overall, the project is an effort to explore whether an innovation measurement system can contribute to development of innovation capabilities. To achieve this purpose a qualitative approach is required.

The qualitative approach seems appropriate in this case as both, implementation of innovation measurements systems and the development of innovation capabilities in practice, are phenomena on which little research has been done and there is little consensus. (Börjesson & Elmquist 2011; Anderson et al 2014; Bourne 2003; Edmondson & McManus 2007)

Another point that suggests the adequacy of qualitative methods is the complexity of the topics and the kind of research questions. Innovation, innovativeness and its related capabilities are complex and researchers have looked at innovation, innovativeness and innovation capabilities from the perspective of many disciplines, which causes the literature on innovation to be fragmented (Fagerberg 2005; Steiber and Alänge 2013; Baregheh et al 2009). Innovation can be seen as multiple factor complex. Crossan and Apaydin (2010) offer an interesting framework considering innovation as both an outcome and as a process, and offer some determinants of innovativeness. Such frameworks can help to operationalize innovation more easily and provide focus for action

and measurement. At the same time it leads to a question as to whether causal links between actions and outcomes can be established. Due to the complexity, generated from the multiple factors and different units of analysis, innovation capabilities are not easily subject to prediction and causal testing.

Furthermore, the nature of the questions requests a more qualitative approach. Quantitative research supports the identification of causal links. However, it does not explain how or why such a relationship happens (Yin 2009). The aim of this research is to describe how a measurement system can be implemented and how it can support the development of innovation capabilities. How would one know whether it was this implementation that supported the development of the capabilities? This research aims to establish a correlation between current reality, a designed intervention, consequent changes and potential outcomes by looking for changes in form of perceptions, meaning and behaviour that can be associated with the research intervention.

2.2. Methodology

Design research is the main methodology that drives this research and the selection of qualitative methods. In addition, within design research, participatory action research was also a methodology used for guidance. This section explains the two methodologies.

2.2.1. Design Research

The research is inspired by the design research methodology (DRM) proposed by Blessing & Chakrabarti (2009). The methodology provides a structure to support design research with more scientific rigour.

Before explaining the specific stages of the methodology, a brief clarification of the term “design” and “design research” is needed. Design is the development of a product that is purposefully created from a need, product idea, or technology. Such a product can be related to technological gadgets or be of social or economical nature. It considers the whole process and the stakeholders involved in order to satisfy user needs.

Design research helps to understand and inform the design process. It does that by exploring the current situation in terms of needs and solutions, as well as developing a desired solution and devising a way to implement such a solution. This study intends to help the case company to measure and refine their innovation capabilities; at the same time this application leads to insight and reflection about the innovation measurement framework.

Finally, design methodology intents to support design research by providing methods and guidelines. Although it is a methodology formulated for design and related research, it is open for many disciplines to draw from (Blessing & Chakrabarti 2009).

Design stages

There are four main stages suggested by DRM (fig. 1), they are: research clarification (RC), descriptive study I (DSI), prescriptive study (PS), descriptive study II (DSII) (Blessing & Chakrabarti 2009 pp.14-17, 29-38).

Research clarification entails exploration of the field of interest and development of a research plan and its goals. It can involve exploration of the literature for focus and definitions of areas of study.

The descriptive study I explores the literature, influencing factors and description of current reality, its challenges and relevance for research. Evidence of theoretical elements and the design problem formulation can be also informed by empirical and qualitative studies.

The next stage is the prescriptive study. The researcher uses the findings of previous stages and creates a desired solution and within this stage it uses the research to test, evaluate and improve the design solution. Finally the descriptive study II describes the overall impact and success of the designed solution.

The framework is not linear. This means that findings from one stage can influence the others. For example, a finding from the prescriptive study might help to reformulate research questions and goals. In addition, such non-linearity means that each stage is generally adaptable to the context without a rigid set of procedures and methods. It also means that such stages might overlap or be run in parallel.

Figure 1 visualizes the papers and other documents in relation to the general stages of design research. Specifically paper A informs the research clarification. Papers B and C provide a descriptive study (DSI) intended to observe the

current reality and whether the assumption about the need for metric and innovation capability development is actually a perceived need within the case company. Finally, paper D is a mix of a prescriptive study (PS) and descriptive study II (DSII) because it lays out the intervention and its results.

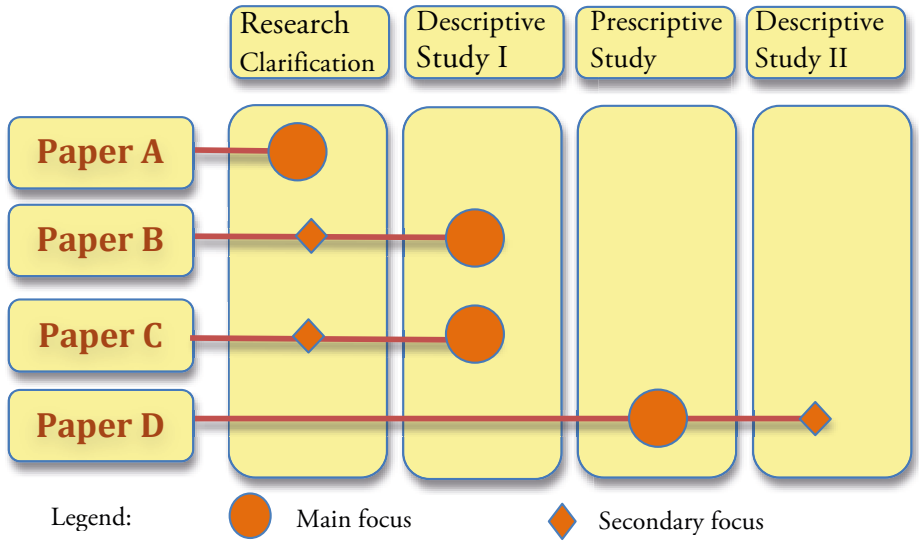


Figure 1 Relation between papers and DRM stages

One particular aspect to mention is that within the overall project, that this licentiate is a part of, the intervention framework (MINT) was already selected for the work with the case study. The appropriateness of the use of this framework was re-confirmed by the background literature review in this licentiate. However, in terms of DRM this means that to some degree the designed intervention was previously developed and did not derive directly from the stages "RC" and "DSI" as suggested by the methodology. Nonetheless, the respective stages were used to explore the literature, problem setting and current reality as suggested by the methodology.

2.2.2. Participatory Action Research

Action Research can be defined as "an approach in which the action researcher and members of a social setting collaborate in the diagnosis of a problem and in the development of a solution based on the diagnosis" (Bryman 2008).

In the same way as design research, Participatory Action Research (PAR) focuses on real problems and aims to learn from and develop solutions to these problems (Whyte 1989). It complements DRM by explicitly stating that the need finding, problem formulation and envisioned solution is developed in collaboration between researchers and participants in the social context in focus (Whyte 1989; Ghaye et al 2008).

As previously mentioned the development of innovation capability and its measurement is a field that has been explored very little (Börjesson & Elmquist 2011; Anderson et al 2014; Bourne 2003). When research has reached a solid theoretical foundation and consensus around hypothesis, PAR or design research is not the best method given the need for control (Whyte 1989; Edmondson & McManus 2007). However, this is not the case, since the field is young and the variables of the phenomena in focus are multiple and still not certain.

In addition, due to this multiplicity and uncertainty around variables it is hard to predict outcomes. Each context represent a unique set of conditions, that makes positivistic experiments difficult, also due to the agency and emergent properties of human interactions and interpretations. Therefore, instead of formulating hypotheses and predictions, in this type of research there is a need to be open for the uncovering of new perspectives, or solutions. The results can be presented as the reformulation of the problem or alternative interpretations (Whyte 1989), as well as desired interventions.

2.3. Methods

Case study is the overall research method used within this research. This method is often used with the methodologies mentioned above, and it fits with this particular research. Yin (2009) explains that a method is decided based on the type of research questions, the extent to which the researcher can "control" the behaviours and the time perspective of the phenomena studied, e.g. whether it is a historical or a contemporary event. Case study methodology relates to question that explore "how", within a contemporary event over which the researcher has little control. This description matches the situation of the current research.

2.3.1. Methods for data collection and analysis

Overall, research was conducted and data was gathered through different methods that are suitable and often used within case study design, as well as in design research and PAR methodology. The methods used were: literature review, interviews, workshops, participant observation, survey and document analysis (Yin 2009; Blessing & Chakrabarti 2009; Coughlan & Coghlan2002). The specific methods and their uses are described in the following paragraphs.

Literature review

A literature review helped the identification of the state of the art in the field. It was conducted using independent search strings for the topics of "innovation", "innovation climate", "innovation measurement" and "innovation capabilities". The strings were explored within the database Compex/Inspec and Business source complete, because they cover journals that deal with the managerial side of metrics measurement and innovative work in the relation to engineering context.

In addition, tracking back the main references of key articles (snowballing) was often used in order to verify sources and interpretations, as well as to get more details and key references on relevant work in the field (Sayers 2007).

Participant observation

In total, researchers participated in 15 workshops. In seven of those workshops, researchers were participants observers. In addition, researchers also participated in monthly meeting over a two-year period. Participation in these workshops and meetings allowed observation of current reality, challenges and positive results of the work to develop innovation capability.

Workshops

Eight workshops were specifically focused on the development and implementation of the innovation measurement. Six workshops helped to validate the innovation capability benchmark, as well as brainstorm relevant indicators and measures for the teams. The other two workshops were used to work with the implementation of and follow up on the actual measurement. Overall about 120 people were involved. Twenty of those represent the 'innovation team' called 'iCoaches'. As described in the papers within this thesis, they are a group with the mandate to support the development of innovation

climate and capabilities, as well as to support the metric implementation within their respective work teams and sites. The other participants were design engineers that work in the case company and for this reason have interest and were in adequate positions to suggest indicators.

Interviews

In total 14 interviews were conducted. First, 9 semi-structured interviews with the innovation support group (iCoaches) helped to gather the data that described the current reality benchmark, which was validated in the workshops mentioned above. The data from these interviews was transcribed and coded. Pattern recognition was created to make a map of the coded data; first, by finding emergent topics, later by matching the topics to the six areas and subareas of the MINT framework (for the MINT areas see section 3.3.3.1.).

Five interviews were conducted with the persons responsible for metric implementation in order to follow up on the results of the measurement. In addition, open-ended interviews were conducted with the management team. The management interviews helped to gather examples and clarify aspects related to historical accounts and implementation. For these interviews, the analysis was done by taking notes and organizing specific answers in relation to the topics being explored.

Survey and documents

The last two methods used were a survey, that helped to follow up on the results of the metric system implementation, which created the base for the follow up interview; and analysing documents developed for the top management team in order to understand the context and development of the initiative.

Because of the number of respondents (9) statistical analysis was not conducted on the surveys. However, the answers provided supported an initial reference point and understanding that helped to frame the respective follow-up interviews.

Documents were used as a source of triangulation that allowed for comparison of the reports given from memory to the data gathered through interview and surveys.

2.3.2. Validity

Internal reliability and validity is considered by having multiple observers discussing perceptions and findings. Within the different papers this aspect of validity was addressed in different ways. Often having more than one observer, sending interpretations and findings back to members of the context being researched.

Often external reliability (replicability and transferability) and external validity (generalization) can be an issue in qualitative research; even the same context can present different findings at different times. Often, to overcome this challenge researches are encouraged to have a detailed description of the phenomena (Bryman 2008). That is also true for this research. Despite the efforts to describe the situations and changes in as much detail as possible in order to allow comparison with other cases, the generalizability and transferability need to be further explored and tested in more detail. This will require continuous experimentation and accumulation of data, until the field is more established allowing specific categories for operationalization and analysis that can be quantified.

3. Theoretical framework

The following section describes some of the background theory that influenced this work. First, it explores the definition of innovation and perspectives around the term innovation. Then it unfolds the concept of innovation capability. Finally, it explores innovation measurement systems focusing on what and how to measure.

3.1. What is innovation and innovative organizations?

Innovation can be defined as the successful implementation of a novel idea on the market (Garcia & Calantone 2002). This definition has some advantages. Implicitly, it emphasizes the distinction between creativity and invention on one side, from product development and implementation on the other side. It gives an aim and push to organizations by suggestion that creativity is nothing without follow-through. The advantage of such a definition is to move beyond classical boundaries of innovation idea generation and patenting. However, it puts great pressure on the outcome.

While successful implementation can be defined by the degree of adoption, usage and amount of sales, the novelty of an idea might be more difficult to assess. There are many ways in which we can think about and define novelty. Often innovation is understood on a spectrum from incremental to radical. Jacoby and Rodriguez (2007) suggest a simple view about innovation classification that considers old and new costumers, as well as old and new offerings. Existing offerings to existing costumers is an incremental innovation; it might involve changes in production, maybe some cost reduction. New offerings to new customers represent the most radical innovations. In between, old offerings to new costumers and new offerings to old costumers represent an evolution or intermediary step.

Garcia and Calantone (2002) unfold that view suggesting that the criteria for classifying an innovation is to look at technology and market discontinuity (or "s-curve") from a firm (micro) and industry (macro) perspective. If an innovation is new to the firm either in market or technology, but it is not new to the industry it can be classified as incremental. In the same way, if the innovation is new also to the industry in terms of technology and market, it is a radical innovation.

Moreover, one should keep in mind that innovation can also refer to a number of things, not only to product and offerings. Francis and Bessant (2005) say that innovation can relate to products, processes, positioning of the firm and firm paradigm. Doblin (2015) suggests many areas in which innovation can happen; they are organized under three general headings: 1. Configuration (Profit-model, Network, Structures and Process); 2. Offering (Product performance and Product system) and 3. Experience (Service, Channels, Brand and Customer engagement).

It is unlikely that a company needs to innovate in all (or many) of the areas and classifications mentioned above in order to be innovative. Intuitively we know that one good change in one of those areas means an organization has scored on being innovative. However, such classifications can be helpful to evaluate ideas, output and outcomes. It can help to decide whether one has a diversified portfolio, as well as to inspire and inform possible dimension to innovative work.

In this sense innovation and innovativeness relate to the outcome and the diversity of portfolio, which should contain radical and incremental ideas on different "fronts". Hence, innovation capabilities can be thought as the capacity to achieve innovative outcomes at will and routinely (Francis & Bessant 2004; Wallin et al 2011)

A point to consider is that a strong focus on outcomes might actually hinder another facet of the innovation process, namely learning and the iterative process that innovation often requires. For example, failure and experimentation seems excluded from the definition of innovation as an outcome. However, the importance of the capacity to learn from failures is also a success criterion in innovation (Elmquist & Masson 2009). Kelley et al (2011) suggest that managers should select project leaders with a lower concern about failure, as well as protect those leaders from the "downsides and risks" associated with failure in

radical projects. This is echoed by famous innovation mottos, e.g., the IDEO slogan "fail often to succeed sooner" or Stanford d.school's "there is only make".

Hence, although innovation can be understood as those inventions that successfully reach the market, the elements of an innovative company go beyond invention and market success. Output and outcomes need to be considered when trying to become an innovative organization, but for long-term innovation and long production cycles, waiting for the outcome is not the best way of making sure one is being innovative (see introduction). Moreover, evaluating one idea or project as radical does not mean that the organization has the capacity to pull it off.

Innovation and innovativeness can also be looked at through the lenses of process (Nilsson et al 2012; Crossan & Apaydin 2010). Instead of focusing on results, the focus turns to determining whether the organization is working innovatively. More broadly this means to evaluate whether a company has an innovation capability.

The spectrum from radical to incremental is often associated with two ways of working – exploration and exploitation (Nilsson et al 2012; March 1991). Looking at the quality of such ways of working might provide good indication of the overall innovative direction of an organization.

The assumption is that one does not need to wait for outcomes in order to evaluate and build innovation capabilities. In this sense, one can still take outcomes as a reference point to guide part of the evaluation. If an organization has been working as innovative as they can without any positive outcome, it is a strong indication that something is off. But what could it be? Is it the ways of working or the creative bit? Is it the market, or the need the product addresses? Most importantly, what do we look at in order to determine that a company does or does not have innovation capability?

3.2. Innovation Capabilities

In order to develop innovation capabilities one needs to find ways to "develop alternative routines for discontinuous innovations which can sit alongside those for steady state 'do better' innovation" (Bessant et al 2005 pg.1368). One of the assumptions in the project is that innovation capacity is a skill that can be

developed, or cultivated in order to generate innovation. It is a capability that takes expertise, vision and knowledge, and transforms it into an understanding that allows invention, development and dissemination of novel products, not at random, but consistently.

3.2.1. Internal or external to daily company business?

One Dof thought argues that innovation happens by establishing a separate entity from the core business, either by creating a new organization, such as an start up, or by creating 'shielded' projects or teams that will work on new ideas and inventions. Other researchers suggest that integrating both of these aspects within the company are the capability required to be an innovative company (Lawson & Samson 2001; O'Connor and DeMartino 2006; Bessant et al 2005).

In large companies there is often on the one hand R&D, which deals with the creation and development of new products, and on the other hand the division that is responsible for operations and maintenance (Lund 2014, Lawson & Samson 2001). Such a division implies a more managerial and top down decision and investment in R&D, and it is a possible way of organizing innovation work. However, innovation can also be thought of as integrated into daily work; for example, by having set times when to do exploration, or by expecting that every project can take a turn towards more radical exploration. Such integration requires ways of working that are complementary and beyond the boundaries of R&D (Corso 2002), and which allow for creative output, as well as, identification and development of opportunities.

This thesis focus on the development of innovation from innovation capabilities that are inherent in the way the company works. This is not only a philosophical stance, but also helps to avoid practical challenges. If separate entities have the authority over and focus on the innovation, they might face difficulties when transferring the product from 'outside' to inside the company. For example, the culture within both companies might be too different preventing adoption of the innovation (Lawson & Samson 2001).

3.2.2. Exploitation and exploration from within the company

Many organizations are set up to focus on exploitation by having selection criteria that prioritize exploitation through lean and incremental innovation (Assink 2006). However, while total reliance on current capabilities might provide an advantage today, these capacities might quickly become out-dated through the development of cheaper processes, better business models or even by a different line of product that fulfils the same demand better (Barton 1992). Therefore, innovation capability generally involves both exploration and exploitation of current and new ideas (Kim & Mauborgne 2004; Soosay & Hyland 2008; March 1991).

Both exploration and exploitation are modes of working with innovation that might benefit from an adequate innovation process. Exploration relates to novelty, experimental risk taking, uncertainty, change of the current paradigm and core competences. Exploitation relates to producing and executing effectively and efficiently, and is about refining existing competences (March 1991; Nilsson et al 2012)

More specifically, innovation capabilities can be understood as the readiness to explore and create new opportunities as well as exploit current and new ones (Börjesson & Elmquist 2011; Bessant et al 2005). From a dynamic capability perspective such readiness is achieved by rearranging company resources in order to create new knowledge and competences that would result in novel outcomes. One of the main elements in this perspective is focused on leadership and asset organization, which requires rearranging human capital, processes and financial capital, among other resources (Teece 1997; Teece 2014).

Along a similar line, continuous innovation suggests that innovation capability is about exploring operational excellence and strategic flexibility, i.e., improving current products and production methods, while being able to change current offering and directions by developing radical ideas (Boer & Gertsen 2003; Bessant et al 2005; Boer et al 2006; Magnusson and Martini 2008). One of the main elements here is related to strategy and learning, which allows to refine current offering as well as to explore new directions with ease (O'Connor 2008).

In short, this thesis aligns with the understanding above; it considers innovation capabilities to be the capacity to act and work on exploration (radical) and exploitation capabilities simultaneously. This is done by the continual

improvement of current offerings, as well as by the flexibility in strategy to purse new opportunities, whether they are "planned" or stumbled upon.

3.2.3. Other elements related to innovation capabilities

There are many elements that allow the enactment of innovation capabilities. In the lines of thought mentioned above there are recurring characteristics around the dimensions that compose innovation capabilities. Beyond the examples already mentioned, other elements that are associated with innovative organizations and their innovation capability, are a balanced portfolio (Kim & Mauborgne 2004; Nagji & Tuff 2012; O'Connor 2008) and knowledge development and its assimilation (Soosay & Hyland 2008). Calantone et al (2002) suggest a strong relationship between learning set-up and innovativeness. Boer et al (2001) aim to develop a framework for facilitating knowledge transfer, from within an organization as well as with external partners. Some of these elements will be further listed when exploring "what to measure" in 'section 3.3.1.

This thesis focuses on two aspects that are part of the development of innovation capabilities. The staring point is that innovation climate and innovation process are essential elements for allowing exploration and exploitation to happen. The first creates conditions in which radical and incremental ideas can be shared and explored; the second provides tools and a framework for working on the ideas. These two concepts will be further explored below.

3.2.4. Innovation climate

Climate is understood as the patterns of behaviour and attitudes that are manifestation of the cultural aspect of a group, whether they are a team or an organization. In turn, culture is related to the values, assumptions and social norms, whether they are explicit or not (McLean 2005). Culture and climate have a subjective and objective dimension. The subjective dimension considers individual perceptions and how they relate and contribute to the current culture and climate. There is also an objective side, namely the collective perception that allows identification of common and shared patterns with more precision, since the subjective perceptions and observations can be confirmed through different sources (Ekvall 1996; Isaksen & Lauer 2002; Björkdahl & Börjesson 2011).

In general, organizational climate includes several elements that are related to elements such as, leader behaviour, job satisfaction, turnover, as well as organizational performance and innovation (Patterson et al 2005). Specifically, an innovation climate involves a number of elements that can facilitate or hinder innovation work and innovative outcomes.

There are a few classifications of climate categories (West & Sacramento 2012). One of the commonly used ones addresses the following elements: challenge and involvement; freedom; trust and openness; idea time; playfulness and humour; conflict; and idea support and risk taking (Ekvall 1996). Other frameworks add vision, task orientation, participation safety and autonomy (West & Sacramento 2012) as elements to be considered at organization and team level.

Innovation climate characteristics are considered to be part of innovation capabilities because of its potential to bring innovation about. Innovation climate is not only a set of indicators that can reveal the assumptions, values and behaviours of an organization; but climate aspects also correlate with conditions that make innovation more likely to happen. It is not impossible to be innovative without a proper climate, but it is a lot harder (McLean 2005; Björkdahl & Börjesson 2011).

Despite its importance, having an innovation climate is not a sufficient condition (Björkdahl & Börjesson 2011); the general structures for dealing with ideas are also relevant. Such structures can be explored by investigating the innovation process, which is the topic of the next section.

3.2.5. Innovation process

Innovation process is not to be confused with process innovation (Crossan & Apaydin 2010). The later relates to changes in ways of producing and organizing (Francis & Bessant 2005) and it is a kind of innovation, a possible innovative outcome – one might say: "I have a new and better process for doing 'X'".

As mentioned earlier, innovation can be seen from a process lens, where it is a way of performing and organizing activities in order to have an innovative outcome; for example, deciding to follow an ideation and its subsequent development activities or phases in order to have an innovative outcome (Nilsson et al. 2012; Crossan & Apaydin 2010). In this sense, an innovation process is suggested to be one of the elements to be developed within innovation

capabilities through processes that allow learning (Björkdahl & Börjesson 2012; Bessant 2005; O'Connor 2008).

Understanding the different phases of the innovation processes helps to set adequate expectations and activities according to each phase (Dewanga & Gdose 2014; Langdon 2008). For example, in early stages it might be difficult to come up with definite specifications for a product design or correct production costs. If the project is on the other end of the innovation process spectrum, for example, in a decision board to go to the market, then costs and precise design specification should be clearly defined.

There are many ways in which the innovation process can be divided. A simple way of doing it is by focusing on input, throughput and output; such a definition is based on the general idea of a process (Muller et al 2005). It is also possible to consider the innovation process by taking into account specific phases related to innovation (Gericke & Blessing 2012; Bessant 2005). In general it follows a structure such as invention, development, implementation or exploration; development and exploitation; or more broadly need finding, task analysis, concept development implementation, use and post-use (Garud et al 2013; Gericke & Blessing 2012; Langdon 2008). Even though the number of phases can vary, in general, innovation processes have a common structure that allows organization to develop and transform their current capabilities.

It is interesting to notice that Woolley (2009) suggests that a strict focus on process reduces team performance, while focus on outcome supports it. The reason is that the focus on outcomes allows participants to identify meaningful actions at a given time (Woolley 2009). This result is coherent with the idea that goals clarity and goal setting are valuable dimensions for innovation (West 2012).

Indeed, the suggestion of this thesis is to consider the innovation process as one of the main aspects of innovation capability; however, it does not suggest that it should be a prescriptive and sequential process. Even though some models consider innovation process sequentially (Gericke & Blessing 2012; Cooper 2014) for the purpose of this thesis, the innovation process describes "stages" that are more or less connected, and that are often relevant for innovation. Such stages should be present perhaps more than once, due to the iterative nature of the process. Beckman and Berry (2007) suggest that innovation is best understood as a cycle of learning, that moves from observation and reflection towards problem definition, concept development and implementation.

Furthermore, even though the process and mind-set that relate to exploration and exploitation are different from each other, it is not necessarily so that they cannot share the same space. O'Connor et al (2008) observe that some companies despite the verbal distinction between radical (exploratory) and incremental (exploitative) innovations do not make a practical distinction between them. This means that projects were directed and managed according to their need and potential.

Moreover, looking at the innovation process phases it is visible that exploratory processes tend to move toward exploitative ones. Therefore such distinction helps one to consider and decide what is needed in a given moment rather than following a step-by-step recipe or completely disconnected threads. This is precisely what innovation capabilities allow - the ambidexterity that permits an organization or a team to "manage and meet conflicting demands engaging in fundamentally different activities" (Bledow et al 2009 p.320; Anderson et al 2014).

3.3. Innovation Measurement

The literature highlights a few uses of an innovation performance system. Overall, it can be used to diagnose, motivate and secure implementation efforts, as well as, for learning (Chiesa et al 2009; Godener & Söderquist 2004). The coming sections explore what to measure and how to create measurement systems that can be used to support the development of innovation capabilities.

3.3.1. What to measure

As explored above, innovation capabilities are composed by a number of elements; the question is which ones to measure? In general, innovation measurement has been focusing on input and output, such as money allocated in R&D and patents (Nilsson 2010; Adams et al 2006). As explained earlier, focusing solely on outputs is a partial perspective and inadequate for the case specific context. Furthermore, focusing on input and output doesn't help to identify which activities to improve and therefore does not drive new and desired behaviour that can lead to innovative results. This research aims to move beyond the traditional measurements and focus on the activities that relate to

innovation capabilities. Hence, the inevitable question: "What measurements are related to innovation capabilities?"

There are a number of suggestions (Björkdahl & Börjesson 2012; Adams et al 2006; Langdon 2008), and each one of them has its nuances. Adams et al (2006) suggest seven categories that are subdivided in further subcategories: Inputs (people, physical and financial resources and tools), Knowledge management (idea generation, knowledge repository and information flows), Innovation strategy (strategic orientation and strategic leadership), Organization structure and culture, Portfolio management (risk and return), Project management (project efficiency, tools, communications and collaboration), and Commercialization (market research, market testing, marketing and sales). Björkdahl and Börjesson (2012) suggest Strategy for innovation, Prioritisation, Culture, Idea management, External environment and linkages, Implementation systems and decision rules, Organizational context and learning. Kianto (2008) suggests strategic competence, connectivity, exploiting time, learning orientation, leadership and managing knowledge, and each of this elements is divided in subsection that have further subdivisions. Despite the differences it is possible to find common elements.

It is also possible to frame categories for measurement that are related to the innovation process. Dewanga and Godse (2014) affirm the importance of focusing on innovation processes and that each phase of the innovation process has its particular needs. They outline 4 broad phases that have related activities for measurement. They are 1) Generation and selection of ideas; 2) incubation of ideas 3) commercialization, and 4) Realization of ideas, which relates to outcomes. A process perspective can focus on general elements, such as fuzzy front-end, product definition, product development, testing and launching (Zedtwidtz et al 2014). This perspective brings questions about opportunity identification and analysis, as well as idea generation and selection. Langdon (2008) reports that Innovation Labs uses a funnel metaphor to describe how innovation happens. The funnel starts large in the more exploration related phases and shortens towards the production (exploitation) phase. They reinforce the importance to understand what happens inside the funnel, and suggest measurements for 9 areas: strategic thinking, portfolio management, research, ideation, insight, targeting, innovation development, as well as market development and sales.

One aspect to consider is that some elements that are part of managing and participating in innovation processes have a paradoxical nature, or they can be

seen as dichotomies. “Dichotomies or dualities refer to polar opposites that often work against one another in an organization i.e. the choice to focus on one of the poles creates a tension and a difficulty to enact both ends of the continuum simultaneously (Poole & Van de Ven 2004 as cited in Nilsson et al 2012 p.887).” Some examples are uncertainty (ambiguity), flexibility (within process, structures and strategy), time for exploration and exploitation (Nilsson et al. 2012; Magnusson & Martini 2008; Mastenbroek 1996). These elements can be measured; however, the positive evaluation depends on the context and purpose of activity. Hence the duality is that these aspects can ask for conflicting behaviours.

Culture and climate are often considered in general frameworks that study innovation capability; however, they have a large degree of nuances and have a literature body on their own. Some examples are Ekvall (1996) and Björkdahl and Börjesson (2011). The authors consider elements such as time for ideas, management support, freedom, among others, as mentioned in section 3.2.4.

The first question that comes to mind is what framework to use? Does it depend on the purpose? In addition to the common characteristics, nuances might be helpful. In any case, it is very difficult to measure everything, and for this reason, as will be explained in section 3.3.2., the measurement implementation is based on the selection of a few indicator that are relevant in a given context at a specific time.

In addition, many of these classifications are directed at an organizational level, and organizational management. This is an appropriate focus; however, it is not the only possible one. The team level is as important since R&D activities are developed within teams (Zedtwitz et al 2014). Therefore, teams’ innovation capabilities become a relevant topic. Moreover, teams are also an adequate unit of analysis for researching innovation climate because teams have a particular climate that is not likely shared with the organization (Anderson & West 1998). For this reason this research considers and focuses on the team perspective.

3.3.1.1. Measuring Team level

The categories mentioned above can also direct and help the measurement of innovation capabilities at the team level. However, there are also specific nuances that are particular to this unit of analysis.

A team is a group composed by more than two people that is set within an organization; the individuals in the group perceive themselves and are perceived

by others as members of the group, and the members collaborate for a common task and goal (Hoegl & Gemusen 2001; Hackman 1998)

A common way used to research team innovation is through the concept of team performance (Bain et al 2001; Sivasubramanian et al 2012; Hoegl & Gemuenden 2001). Performance is normally operationalized through the concept of efficiency and efficacy, as well as, speed to market. Efficiency relates to achieving deliverables on time and on budget. Efficacy speaks to the degree to which a team can deliver what is expected of them (Hoegl & Gemuenden 2001). In addition, teamwork quality is a construct that can intermediate the relation of the elements suggested. Teamwork is composed by elements like group cohesion, balance of member contributions, communication and coordination of activities (ibid). Therefore, it is expected that teams with a high quality of teamwork should perform better, and have a positive impact on an innovation project (ibid).

In the same way team climate can also be used to establish a correlation between team performance and potential innovative outcomes. For example, Weiss et al (2011) describe a positive relationship between team performance and innovation climate in resource-limited projects. In relation to innovation climate, some factors are related to the team level. They are vision, participation safety, task orientation and support for innovation (Anderson & West 1998; Hülsheger et al 2009; Isaksen & Lauer 2002; West 2002). Some authors also mention reflexivity (West 2002) as a relevant climate characteristic for teams.

An important remark is that the specific correlation to a given innovation climate characteristic may vary depending on the kind of team in focus. For instance, according to Bain et al (2000), innovation climate characteristics like task orientation and innovation support show a positive relationship to innovation and performance when related to research teams. However, in regards to new product development (NPD) teams, characteristics like goal clarity and attainability of objectives were the ones who showed a stronger correlation.

Individual characteristics also have impact on team innovation (Chen et al 2013). Research in this area explores types of cognition and their influence on teamwork (Miron-Spektor et al 2011; Kelley 2006). Such studies can help to define metrics and reference values for diagnosis and prescription of actions in relation to team composition and some aspect of team diversity. Other studies

explore the influence of the openness of an individual or group at the team level (Davison & Blackman 2005).

It is possible to assess innovation capabilities by looking at the innovation process at the team level. As mentioned before (3.2.5.) an innovation process can be classified in stages, and each stage has its particular needs. Therefore, when the current team stage is understood, knowing the innovation process can help to set adequate expectation, indicators and feedback. (Langdon 2008; Gericke & Blessing 2012; Dewanga & Godse 2014). Overall, this perspective focuses on questions related to the identification and evaluation of the actions and outputs from different process phases. An example would be "how to measure" activities and relative outcomes related to needs and opportunity identification or to idea generation, selection, and development.

Most of the research around teams takes the perspective of identifying team innovation antecedents, predictor or moderators, i.e, pre-conditions that can indicate and facilitate innovative work. However, the research does not relate these antecedents to building innovation capabilities or measuring innovation in teams. Therefore, there are a number of aspects to consider as outlined above. Although measurement frameworks indicate what should be measured, they seldom explain how to do it.

3.3.2. How to measure

Performance measures have been developing to go beyond audit and financial control measures. In its evolution, a number of frameworks have been developed that are useful to provide categories that are relevant to performance (Bourne et al 2003). The choice of an appropriate R&D measurement metric depends on the user's needs in terms of comprehensiveness of measurement, type of R&D being measured, available data and amount of effort the user can afford to allocate to the exercise (Adams et al 2006). This implies that innovation measuring systems need to be adapted to their context and possibilities (Bain et al 2001). So how to start?

In general, there are five steps that can be synthesized from the selected literature. The first step is about selecting the approach. Bourne et al (2003) suggest that there are three approaches to design measurement systems, the 1) need-led approach, 2) audit-led and 3) model approach. The first approach focuses on the identification of customer and stakeholders needs. The audit-led

approach, takes a more bottom up perspective makes an evaluation of current reality in order to challenge the status quo. The model approach uses a framework (model) to that determines the relevant elements that will be measured.

Another distinction that should be considered when defining the approach is whether the work will be done by a third party, such as a researcher or consultant, or whether the general implementation will be carried out by the management team and other team members with input and collaboration from the research team or consultant.

The next step relates to the set-up of the measurement system. One condition that is often mentioned as relevant for implementing the measuring system is the alignment between strategy and measurement (Neely et al 2000; Davila et al 2006). Organizational vision and decision should be in place and calibrated to support innovation exploration and exploitation (Bessant 2005; Kianto 2008).

In addition, the involvement of members of the organization in designing and implementing the measuring system also helps to get the most out of it (Meyer 1994; Hallgren 2009; Bourne et al 2005). The involvement of personnel and the interaction with the measuring system should be promoted trough regular analysis and knowledge sharing as well as dialogue throughout the organization (Simons 1990; Bourne et al 2005; Nilsson & Ritzén 2014). Moreover, identifying the use and purpose of the evaluation early on, as well as the intended users and stakeholders that should be involved increase, the likelihood of the evaluation (measuring system) being used (Russ-eft & Preskill 2009).

The third step relates to the identification and use of indicators. There are many nuances between the types of indicators, and integrating these different types can strengthen the measuring system (Neely et al 2000). One classification of indicators refers to subjective or objective measurements. Often it is suggested that a balance between these two types of indicators helps settle the knowledge foundation that supports the learning (Janssen et al 2007).

The measuring system should support the identification of key performance indicators related to dimensions that adequately capture innovation dimensions (Dewagan & Godse 2014), and often a few "key" indicators are better than trying to measure it all (Davila et al 2006; Parmenter 2010).

Furthermore, it is also useful to consider types of indicators that relate to both activities and outcomes (O'Connor 2008). Such indicators can be thought of as result indicators (lagging) and determinants of results (leading indicators) (Neely

et al 2000; Parmenter 2010). A similar distinction is seeing the indicators as past indicators that relate to performance, and future indicators that are related to planned activities (Parmenter 2010). As explained in section "3.1." it is not sufficient to consider innovation capabilities only according to outcomes, and hence it is not useful to measure only outcomes either. Activities leading to outcomes are also important. These activities could be either measured individually such as number of brainstorming sessions, or indirectly by exploring satisfaction with number of concepts explored, general satisfaction with ideation and concept development phases.

Data gathering, its analysis and reporting is the fourth step. This is often a challenging aspect of the measurement system implementation (Bourne et al 2005). In addition to challenges of collecting the data and interpreting it, communicating the results also play a strong role (Nilsson & Ritzén 2014; Neely et al 2000; Bourne 2003). Bourne et al (2005) suggest that high performing units gather data from different sources and are in frequent interaction with it. Such units pay attention to meetings and other interactions to triangulate the data of the report. "In high- performing business units, the simple control approach was used to verify performance at the end of the period, but the main drive for performance came from continual interaction with the performance data" (Bourne et al 2005 p.386). Therefore, continual observation, communication and interaction with the data and multiple sources help to understand and validate the information.

Lastly, the fifth step, is related to actions and the (re)evaluation of the measurement system. Reporting and validating information is not the end or main purpose of an evaluation or measuring system. Considering ways of action and next steps might be required in order to correct a course that is pointed out by the indicators.

Furthermore, one of the actions to be taken is the periodical revision of the indicators and the system; overall usefulness and specific indicators that are obsolete should be substituted (Neely et al 2000). High effective units ignore inadequate targets and run based to their own targets (Bourne et al 2005).

3.3.2.1. Challenges of Implementing (innovation) Performance Measurement

Measurement system implementation is not as easy as it may sound. First, there is a tendency towards indicators related to new product development including focus on technology, and stage gates. Indicators connected to flexibility and innovation structures could help to balance that focus (Adams et al 2006).

The early evaluation of ideas is often a common pitfall and a challenge to be overcome. Without adequate exploration it is hard to establish the potential of new ideas (Langdon, 2008). For this reason, if, on the one hand, the measuring system can help the evaluation of ideas, it also needs to be calibrated in a way that allows exploration, setting evaluation and more exploratory related topics for appropriate phases.

Another common challenge is that the measurement system and the metrics can be perceived as a bureaucratic exercise that limits or cut down creative time (Chiesa et al 2009; Saunila 2014), and such perceptions, of course, undermine the benefits of the measurement system. A challenge that might interfere with the relevance of measuring systems is if strategy is not connected to goals from departments and teams (Bourne 2003).

Practical challenges are found in data collection, processing and interpretation (Nilsson and Ritzén 2014; Neely et al 2000; Bourne 2003). Moreover, the results can stagnate and become merely informative, without leading to action. Knowing how to use the measurements results is often challenging (Stufflebeam & Shinkfield 2007). Other practical challenges are if the strategy is not linked to resource allocation or if the feedback is tactical instead of strategic, i.e., it might become telling people what and how to do something instead of allowing them to find their own creative ways. Also, the measurement exercise, as well as the actions derived from it, can be received with resistance - a topic studied as resistance to change (Bourne et al 2003).

3.3.3. The MINT Framework

This thesis is based on a framework called Measuring Innovations in Teams (MINT) (Regnell et al 2009; Nilsson et al 2010). It is a research-based framework that supports the identification, selection and implementation of metrics for the development of innovation capabilities. It is a good fit for the aims of this research because it provides a good synthesis of the literature in terms of elements to consider, as well as, an implementation procedure.

3.3.3.1. MINT Implementation

The MINT framework takes the implementation approach as a mix of audit-led and model approach. In simple terms it means that the implementation assesses the current innovation capabilities, thereby creating a benchmark reference.

Based on such a benchmark, short and long term goals and measures are investigated and selected by the company, which were supported by facilitation and analysis from the researches in the case of this research. The aim is that the work with the measuring system will help to challenge the current reality and align activities with strategic objectives, as well as bring about activities that are in line with more innovative ways of working.

The framework has 8 steps of implementation that guided the development, implementation and testing of the measurement system within the case company. Table 1 lays out the specific steps suggested by MINT and the overlap with the general implementation steps outlined in section 3.3.2.

The MINT framework takes into account that indicators are dynamic and context specific (Nelly et al 2000). It provides a synthesis of several elements related to innovation capability mentioned in section 2.2 such as process, climate and outcome measures. However, the implementation process is not limited to these categories. This allows flexibility and adaptation to current needs. The framework also provides references for examples and inspiration for measurements.

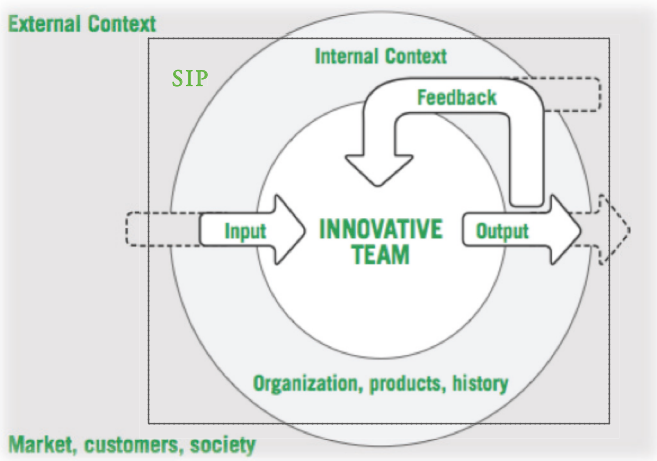
Table 1 Comparison between literature and implementation phases

5 general steps	8 MINT steps	Explored
1. Identify approach and person responsible for conducting activities	The Mint framework takes a stance that mixes the audit let and the model led approach. Company case had the main responsibility and researchers follow in a participatory action research manner	Regnell et al 2009 Nilsson et al 2010
2. Involve the company and align of purpose	Step 1: Introduce MINT Step 2: MINT Current Situation: Characterize and discuss current innovation capability Step 3: MINT Goals: Discuss general goals and improvement areas for the innovative team	Benaim et al 2014a,b

Table 1 Continued

5 general steps	8 MINT steps	Explored
3. Identify indicators	Step 4: MINT Candidates: Brainstorm candidate measurements inspired by Step 1 &2 Step 5: MINT Measurements selection: Select a small set of most important measurements Step 6: MINT Compass: For each measurement: * long-term goal * current position * short-term goal	Benaim et al 2015
4. Collecting and Analysing data and communicating results	Step 7: MINT Implementation: Decide on tools. Communicate actions. Collect data for next "n" months.	Benaim et al 2015
5. Do and Evaluate	Step 8: MINT Evaluation: Evaluate achievements and measurements	Benaim et al 2015 and future work

The analysis of current reality is based on an analytical framework (Fig. 2) that is organized in 6 main areas:



1. Strategic Innovation Processes (SIP)
2. Input
3. Output
4. Feedback
5. Internal context
6. External context.

Figure 2 MINT 6 main areas (Nilsson et al 2010)

The elements explored within the SIP perspective are: Process, Climate, Strategy and Incentives. In addition to innovation climate, organizations that are innovative have a process for dealing with ideas (Nanda and Singh 2009; Björkdahl & Börjesson 2012, also see section 3.2.4. and 3.2.5.). Strategy relates to the decisions about what innovations to pursue, in what field and how, not only from a managerial perspective (Francis & Bessant 2005; Lazonick 2012).

Furthermore, incentives are often mentioned as a positive factor in relation to promoting innovative work for individual and teams (Metz et al 2007; Lawson & Samson 2001; Folkestad & Gonzales 2010). Rewards can support characteristics like risk taking or idea generation (Nanda & Singh 2009).

Input focuses on the Resources and Innovation Task; resources related not only to financial aspects but adequate time and human capital. Resources should be adequately used and often have some "spare"(slack) to give room for manoeuvre (Teece 2014, Metz et al 2007). Moreover, clear vision and purpose aligned with clear goals support innovation development (West & Sacramento 2011; Katzenbach & Smith 2005). Goals that are a challenge and motivating are often an ingredient for creative teams (Isaksen & Lauer 2002)

In terms of Output (Deliverables and Effects), Katzenbach & Smith (2005) suggest that teams can be classified based on their deliverables. The authors mention "teams that recommend things", and "teams that run things", i.e., teams that explore and analyse and teams that run and develop products. Furthermore, innovation has many forms of output, as seen in section 3.1. For this reason, translating vision, purpose and tasks is essential to define action and outcomes for teams (Katzenbach & Smith 2005).

Furthermore, beyond relating to changes in offerings and process, output relates to learning and changes of roles and ways of working (Börjesson & Elmquist 2011; Alexy & Wallin 2013).

Feedback includes elements such as goal attainment, innovation measurement and evaluation. As mentioned, often innovation measurements are not useful. They focus solely on input and financial aspects, lacking a focus on processes and other relevant characteristics like flexibility and openness (Adams et al 2006; Nilsson et al 2012). Schreyögg and Kliesch (2007) suggest companies need to develop a "capability of monitoring" in order to assess the validity of innovation capabilities in relation to new activities (Börjesson & Elmquist 2011).

Goal attainment is connected to goal setting and its translation into actions. It is connected to feedback because it supports accountability by having the team to discuss meaning and actions to select appropriate ways to follow up (Katzenbach & Smith 2005).

Feedback also relates to idea generation and evaluation. If not properly done it can hinder creativity, although research also describes a positive relationship between idea evaluation and innovation performance (Nanda & Singh 2009).

Internal context relates to knowledge transfer or handover of outputs from the innovation team towards possible receivers within the organization. In this sense it is close to concepts like absorptive capacity and idea management mechanism. In addition, internal context can be related to pressure to innovate and demands, which can hinder creativity (West 2002; Baer & Oldham 2006).

External context relates to user, receiver and stakeholders. It is about reaching out and going beyond the company boundaries to open up to new technologies, as well as new perspectives to understand stakeholders' context and needs (West et al 2004; Folkestad & Gonzales 2010). It is an area that relates to input, feedback and output, allowing learning from situations and outcomes.

The following sections explain the papers and the main findings in relation to the preparatory work and implementations of the MINT framework.

4. Paper synthesis and contribution

The papers described below have the same starting point as this thesis; it comes down to the idea that innovativeness is a important capability for organizations, and it can be synthesised by the capacity of conducting exploration and exploitation activities.

4.1. Paper A - Dualities, processes and outcomes

Nilsson, S., Wallin, J., Benaim, A., Annosi, M.C., Svensson, R.B., 2012. Re-thinking innovation measurement to manage innovation-related dichotomies in practice, Proceedings of the 13th CINet Conference, September 16-18, 2012, Rome, Italy.

Contribution

This paper was developed within the PIEp project. During the work meetings, all authors contributed to finding the scope and main elements to be explored. Literature review and general findings were discussed in live meetings, as well as, through a blog. Three authors (Nilsson, Wallin, and Annosi) contributed with experiences from their case study. Susanne Nilsson and Johanna Wallin worked on synthesis and final version of the paper, which the author of this licentiate supported with review and comments.

Summary

This paper explores innovation measurement from the perspective of dualities. It settles on the idea that innovation is a process as well as an outcome. In addition, the article departs from the premise that there are a few aspects that are pertinent and difficult to deal with in relation to innovative work and its management. These aspects are not a binary dimensions, but “opposites" that are to be understood and enacted according to the situation. For example, time

for exploration and time for exploitation are two qualities of time usage and neither of them is preferable over the other. However, one might be more adequate in a given context, or prevalent in a given innovation process stage. For this reason such aspects are categorized as dichotomies or dualities.

Literature review helped to formulate the general framework, as well as identify the dichotomies and related challenges within them. In addition, data from three case study companies was used in order to complement and validate the review.

Four dichotomies were selected and further explored in comparison to exploration (radical innovation) and exploitation (incremental innovation): uncertainty, time, flexibility and control. Uncertainty can relate to technology or business success; in exploitation projects it is expected to be low. However, it is high in exploration innovation projects, and such risk can be carried forward up to the implementation phase. Time related to radical innovation can require long-term perspectives and the process is not linear, while in incremental innovation the time and process can be reasonable predicted. Flexibility relates to processes. In exploratory projects and processes it implies weak ties, quick prototyping and testing of product and market to define strategy and outcomes. Exploitation processes are more predictable and have goals set in the beginning; the process is based on developing strong ties and uses current teams and stakeholders. The final dichotomy is control and it relates to roles and leadership. For exploration a champion is needed and the process can be bottom-up; management support is essential for the later development of the ideas, as well as feedback and recognition for persistence and risk taking. From exploitation side it focuses on rewards, recognition and forms of organization that foster short-term goals.

The dichotomies are analysed according to effectiveness, efficiency and pre-conditions for innovation. Effectiveness relates to outputs and outcomes; efficiency relates to processes, and pre-conditions to elements such as climate. Implications for measurements that relate to exploration (radical) and exploitation (incremental) are explored. In conclusion, ambidextrous organizations use innovation indicators or measures that can be opposites, valued according to the context.

Relation to the thesis

This paper helped to explore the innovation measurement context. Among other things it helped to understand the distinction of process and outcomes, dualities and challenges related to working with innovation in an ambidextrous manner.

4.2. Paper B - Assessing Innovation Capability

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J., 2014b. Becoming an Innovative Company: Assessing an Organization's Innovation Capability from the perspective of a team. Proceedings of the 15th CINet Conference, September 7-9, 2014, Budapest, Hungary.

Contribution

The article was developed by the author of this licentiate with support from Andreas Larsson and Jenny Elfsberg, who reviewed the academic and practical aspect of the article. Tobias Larsson, proposed and introduced the theoretical framework, as well as, survey questions. Later on, he supported the article development by reviewing and suggesting changes to the final article. The main author reviewed and adapted the questionnaire, translated it to English, conducted the interviews, as well as, coded and analysed.

Summary

This paper assesses innovation capability from the perspective of the employees. For this reason it describes the current reality of innovation capability from the perspective of a team (iCoaches).

This team has the task to improve the "innovation climate" and support the development of innovation capabilities. The data was collected through interviews that were recorded, transcribed, coded and finally analysed.

In relation to the overall innovation measurement implementation, this paper reports the results of the second step of the MINT implementation. It is an assessment of the current reality of the case company's innovation capability. The theoretical framework helped to structure the assessment, which was organized based on the six categories and sub categories suggested by the MINT framework (see section 3.3.3.).

The findings confirm known challenges related to innovation. However, the most relevant part is to understand which ones are present within this context. In conclusion, some of the main issues identified are time, risk management, management support and continuity. One thing that surprised the researcher is that these issues have been dealt with for such long time; why are they still so present? In addition, the findings also show activities and structures devised in order to support the development of innovation capabilities.

Relation to the thesis

Understanding the current reality of the company in relation to the subject studied represent an important step for both, measurement implementation and research methodology. The research methodology, whether it is design research or participatory action research, has as its premise to understand the context and its needs, which is the aim of the paper.

Regarding measurement implementation the article contributes to the thesis in three ways. First, it provides a clear picture of the challenges related to the specific case study. Such picture provides a reference point for measuring progress, which is required to evaluate the success of the measurement framework and innovation efforts. Secondly, it helps to answer RQ1.1 by describing the current innovation capability. Thirdly, it allows researches to explore connection between team and organization capability (RQ2).

4.3. Paper C - Innovation Platform (Interact)

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J.,2014a. Building a Pathway for Innovation: Lessons learned from developing an online platform. Proceedings of the 10th NordDesign Conference 2014, August 27-29, 2014, Espoo, Finland.

Contribution

The author of this licentiate was part of the workshops and meetings that produced part of the data: moreover, he conducted the follow-up interviews. In addition, Benaim collected additional data and analysed all data for the paper. Tobias and Andreas Larsson supported the development of the article by reviewing the text and the theoretical background. Jenny Elfsberg contributed with the understanding of the historical developments, as well as the organizational context around the online platform.

Summary

This paper analyses one of the activities that the company is undertaking in order to support the development of innovation capabilities. It describes an online platform for sharing and cultivating ideas to the point where they can be funded (or not) for further exploration or incorporated into R&D.

The data was collected through participant observations in development workshops for the online platform. A historical view as well as current challenges and solutions were discussed during the workshops. Follow-up interviews were conducted to clarify and confirm the precision of the description. In addition, participation in monthly meetings and two annual workshops with the innovation support group (iCoaches) allowed insight into daily use and general impact of the platform.

The paper describes three versions of the platform and how it developed from one version to the next, highlighting challenges and successes. Successes relate to the motivation of employees and topics that flourished and developed into concepts. Some of the challenges relate to the process related to maturing the suggested ideas, as well as developing ownership. Some of the learning is that the idea pipeline does not come to life unless there are assigned people that are responsible and can act as facilitators. In addition, topics that were focused and within time delimitations seemed to flourish. Time for contribution and integration of the tool into daily work also seem to be a challenge.

The conclusion is that structures themselves are not enough for innovation. The platform had a positive impact, as it showed potential for creating activities that are related to a positive innovation capability. In some cases owned by employees, it promoted discussions, as well as in those promoted by management. In addition, two ideas were developed from the jam session the platform facilitated. Moreover, the tool is itself a natural measure point which could be a helpful tool measuring the innovation capability.

Relation to the thesis

The paper describes one aspect of the current reality of the company, which relates to the efforts to build support structures and pipelines for the innovativeness of the company to flourish. Therefore it complements the previous paper by focusing on structures and related activities that were designed to support innovation capabilities. It further supports the understanding of RQ1.1 and RQ2.

The paper relates to central aspects of innovation capability such as climate, and idea management processes, as well as to potential connections between innovation measurement and the online platform. In addition, it aids in the understanding of support relationship between team and organization level.

4.4. Paper D - Innovation Measurement Implementation

Benaim, A., Elfsberg, J., Larsson, T.C. & Larsson, A., 2015. Implementing Innovation Metrics: A case study. Proceedings of the 20th International Conference on Engineering Design (ICED 15), July 27-30, 2015, Milan, Italy.

Contribution

The author of this licentiate developed the paper, and together with Tobias Larsson and Jenny Elfsberg developed and worked with the implementation efforts. These include the workshops that established the ground for the definition of a pool of indicators and relevant metrics, as well as its selection and deployment. Andreas Larsson supported the development of the article.

Summary

The fourth paper describes the challenges, uses and lessons learned during the implementation of a framework to measure innovation in teams (MINT).

The methods are based on design research methodology and participatory action research that help with testing and refining the implementation method. At the same time, they allow to work with the practical challenge of measuring innovation and developing innovation capabilities.

Workshops helped to validate the picture describing the current reality (paper B) and served as settings for the brainstorming of metrics related to innovation work. In collaboration between the researches and the project managers the suggested indicators were synthesized and prioritized for different teams. The teams the reviewed the indicators and could adopt them or suggest new ones. Measurement implementation followed, data was gathered through surveys and, when applicable, key people would input data themselves. In order to understand the teams' relation to and impact on the selected indicators, a survey

was distributed and followed by a semi-structured interview with the survey respondents.

Findings are related to implementation challenges, metric selection, use of indicators, and meaning of the selected measures. In relation to metric selection the experiences range from easy, as it was taken as experiential learning, to difficult, as teams tried to identify the best indicator.

The research shows that indicators were being used proactively in four ways, to: 1. Drive action; 2. Monitor trends; 3. Experiment and learn; and 4. Reflect. Some of the challenges within the implementation relate to defining the team boundary and its level, management engagement so the measurement would be prioritized, and data visualization.

In conclusion, the measurement seems to provide the intended results of focusing on meaningful aspects. However, working on defining the team boundary and considering the influence of other levels is something to be considered for the next implementation. One next step is to consider the specific metrics selected and their relation to innovation capabilities, as well as to consider the need for the development of a team level measurement after, or in parallel to an organization level approach.

Relation to the thesis

This paper addresses the implementation of an innovation measuring system. It focuses on general and specific implementation challenges, as well as uses of the system. For this reason it directly relates to RQ1, supporting research questions 1.2 and 1.3. Moreover, it is one of the central aspects of the design methodology, which reflects the use and learnings that will allow for the refinement of the measuring system, its framework and implementation practice.

5. Measuring Innovation and building Innovation Capabilities

This licentiate thesis explores the implementation of an innovation measurement system that supports the assessment and refinement of innovation capabilities. The main question "how can innovation capabilities be measured?" implies both the development and the implementation of such a measurement system. The first is more theoretical and mostly relies on previous research. In this thesis, it is reflected in the literature review, in the use of the MINT framework as well as the understanding provided by paper A. It will therefore not be include again here. Instead, this section focuses on findings in relation to the implementation in the case study. This is explored by looking at uses, impact and challenges of implementation.

Table 2, presents a general outline of the main findings related to the practical work with implementation using the MINT frame. In the following section, however, the findings are presented in a different order. The section starts with the findings related to the use of the tool, followed by challenges and implications of changes that occurred during the time frame of the project work. These changes had effects on earlier phases of the implementation and are listed under the matching phase in Table 2, but can only be put there in hindsight and are therefore elaborated on after the use and challenges.

The research started with assessing the current reality related to the firm's innovation capability. The development of this picture had a dual purpose. One purpose was to establish a baseline to understand progress and changes as implementation efforts developed. It also allowed for an analysis of the relevance of the selected metrics by setting an expectation about the topics indicators would be likely to be addressed.

The current reality was analysed in two ways; first through the development of a benchmark picture explored in paper B. Secondly, by examining the efforts in the case company for managing innovative ideas via an online platform

described in paper C. It was possible to identify challenges and positive factors related to the different elements of innovation capabilities as they are described in the literature.

Paper B explores the current reality according to the 6 MINT categories explained in section 3.3.3. Overall, time for ideas and overwork, as well as, management support and risk management were some of the main issues. Process aspect could be seen in the request for continuity, and feedback.

The ideation platform and current innovation capability

The ideation platform (Interact) also helped to describe the current reality in terms of innovation capabilities. The platform is currently in development and testing stages, and therefore has not yet settled into a format that helps to achieve its envisioned function, i.e., being a centre for coordinating innovative ideas. However, some benefits of working with it have already been observed and there is evidence that its envisioned function is possible.

In relation to the current reality of innovation capabilities, the platform speaks to the work being done to support innovative climate and innovation process. In relation to climate it facilitates the support of ideas, and the grants connected to the platform can ensure time and resources for developing innovative ideas. In relation to the innovation process, it helps to establish an entrance door and follow up process for new ideas. Once an idea is shared it is meant be coached through stages that indicate the level of maturity until an idea can be evaluated for further exploration through grants or be directly adopted by R&D. Hence, the platform encompasses phases from ideation, development and implementation. In addition, because of the structure of the platform, it can be easy to visualize progress and can therefore easily facilitate measurement-related to innovation capabilities to take place.

Table 2 General findings' relation to measurement implementation phases

5 general steps	8 MINT steps	Findings
1. Identify approach and person responsible for conducting activities	The MINT framework takes a stance that mixes the audit-led and the model-led approach. Company case had the main responsibility and researchers followed in a participatory action research manner	Define level(s) and focus group Consider implications for other levels
2. Involve the company and align of purpose	Step 1: Introduce MINT Step 2: MINT Current Situation Characterize and discuss current innovation capability Step 3: MINT Goals: Discuss general goals and improvement areas for the innovative team	**Current reality and expected measurement focus:** Time and overwork Risk management Management support Continuity Feedback
3. Identify indicators	Step 4: MINT Candidates: Brainstorm candidate measurements inspired by Step 1 &2 Step 5: MINT Measurements selection: Select a small set of most important measurements Step 6: MINT Compass: For each measurement: * long-term goal * current position * short-term goal	**Metric selection approaches:** 1) Experimental approach 2) Reflective approach 3) Certainty approach **Use of indicators:** 1) To implement strategy by promoting a certain behaviour 2) To diagnose and monitor trends 3) To learn by experimenting with metric system 4) To reflect on practice
4. Collecting and Analysing data and communicating results	Step 7: MINT Implementation: Decide on tools. Communicate actions. Collect data for next "n" months.	Leadership and empowering of implementation team and focus group Management engagement
5. Do and Evaluate	Step 8: MINT Evaluation: Evaluate achievements and measurements	In general metrics address innovation capabilities. However, the impact and relation to current capabilities require more time and further research

5.1. Balancing approaches to metrics selection

A central aspect of a measuring system is the metric selection. Following the adopted measurement methodology, after the validation of current capabilities (Benaim e al 2014 a,b) metrics were brainstormed and went through a selection process. In this particular case, the support measurement team (iCoaches) selected metrics relevant for their departments in conversation with their manager. In relation to metric selection 3 approaches amongst participants were identified:

1) Experimental approach

2) Reflective approach

3) Certainty approach

The first approach matches a more trial and error perspective. Participants were happy to just experiment with different metrics and therefore had no difficulties in selecting (a first set of) metrics. Participants who exhibited the second approach took some time to consider what to measure. Participants who took the second approach reported that they had put some thought into which information would be relevant for them to know, and were satisfied with their conclusions and ready to test the metrics. The group with the third approach wanted to make sure they were selecting the right indicator and such seeking for certainty got unanswered and made the selection difficult.

Most likely all three of these approaches will be represented in a given group. Therefore, a take-away for managing this metric selection process is to pay more attention to the balance between the first two approaches and create environments that avoid the third. Due to of the dynamic nature of measurements and the complexity of innovation capability looking for "the" right metrics might be a difficult and demanding task that can delay implementation too much.

By the end of the second measurement implementation support team were satisfied with the selected metrics and were willing to continue with them for a few measurements rounds. One participant pointed out that the measures were still insufficient. However, during a follow-up interview it became clear that the challenge was more related to the quantity of data, due to the low number of responses. It turned out, that in this particular case only data from management was gathered. This led to a small number of responses and did not represent the

ground level. This confirms that to be effective in the process of selecting metrics it is important to focus on the adequate organizational level (see 5.4.1)

5.2. The drivers of indicator use

Another aspect that is central to the measurement system functionality is the uses of the selected measurements. As suggested in the introduction, often indicators measure output and outcomes. Findings from this research point out that the measurements were used in four different ways:

1) **To implement strategy by promoting a certain behaviour** – Participants report that some of the selected metrics functioned as a reminder to conduct the desired activity, as well as to visualize progress on its implementation. For example, following the number of cross-functional meetings works as a reminder to set up the meetings, as well as to follow up whether they have happened or not.

2) **To diagnose and monitor trends** – While some metrics were used to monitor activities, others were specifically used to confirm a perceived trend. For example, counting the number of customer visits allows one to think about the amount of direct customer input. If this trend diminishes steadily, one might ask whether the department is loosing touch with this important stakeholder group or explore the quality of marketing.

3) **To learn by experimenting with metric system** – Similar to the metric selection approach, some participants were taking the opportunity to experiment with indicators and see how they could make them work for them. It didn't matter to them what indicators they selected. Instead, how they could get better of using the tool and slowly calibrating the implementation

4) **To reflect on practice** – In preparation for the second measurement, the indicators were normalized to allow for comparison. Participants then used the data to share and compare results and explored the behaviours that lead to high and low scores.

5.2.1. Small and focused indicator purposes

After the measurements, when asked about the purpose and uses of the indicators, some participants questioned and reflected on the extent to which indicators can show organizational innovativeness. This was a very important reflection as many measures do in fact not do so, but most approaches do not address this question. For innovation capabilities, the point in focus is whether one is creating the right conditions that allow innovation to happen. There are too many indicators for these innovation conditions, for this reason it is helpful to focus on small and context specific aspects rather than matching all important aspects. It is important therefore important to focus on these small and context specific indicators in an overall measurement approach.

5.2.2. What is a sufficient measure?

After a first round of measurement, some participants questioned the adequacy of the metrics. The trigger for such questions was that some of the results were above participants' expectations. The measurement gave them a different result than what was their perception of the innovativeness of a particular feature or department. Hence, a question emerged about how to determine adequate reference points and sufficient targets for the indicator' benchmark.

5.3. Moving towards innovation capabilities development

In the long run, the research intends to develop a closer correlation between the measurement activity and the development of innovation capability. The measurements analysed so far represent the test round of implementation, and allow for small insights regarding this correlation.

5.3.1. Metrics content and innovation capabilities

To speak more precisely about the content and impact of the selected metrics a more detailed study is required. This section illustrates some of the metrics

content and preliminary insights into the relation to aspects of innovation capability.

As expected from the current reality analysis, some of the metrics selected by the innovation support team were close to innovation climate and contingent aspects of innovation. For example, metrics about time to explore ideas, about customer and external connection, as well as about perceived management support were in place.

Some indicators relate to the process dimension of innovation capabilities. One example is a set of measurements that is related to the idea management platform (Benaim et al 2014a). The measurements asked about number of ideas suggested and their progress to idea development stages (gates) within the platform. Additional measurement inquired about the clarity of the innovation process, as well as if employees knew where to look for clarification. One indicator asked whether employees knew the innovation process (routine). Some measures focused on outputs, such as: the numbers of features incorporated into products, and articles related to innovation developed by the company.

Some indicators were related to resource distribution in terms of portfolio management and strategy alignment. A number of measurements focused on the innovation budget and its distribution during the first two round of measurements. In addition, there were measurements for the number of projects that work with a high percentage of innovative features in a given product. A measurement also asked about the alignment between projects and strategy.

In relation to the phrasing of the measurements, there were some revisions and small changes in the wording of some indicators in order to make them clearer, as well as, to set a standard for departments measures which allows for easier comparison.

5.4. Implementation Challenges

The research identified 3 challenges in relation to the measurement system implementation. The main one was defining the focus and level of the measurements. The other two were about management engagement and legitimization of the measurement system, as well as the visualization of results.

5.4.1. Choosing the level of the measurement and focus

a.1. the level of measurement

The original focus of the measurement was on project teams. The results were then supposed to be aggregate in order to create a pyramid effect across organizational levels and create a cumulative result. However, the executive manager decided to shift this focus to department level. The explanation for this shift was that measuring at the project team level could have been a complex and unfocused exercise because team formations and characteristics are varied and fluid. For example, a project team can last for a few weeks, or a few years; some are small, co-located and focused, while others can be big and have members from different site across the globe; also employees are part of more than one project team at a time. In contrast, departments represent a more stable group. The responsible (line) manager reports to directors and the directors to top management.

In addition, a perspective that contributed to the level shift was the idea that by measuring the department level, it would be easier to work with the working climate. Measuring at the department and even site level would enable observation of management support in terms of encouragement towards employees and their innovative solutions. More importantly, the change was a strategic decision to engage management not only in contributing to the creation of the metrics but to feel responsible to implement and develop the measurement process.

Finally, one more factor that contributed to the shift was the frequency of measurement activity. The company decided that measurements would be conducted two times a year. Such a measurement rate would not make an in-time contribution for most of the project teams, providing only after-the-fact statistics.

a.2. Measurement focus

The change in level from team to department brought with it a new challenge: focus. The noticeable spread of selected indicators - from overall finance over implementation of new features to cross-department collaboration – showed that, at the department level, there were clearly many different aims to consider, which may have led to a lack of focus in what to measure in the context of innovation capability.

Generically the selected metrics could be good indicators. However, to be suitable for developing innovation capabilities, the measurements needed to be specific: to whom are these indicators relevant, in which context and which innovation challenge do they address?

One example that illustrated the need for context-specific focus comes from the product platform development department. They reached the conclusion that a small group of indicators would suffice to reveal how innovative one is: e.g. the number of innovative features implemented into product. This conclusion made sense and worked for their level of measurement, because they have an overview of products, their progress and monitor the end products. However, different departments may require different indicators that are more closely related to their work, e.g., departments related to machinery parts might want to know how efficient the handover of innovation is, or projects teams might want to know their performance delivering innovative solutions rather the percentage of innovative features alone.

5.4.2. Engaging and legitimizing the implementation

Despite approval by top management, some of its members did not see the measurement as a priority or relevant. The next layer of management had a similar division. Sometimes this required meetings with top management to clarify the legitimacy and engage the managers. Moreover, managers would tend to support the initiative in accordance with the views of their top management. If the top manager was keen on the initiative, they middle would be more incline to work towards it.

The change in measurement level described above speaks to this challenge, because the change of focus and level can be seen as a solution to this engagement and legitimation challenge.

5.4.3. Sharing data and visualization tool

A visualization tool, in which the gathered data would be placed and displayed, was in place from the beginning. This tool also posed a few challenges when implementing the measurement system. Few members of the support team used the tool and it was mainly continued because it was mandatory. The challenges were connected to implementation set-backs and the learning curve associated

with the tool. Participants pointed out that some additional training (beyond the walk-thought workshop) would have helped.

In itself the visualization tool, which was a software app, presented a variety of technological challenges such as: "a) Frequent app crash, b) Visualization of correct quarter and year was not intuitive - One had to be careful to display the right time frame, c) The tool was not ready to use - Wi-Fi connection and log-in problems prevented immediate access, d) Infrequent use makes hard to remember how to use it, e) Aggregation on hierarchical layer had problems" (Benaim et al 2015). For these reasons, participants often worked on their own spreadsheets. Additional advantages of using ones own document was that it allowed making notes and personalizing items related to particular results, which the official visualization tool did not.

The support group shared the results of data collected with their managers. Managers' reactions were to take in the information and some asked for next steps. Some of the managers were presented with site data and inquired about specific data related to their level within the site.

5.5. Creating a positive dynamic between organizational levels

This section explores the relationship between actions from organizational level and team level that support innovation capabilities and its measurement. Within it three topics are highlighted. The first is leadership, the second one again relates to the level of measurement and the third is about the creation of opportunities and focus topic for innovation.

5.5.1. Securing implementation

Leadership and employee empowerment have a supportive role in creating conditions for measurement to happen. The background work that the project management team and research partners did to create an adequate setting and ensure acceptance of the initiative was noticeable and noteworthy. One example was the constant interaction with top management to explain the need and case

for measurement, the proposal and progress, as well as to clarify any questions they might have.

Moreover, the management team responsible for the metric implementation played an important role in empowering its members. One way in which empowerment happened was that the management created psychological safety and space for participants to take ownership of the initiative. For example, during the workshop to discuss the second measurement results, participants asked about what top management expected from them, and what they expect to get from the exercise. The executive manager replied "what is it that you want to tell the top management". The fact that he wanted to shift the focus from one of delivering on expectations to one of being able to share ideas indicates that participants have the ownership and freedom to direct and develop the initiative if they take it. However, even though the participants were told that the indicators and results should be relevant for "them", the questions pointed to a way of working that was more traditional and task focused. The measurement, on the other hand, is meant to be a pro-active approach. The empowering leadership was a key stepping stone to make that shift.

Another central role played by the management team was the setting of dynamics between participants and the required activities. Participants were spread all over the globe, working in different departments and sites, as well as with little time assigned for the measurement work. The approach, on the other hand, required to coordinate meetings, follow up with activities, and to create space for discussion and feedback in order for the project to develop. Hence, even though innovation should be spread and integrated in everyone's work, having a coordination group to observe and coordinate innovation efforts was helpful.

5.5.2. What level to start at?

The shift in level of measurement also brought up some questions about the dynamics between the different levels of the organization. Originally, there was an aim to aggregate results across levels; for instance, teams' indicators would be aggregated at management level. In parallel, metrics related to managerial innovation would be added, and aggregated to top level. Each level would have indicators that were relevant to them.

The need to shift levels of measurement in order to engage managers indicates that perhaps the measurement intervention cannot start only at the bottom levels. Overall, these insights led to new questions, namely:

a. Is it better to address team innovation capability indirectly through higher levels of the organization?

b. Does implementation of innovation capabilities metrics require measurement at more than one level at the same time?

5.5.3. Creating the space for, and ownership of, innovation

From the study of the current reality, the request from the team level for middle management support in relation to becoming more innovative was clear. Even though the pressures on middle management were acknowledged, the team level asked for management support in term of time, idea support, innovation oriented idea selection criteria.

When space and focus for exploration were given ideas seemed to flourish. The success cases within the ideation platform suggested that when management created a focus for exploration, ideas were suggested. The next step of support needed is then adequate feedback and continuity in implementation.

Alternatively, when employees took ownership of the topic, ideas were also developed and the exploration flourished.

These observations speak to the importance of exploration focus, goal setting and employee empowerment, as well as, balancing support and employee initiative. The study of such aspects can improve practice, and at the same time, provide indications of relevant aspects to be measured in order to support the development of innovation capabilities.

Moreover, from an innovation process perspective, the creation of innovative spaces and focus can trigger innovation activities. Such activities can give ground for innovation capabilities to be evaluated, in addition to the evaluation of practices that occur within projects.

Open questions identified here are: What moves an employee to take ownership of a topic? Is it personal interest, connection to a current project? In what ways does the discussion within such innovative spaces help?

6. Discussion

The next chapter explores the implication of the findings in relation to the implementation and further development of innovation measuring systems for teams. As this research is based on a design research approach, the first reflection is about whether the metrics system fulfils the design criteria established at the introduction and whether it supports the development of innovation capability.

In a second point of reflection, the discussion aims to touch upon how the findings impact the design and implementation of the innovation measuring system. The main aspects to be highlighted revolve around the change of measurement level, specifically the significance of measuring higher organizational levels and the implications for team level measurement. In addition, the discussion talks about the selection of specific focus groups within the chosen level and the relevance of having a specific set of metrics. Finally, it discusses unseen ways in which the company currently innovates that allow for capability development and measurement follow up, expanding on item 5.5.3. The discussion ends outlining future research and practical recommendations.

6.1. Meeting innovation measurements design criteria

This first section discusses the relation of the findings and the "requirements" for innovation measuring system as they were outlined in the introduction (section 1.1.). The requirements are:

- Move beyond outcomes and focus on activities
- Determine the relevant areas and aspects to be measured
- Consider the contextual moment
- Provide a practical support for teams, and not only managers; and
- Consider both exploration and exploitation

The findings about metric selection, its uses and content indicate an overall positive direction in meetings these requirements. However, these findings are preliminary and they need further exploration. Their contribution could be established by analysing the correlation between the measurement aspects mentioned above and specific capabilities; this can only be obtained over time when there is enough data to support a study that explores such a correlation.

Reflecting on the first design criteria, the measurements do take into account more than outcomes. In addition to outcomes, they also consider elements from climate and input, for instance. This assessment can be supported in two ways; one is when participants use the indicator directly to promote a desired behaviour, such as selecting how many inter-department meetings one is going to aim for in a given month; the other is by using them to monitor a trend with the intention to act, if results of the measurement are unsatisfactory.

In relation to determining relevant areas and considering the contextual moment, it seems that the tool is well accepted. The sites decided to keep the selected metrics with minor adjustments. Comparing the 3 approaches to metric selection, more often than not the flexibility and dynamic aspects of the selected metrics helped the process to flow easily. The emphasis on the transitory nature of the selected metrics seems to keep the process going, and avoids the unhelpful aim to find a perfect indicator.

The contextual relevance of the metrics will also become more evident as the focus and boundaries of teams get more defined (see 6.4), as well as with further research comparing the uses of metrics and the relation to capability support.

In relation to being a practical support for teams and managers, due to the level shift, this criterion has changed. Even though the overall design criteria could remain the same, the specific exploration has shifted directions. From being a criterion about whether team measurements would help both, team and managers, it seem to have shifted to whether departmental level measurement have an impact on teams. In consequence of the shift and in face of the need for further studies to establish the relation between measurement and capabilities development, it is not possible to assert the achievement of this criterion. One way forward is to identify multiple levels and create small focal units for measurements that are independent in themselves, but part of the whole. This implies clarifying the teams in focus and their relation to different levels.

Since the active use of measurement helps to put in place general conditions for innovation and innovation capabilities to take place, it is plausible to think that

they will affect both exploration and exploitation of ideas. However, such a link cannot be made at this stage of implementation and data collection.

6.2. Implications from moving the measurement level

As noted above, the shift of focus and level is one of the biggest changes in the implementation process. What does this tell about the implementation and the original focus on teams? Was it necessary?

Reasons that led to such a shift include middle management engagement and legitimation of the measurement implementation. At the same time, the level shift was an attempt to drive innovation capabilities through management by creating the contextual environment for innovation. Overall, it seems this shift can be a valid approach; different from the starting conditions, nonetheless potentially functional.

The first reflection is about the possibility of the management level to contribute to team innovation capability development. It is simple to imagine such a possibility. Innovation climate has an influence on innovative outcomes and managers can have an influence in the climate; hence it seems that it is a likely proposition. Considering that beyond current projects the company is also working on innovative pathways and process for innovative ideas to be developed, that seems like a plausible match. However, further research is needed to confirm whether this actually works.

Another reflection is about the need of such shift: Despite being a possible valid path, one might ask "was it necessary"? It seems we have met a classical pitfall here, which is management engagement and buy in. Changing levels of measurement might be one solution to such a problem, but it depends on the validation mentioned in the paragraph above. It is also dependent on the extent to which that is possible. An alternative solution, and possible hypothesis is the possibility that project team measurement need to be associated from the beginning with the implementation of innovation measurement at higher levels. Or that measurement should be more consultant-driven, to secure level of analysis and implementation, even if this could create hand-over challenges.

More radically, one could question the viability of focusing on project teams, and affirm the adequacy of focusing only at management level. However, not

focusing on project teams and lower levels of measurements might create a blind spot about innovation capabilities. Such levels are connected to activities that speak to how innovations are actually developed. It can prevent the understanding of how macro-contexts (departments and managers level) influence the micro-level (team and individual working with innovation). Project teams are working with products and task that are likely to be the focus of innovative work. By moving the measurement way from the team level it is hard to understand how innovation is being conducted. Therefore, it seems that there are reasons for measuring at the team level. This possibility will be further discussed in section 6.3.

6.2.1. Level change and implication for current implementation

The shift in level can also raise questions about the adequacy of the metric selection. Since departments have a common task and work together, in order to achieve a common goal, they can be seen as teams. However, do the metrics brainstormed fit this purpose? The question is about whether the metrics would need to have been developed and selected to reflect the perspective of department.

In principle, this is the case. Even though categories, such as innovation input or output, would be the same, there would be requirements that are specific for the level in focus, where there could be differences. For instance, it is not as crucial to have customers' needs as input for managers as it is for project teams. However, in this particular case the level change happened during the development and selection of metrics. Therefore, the metrics could go through a selection process that was focused on higher organizational levels.

An open question is whether the focus on department and higher level might contribute to the general environment and climate for innovation, but might miss the actual innovation work and micro-climate. This focus may only be able to indicate general aspects without being able to focus on specific innovation work.

6.3. Keeping innovation measurement at the team level

Given the difficulties posed when trying to measure at the project team level, the consequent question is: Are projects teams still a valid and viable focus for the implementation of innovation measurement for capability development?

As mentioned before (see 6.2) project teams might represent an important level to understand and promote innovation capabilities in practice. The challenges found do not prevent the possibility of measuring innovation in project teams. However, they do suggest that one might need to consider more than one level at the time in order to do so. Or, that another approach is required to secure the implementation.

Moreover, other challenges were mentioned as a barrier for measuring teams, such as, quick team "turnover", the need for frequent measures, and employees working in multiple and even multinational teams. This indicates that in large companies measurement needs to happen quickly and must be easy to do. The measurement might need to be developed in such a way that the approach to teamwork is rapid in relation to all aspects of implementation: metrics selection, data collection, analysis, reflection, action and metrics revision. Going towards a model approach might be an alternative here.

In addition, within the attempt to make implementation faster and easier lingers the question: How fast can it be? And, how much training is needed in order to get participants fluent in measuring? Every skill takes some time to learn. Is it possible to learn and go (or learn on the go), or must participants be willing to get some rounds of practices before seeing meaningful results?

One last reflection revolves around the precision of the data. How exact does the data gathering need to be? Reflecting on the implementation, perhaps researchers and practitioners were focusing on getting accurate data, while a general indication and reflection around collective perceptions could be enough to support the development of initiatives for developing the innovation capabilities in teams.

From this discussion emerges the idea that measuring innovation capabilities at the team level requires a fast and easy way, in which reflection is more important than precision. It could be that, in opposition, at higher levels the "tempo" is different, hence more stable. That would allow for more longitudinal data collection and precision in representation

6.4. Groups in focus and sets of metric

This section reflects on the need for establishing focus groups, and their relation to a set of metrics that are relevant to them. One aspect that called the researchers' attention is the spread of the measurements across different organizational layers and a general disconnect between input, action process and output measures.

Looking at the indicators as a whole set or a system it is hard to identify which groups they are relating to. A possible explanation is that the shift in levels also promoted a shift in focus and could explain the spread of metrics. It can be that, on the one hand, when measuring projects teams, there is an implicit scope and focus. The team has a task and a specific product or area to innovate and focus on. They are in a climate that is supportive or not in relation to their management and peers inside and outside the group. They might have more or less contact with outside sources of input and feedback and all these factors might create more or fewer challenges for the innovation work to be developed within the different projects.

On the other hand, when moving the level to managers, departments and sites the innovation work is more diffuse. General categories, such as input, process, expected output and feedback would apply. However, it seems that the meaning of innovation in such "teams" and levels has to be discussed, clarified and anchored in a concrete form before hand, so adequate indicators can be selected in relation to those. As opposed to projects teams, the innovation task of other levels is less obvious, and therefore the relevance of innovation capabilities categories harder to define.

The points here are that the multiple foci and fluid boundaries might require that in implementation one needs to keep better track of the different groups, in order to make a clear link between metric selection and its possible internal logic, when moving to higher levels. In other words, a clear boundary definition of what the focal teams are, and what is relation and mandate to innovate is, is needed.

Another possible explanation is that such spread could have happened as a spin-off of the original idea of aggregating results into different levels. Regardless of whether this is a likely explanation or not, it is interesting to notice such disparity when looking at the data. This might suggest the importance of

experimenting with an internal logic within the set of indicators, in addition to adopting indicators that are perceived as important by the teams.

A complementary explaining factor is that the implementation support team has multiple roles outside and within the innovation initiatives related to measurement. For instance, in addition to their normal design engineering work, they keep the dialogue and implementation at department level going, and work to gather and manage ideas on the idea management platform. Such multiplicity of roles might explain the various levels of measurement, since different measurements make sense to different aspects of their work.

Finally, in relation to the groups defining specific set of metrics, it could be that the measurement systems need to be introduced beforehand. Without the vision of how the measurements system tool is used to support the development of capabilities the contextual relevance of metric selection might be affected.

This explanation could imply the need for more involvement of researchers in training, examples and role-playing (mock up measurements) before the actual prototyping of the system. In the extreme, it could imply that the analysis and selection of metrics has to be done in a consultant-led way, which in its turn can generate adoption issues.

6.5. Unseen narratives about current innovation capabilities

Considering the relationship between levels and their dynamics for the development of innovation capabilities, this section explores the idea that despite a general perception that innovation is not happening outside R&D projects, there are innovations being enacted within the company. From the interviews that developed the current reality (paper B), one notes that there is a clear voicing of needs and requirements to be more innovative. As seen on the ideation platform (paper C), ideas are suggested and discussed when some space is given; however, continuation happens when there is support, and not spontaneously. The unexplored question, that seems to follow is: Is the context so limiting that innovation is very difficult outside R&D projects?

This could lead to further research about self-image and whether employees are empowered to take intrapreneurial action, as well as about the role of innovation

champions and their related behaviours. Both of these research aspects could indicate important areas to measure, as well as give meaningful data and support in adjusting mind-set and actions towards a functional path for innovation.

6.6. Further research

In this section, a few of the opportunities that speak directly to the further development of measurement and development of innovation capabilities are highlighted.

A first aspect for further research is the possibility that and the extent to which higher levels of organization's climate and process affect the development of innovation capabilities at the team (and individual) level. Open questions for further research are: Is it enough to have metrics at the department level to promote innovation capability at the team level? And to what extent is possible to influence and keep sight of micro level activities through higher level measurement?

Even though the research on the macro level is relevant, the author believes it is not sufficient, since the micro-climate and the dynamics of teams have a direct impact on how innovation is developed and innovation capabilities are implemented. In this pathway it might be interesting to explore how measuring projects teams can be made practical, fast and easy to implement.

Due to the multiplicity of focus, the impact of the research suggested above requires different units of analysis. They represent different forms of grouping people, i.e., different forms of drawing boundaries that represent different kinds of teams. These range from managers as a team, or departments as a team to capacity within project teams and outside project teams (idea management).

The actual measurement exercise that continues to occur in practice asks for a detailed analysis of the adequacy between the selected metrics, innovation capabilities and the current reality of the firm. An exploration of the relation and impact of the selected metrics in relation to capability development is also needed. In addition to analysing the content, one way forward is to analyse the impact of the action derived from the metric evaluation.

Finally, considerations about identifying positive deviants, i.e, people that despite the conditions manage to innovate, would allow to identify practices that

are already functional within the company, potentially allowing the replication and monitoring of such behaviours through measurement.

6.6.1. Dealing with innovation and measurement complexity

Innovation measurement and innovation capabilities are complex concepts that involve many variables. For example, innovation involves prototyping, learning, change, and selecting ideas. In addition, not only aspects related to innovation, but also dimensions of implementing a new feature show up in the research. Politics, employee engagement and organizational change are a few topics that come into play when dealing with action research and applied science in humanities.

Perhaps such complex phenomena should be studied in a multidisciplinary fashion. Different academics focusing on different dimensions could give a solid ground to build theory and experiments, as well as provides specific aspects to be implemented by industry. This could be a time-consuming and long road.

One alternative is to downsize the innovation capabilities aspects being analysed. In this scenario, the alternative is to run small experiments based on the priorities of the selected teams. After a benchmark, a workshop would be designed in order to promote an adequate behaviour that would improve a specific measured aspect. It would allow testing the use of the metric system as well as the behaviour.

6.7. Practical recommendations

Before making practical recommendations, it must be acknowledged that a year has passed and much work has been done since the cut off for data gathering for purpose of this licentiate. This is a common challenge when doing (action) research and being embedded in the 'messy' every-day of organizations. Participating in a recent reflection session, I wish I could report some of the results here.

Despite implementation work still being progress, the two focus areas of this section still seem appropriate. The first relates to the option of continuing the

implementation from higher levels, and the other is the suggestion to reconsider project teams as a focus.

For the continuation of the implementation, the next steps are the analysis of the content of the metrics and its relation to current reality and innovation capability. It is a step focused on the reflection, planning and action taken upon the results of current metrics.

A general suggestion is to revisit the purpose of the measurement. If the aim is to understand more general aspects of innovation capabilities, such as general innovation climate and process, then the current development is fitting. If, in addition to that, the aim is to understand how ideas are developed on the ground level (within and outside R&D projects) and whether that work in based on well-developed innovation capabilities, then the suggestion is to re-consider the project team perspective.

In both of these aims, a recommendation is to consider the different teams' boundaries (focus group) at department and project team level. This work would include selecting and "naming" of teams, as well as making explicit their relation to innovation. In this case, some of the possible delimitations and suggested team division could be: a) managers, b) departments c) iCoaches, d) Interact (or idea management and idea development outside current projects), e) project teams within R&D and f) project teams within maintenance.

For the boundaries defined at higher levels, a suggestions is to revisit the teams' innovation mandate, task and expectations, so that the metrics selected can be related to the innovative roles of higher level teams more clearly. This would support the establishment of "user of the metrics", their innovation purpose and the metric functionality.

If project teams are once again set into focus, then, as discussed previously (see 6.3) it might be helpful to keep in mind that reflection, fast action and experimentation around capabilities might be more relevant for projects teams than exact metrics. Hence, the measurement approach will need to be adapted.

7. Conclusion

The current reality for the case company reveals the challenges for developing innovation capabilities are also highlighted in the literature: Time, feedback, continuity, and management support among others. They set a reference for analysing the current and future metrics, and overall progress.

Within the case study, the results show the importance of the role of project and executive management leadership in order to keep the activities going, its implementation secured, as well as, to empower those who are involved.

In relation to the metric system itself, the research finds that it is moving towards the accomplishment of its functions and uses. The metric system promoted measures beyond output. The look at the uses and content of the selected metrics indicate that the measurement system drives activities related to the development of innovation capabilities. Such uses and measurements are actively promoting desired behaviour, keeping track of trends related o innovation activities or supporting learning and reflection about innovation practice.

Practices related to metric selection are to be kept fluid, to respect the contextual and dynamic nature of the measurement system, as well as to not stall its implementation.

The challenges of the implementation point to classical engagement, organizational change, and dynamic challenges. In addition, the challenges point out difficulties in measuring teams due to their dynamic nature. It emerges from the discussion of these challenges that two distinct approaches might be needed to measure innovation capability in practice. One approach focuses on project teams, should be fast and easy to implement and gives preference to reflection over data precision. The second approach explores the general status of innovation capabilities. It focuses on a more macro perspective of the organizational conditions for team and individual action, and hence is more suitable for measuring higher (and more stable) levels (departments,

management) within the organization, as well as taking a long-term perspective on the development of innovation capabilities. This second approach is based on more precise data, analysis, and impact consideration.

8. Bibliography

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

Alexy, O., Henkel, J., & Wallin, M. W., 2013. From closed to open: Job role changes, individual predispositions, and the adoption of commercial open source software development. *Research Policy*, *42* (8), 1325–1340.

Alpkan, L., Bulut, C., Gunday, G., Ulusoy, G., & Kilic, K., 2010. Organizational support for intrapreneurship and its interaction with human capital to enhance innovative performance. *Management Decision*, *48 (*5), 732–755.

Amabile, T. M., 2012. "Componential Theory of Creativity", working paper.

Anderson, N., Potocnik, K., & Zhou, J., 2014. Innovation and Creativity in Organizations: A State-of-the-Science Review, Prospective Commentary, and Guiding Framework. *Journal of Management*, *40*(5), 1297–1333.

Anderson, N. R., and West, M. A., 1998. Measuring climate for work group innovation: development and validation of the team climate inventory. *Journal of Organizational Behavior*, 19(3), 235–258.

Assink, M., 2006. Inhibitors of disruptive innovation capability: a conceptual model. *European Journal of Innovation Management*, *9*(2), 215–233.

Baer, M., & Oldham, G. R., 2006. The Curvilinear Relation Between Experienced Creative Time Pressure and Creativity: Moderating Effects of Openness to Experience and Support for Creativity. *Journal of Applied Psychology*, *91* (4), 963–970.

Bain, P.G., Mann, L. and Pirola-Merlo, A., 2001. The Innovation Imperative: The Relationships Between Team Climate, Innovation, and Performance in Research and Development Teams. *Small Group Research*, 32(1), 55–73.

Baregheh, A., Rowley, J., & Sambrook, S., 2009. Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323–1339.

Barton, D.L., 1992. Core capabilities and core rigidities: A paradox in managing new product development". *Strategic Management Journal*, *13* (S1), 111–125.

Beckman, S. L., & Barry, M., 2007. Innovation as a learning process: Embedding design thinking. *California Management Review*, *50*(1), 25–56.

Benaim, A., Elfsberg, J., Larsson, T.C. & Larsson, A., 2015. Implementing Innovation Metrics: A case study. *Proceedings of the 20th International Conference on Engineering Design (ICED 15), July 27-30, 2015, Milan, Italy.*

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J., 2014b. Becoming an Innovative Company: Assessing an Organization's Innovation Capability from the perspective of a team. *Proceedings of the 15th CINet Conference, September 7-9, 2014, Budapest, Hungary.*

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J., 2014a. Building a Pathway for Innovation: Lessons learned from developing an online platform. *Proceedings of the 10th NordDesign Conference 2014, August 27-29, 2014, Espoo, Finland.*

Bessant, J., Lamming, R., Noke, H. and Phillips. W., 2005. Managing Innovation Beyond the Steady State. *Technovation,* 25 (12), 1366–1376.

Björkdahl, J., and Börjesson, S., 2012. Assessing Firm Capabilities for Innovation. *International Journal of Knowledge Management Studies*, 5 (1/2), 171–185.

Björkdahl, J., and Börjesson, S., 2011. Organizational Climate and Capabilities for Innovation: a Study of Nine Forest-Based Nordic Manufacturing Firms. *Scandinavian Journal of Forest Research,* 26(5), 488-500.

Blessing, L.T.M., and Chakrabarti, A., 2009. DRM, a design research methodology: Springer

Boer, H., and Gertsen. F., 2003. From Continuous Improvement to Continuous Innovation: a (Retro)(Per) Spective. *International Journal of Technology Management*. 26(8), 805–827.

Boer, H., Caffyn, S., Corso, M., and Coughlan, P., 2001. Knowledge and continuous innovation: the CIMA methodology. *International Journal of Operations and Production Management,* 21(4), 490–502.

Boer, H., Kuhn J. and Gertsen F., 2006. Continuous innovation. Managing dualities through co- ordination, CINet Working Paper.

Börjesson, S., and Elmquist, M., 2011. Developing Innovation Capabilities: a Longitudinal Study of a Project at Volvo Cars. *Creativity and Innovation Management*, 20(3), 171–184.

Bourne, M., Kennerley, M., and Franco-Santos, M., 2005. Managing through measures: a study of impact on performance. *Journal of Manufacturing Technology Management*, 16(4), 373–395.

Bourne, M., Neely, A., Mills, J., and Platts, K., 2003. Implementing performance measurement systems: a literature review. *International Journal of Business Performance Management,* 5(1). 1-24.

Bryman, A., 2008. Social Research Methods, Oxford University Press, 3rd edition.

Calantone, R. J., Cavusgil, S. T., & Zhao, Y., 2002. Learning orientation, firm innovation capability, and firm performance. *Industrial Marketing Management*, *31*(6), 515–524.

Chen, G., Farh, J.-L., Campbell-Bush, E. M., Wu, Z., & Wu, X., 2013. Teams as innovative systems: Multilevel motivational antecedents of innovation in R&D teams. *Journal of Applied Psychology*, 98(6), 1018–1027.

Chiesa, V., Frattini, F., Lazzarotti, V., and Manzini, R., 2009. Performance measurement of research and development activities. *European Journal of Innovation Management*, *12*(1), 25–61.

Corso, M., 2002. From product development to Continuous Product Innovation: mapping the routes of corporate knowledge. *International Journal of Technology Management*, *23*(4), 322–340.

Coughlan, P., and Coghlan, D., 2002. Action research for operations management. *International Journal of Operations and Production Management*, *22*(2), 220–240.

Crossan, M. M., & Apaydin, M., 2010. A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*. 47 (6), 1154-1191.

Davila, T., Epstein, M.J., and Shelton, R., 2006. Making innovation work: How to manage it, measure it, and profit from it, Wharton School Publishing

Davison, G., and Blackman, D., 2005. The role of mental models in innovative teams. *European Journal of Innovation Management*, *8*(4), 409–423.

DeCusatis, C. (2008). Creating, Growing and Sustaining Efficient Innovation Teams. *Creativity and Innovation Management*, *17*(2), 155–164.

Dewangan, V., and Godse, M., 2014. Towards a holistic enterprise innovation performance measurement system. *Technovation*, *34*(9), 536–545.

Doblin, 2015. Ten types of Innovation. http://www.doblin.com/tentypes/. Last accessed 5 February 2015

Edmondson, A. C., & McManus, S. E., 2007. Methodological fit in management field reserach. *Academy of Management Review*, *32*(4), 1155–1179.

Edmondson, A.C., & Nembhard, I. M., 2009 "Product Development and Learning in Project Teams: The Challenges are the Benefits". *Journal of Product Innovation Management*. *26*, 123–138.

Ekvall, G., 1996. Organizational Climate for Creativity and Innovation. European *Journal of Work and Organizational Psychology*, 5(1), 105–123.

Elmquist, M., and Le Masson, P., 2009. The value of a "failed" R&D project: an emerging evaluation framework for building innovative capabilities1. *R&D Management*, 39(2), 136–152.

Fagerberg, J., 2005. Innovation: a guide to the literature, in The Oxford Handbook of Innovation, ed. Fagerberg J., Mowery, D.C., Nelson, R.R., Oxford University Press, New York, US, 1-26.

Frigo, M. L., 2002. Strategy, Business Execution, and Performance Measures. *Strategic Finance*, 6–8.

Folkestad, J., & Gonzalez, R., 2010. Teamwork for Innovation: A Content Analysis of the Highly Read and Highly Cited Literature on Innovation. *Advances in Developing Human Resources*, 12(1), 115–136.

Francis, D., and Bessant J., 2005. Targeting Innovation and Implications for Capability Development. *Technovation,* 25(3), 171–183.

Frigo, M. L., 2002. Strategy, Business Execution, and Performance Measures. *Strategic Finance,* 6–8.

Garcia, R., & Calantone, R., 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. *Journal of Product Innovation Management*, *19*(2), 110–132.

Garud, R., Tuertscher P., and Van de Ven A.H., 2013 "Perspectives on Innovation Processes." *The Academy of Management Annals,* 7(1), 775–819.

Ghaye, T., Melander-Wikman, A., Kisare, M., Chambers, P., Bergmark, U., Kostenius, C., & Lillyman, S., 2008. Participatory and appreciative action and reflection (PAAR) - democratizing reflective practices. *Reflective Practice*, *9*(4), 361–397.

Gericke, K., & Blessing, L., 2012. An analysis of design process models across disciplines. Marjanovic D., Storga M., Pavkovic N., Bojcetic N. (eds.), *Proceedings of 12th International Design Conference–Design, Drubovnik, Croatia, 171-180.*

Godener, A., and Söderquist, K. E., 2004. Use and impact of performance measurement results in R&D and NPD: an exploratory study. *R&D Management*, 34(2), 191-219.

Hackman JR., 1998. Why teams don't work. In: Tindale RS, et al Theory and research on small groups. New York: Plenum; 245-266.

Hallgren. E.W., 2009. How to Use an Innovation Audit as a Learning Tool: A Case Study of Enhancing High-Involvement Innovation. *Creativity and Innovation Management.* 18 (1), 48-58.

Hoegl, M., and Gemuenden, H. G., 2001. Teamwork Quality and the Success of Innovative Projects: A Theoretical Concept and Empirical Evidence. *Organization Science*, 12(4), 435–449.

Hülsheger, U. R., Anderson, N., & Salgado, J. F., 2009. Team-level predictors of innovation at work: A comprehensive meta-analysis spanning three decades of research. *Journal of Applied Psychology*, *94*(5), 1128–1145.

Isaksen, S. G., & Lauer, K. J., 2002. The climate for creativity and change in teams. *Creativity and Innovation Management*, *11*(1), 74–86.

Jacoby, R., & Rodriguez, D., 2007. Innovation, Growth, and Getting to Where You Want to Go. *Design Management Review*, *18*(1), 10–15.

Katzenbach, J. R., & Smith, D. K., 2005. The discipline of teams. *Harvard Business Review*, July-August, 162–171.

Kelley, D. J., O'Connor, G. C., Neck, H., & Peters, L., 2011. "Building an organizational capability for radical innovation: The direct managerial role". *Journal of Engineering and Technology Management*, *28, (*4), 249–267

Kelley, Tom. 2006 "The Ten Faces of Innovation." *Academy of Management Learning & Education*, spring-summer, 30-33

Kianto, A. (2008). Development and validation of a survey instrument for measuring organisational renewal capability. *International Journal of Technology Management*, *42*(1/2), 69–87.

Kim, W.C., and Mauborgne, R., 2004. Blue Ocean Strategy. *Harvard Business Review, October*, 1-10

Langdon, M., 2008. Innovation Metrics. White Paper, 1–21.

Lawson, B., & Samson, D., 2001. Developing innovation capability in organisations: a dynamic capabilities approach. *International Journal of Innovation Management*, *5*(3), 377–400.

Lazonick, W., 2012. Who needs a theory of innovative enterprise. *Presented at the annual conferemce of the international Schumpeter Society. July 2-5 2012 Brisbane, Australia.*

Leifer, R., O'Connor G.C., Rice M., 2001. Implementing Radical Innovation in Mature Firms: the Role of Hubs. *The Academy of Management Executive (1993-2005)*, 102–113.

Lund, K., and Glav, R., 2014. Strategies for managing micro-level contextual ambidexterity- combining exploration and exploitation in R&D, *Proceedings of the 15th CINet Conference, September 7-9, 2014, Budapest, Hungary, 595-610.*

Magnusson, M., & Martini, A., 2008. Dual organisational capabilities: from theory to practice–the next challenge for continuous innovation. *International Journal of Technology Management*, *42*(1/2), 1–19.

March, J. G., 1991. Exploration and exploitation in organizational learning. *Organization Science*, *2*(1), 71–87.

Mastenbroek, W. F. G., 1996. Organizational innovation in historical perspective: change as duality management. *Business Horizons*, *39*(4), 5–14.

McLean, L. D., 2005. Organizational Culture's Influence on Creativity and Innovation: A Review of the Literature and Implications for Human Resource Development. *Advances in Developing Human Resources*, *7*(2), 226–246.

Metz, I., Milé, T. & Samson, D., 2007. Development of an Integrated Innovation Capability Model, in: Milé, T., (ed.), Building Innovation Capability in Organizations: An international Cross-case Perspective, Imperial college. Chapter 2, 19-49.

Meyer, C., 1994. How the Right Measures Help Teams Excel. *Harvard Business Review*, 72, 95–103.

Miron-Spektor, E., and Erez, M., 2011. The Effect of Conformist and Attentive-to-detail members on Team Innovation: Reconciling the Innovation Paradox. *Academy of Management Journal*, 54(4), 740–760.

Murray, P. & Blackman, D., 2006. Managing innovation through social architecture, learning, and competencies: a new conceptual approach. *Knowledge and Process Management.* 13, (3), 132-143.

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

Nagji, B., and Tuff, G., 2012. Managing your innovation portfolio. *Harvard Business Review*, (May), 4–12.

Nanda, T., & Singh, T. P., 2009. Determinants of creativity and innovation in the workplace: a comprehensive review. *International Journal of Technology, Policy and Management*. 9 (1), 84–106.

Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M., and Kennerley, M., 2000. Performance measurement system design: developing and testing a process-based approach. *International Journal of Operations & Production Management,* 20(10), 1119–1145.

Nilsson, F., Regnell, B., Larsson, T., and Ritzén, S., 2010. Measuring for Innovation. *Applied Innovation Management*, *2*, 1–30.

Nilsson, S. and Ritzén, S., 2014. Exploring the Use of Innovation Performance Measurement to Build Innovation Capability in a Medical Device Company. *Creativity and Innovation Management*, 23(2), 183–198.

Nilsson, S., Wallin, J., Benaim, A., Annosi, M.C., Svensson, R.B., 2012. Re-thinking innovation measurement to manage innovation-related dichotomies in practice, *Proceedings of the 13th CINet Conference, September 16-18, 2012, Rome, Italy*.

O'Connor, G.C., 2008. Major Innovation as a Dynamic Capability: a Systems Approach. *Journal of Product Innovation Management,* 25(4), 313–330.

O'Connor, G. C., and DeMartino, R., 2006. Organizing for Radical Innovation: an Exploratory Study of the Structural Aspects of RI Management Systems in Large Established Firms. *Journal of Product Innovation Management*. 23(6), 475–497.

O'Connor, G. C., Paulson, A. S., & DeMartino, R., 2008. Organisational approaches to building a radical innovation dynamic capability. *International Journal of Technology Management*, 44(1/2), 179–204.

Patterson, M. G., West, M. A., Shackleton, V. J., Dawson, J. F., Lawthom, R., Maitlis, S., 2005. Validating the organizational climate measure: links to managerial practices, productivity and innovation. *Journal of Organizational Behavior*, *26*(4), 379–408.

Parmenter, D., 2010. Key Performance Indicators, Developing Implementing and Using Winning KPIs, 2nd edition, pub. John Wiley and Sons

Regnell, B., Höst, M., Nilsson, F., and Bengtsson H., 2009. A Measurement Framework for Team Level Assessment of Innovation Capability in Early Requirements Engineering. In Bomarius F., Oivo, M., Jaring, P., Abrahamsson P. (Eds.): Product-Focused Software Process Improvement, 10th International Conference, PROFES 2009, Oulu, Finland. 32, 71–86.

Reid, S.E., & Brentani, U.D., 2004 .The Fuzzy Front End of New Product Development for Discontinuous Innovations: a Theoretical Model." *Journal of Product Innovation Management,* 21(3),170–184.

Ritzén, S., and Nilsson, S., 2013. Designing and implementing a method to build Innovation Capability in product development teams. Proceedings of the International Conference on Engineering Design (ICED13) August 19-22, Seoul, Korea.

Russ-eft and Preskill, 2009. Evaluation in organizations, Basic Books Publisher

Sarasvathy, S. D., 2001. Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *Academy of Management Review,* 26(2), 243–263.

Saunila, M., 2014. Performance Management through Innovation Capability in SME. Finland, PhD thesis

Saunila, M., Pekkola, S., & Ukko, J. 2014. The relationship between innovation capability and performance: The moderating effect of measurement. *International Journal of Productivity and Performance Management*, *63*(2), 234–249.

Sayers A. Tips and tricks in performing a systematic review. Br J Gen Pract. 2007;57(538):425. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2151802/ (last assessed in 24 may 2015)

Schreyögg, G., & Kliesch-Eberl., M., 2007. How Dynamic Can Organizational Capabilities Be? Towards a Dual-Process Model of Capability Dynamization. *Strategic Management Journal.* 28(9), 913–933.

Simons, R., 1990. The role of management control systems in creating competitive advantage: New perspectives. *Accounting, Organizations and Society*. 15 (1-2), 127-143.

Sivasubramaniam, N., Liebowitz, S. J., & Lackman, C. L., 2012. Determinants of New Product Development Team Performance: A Meta-analytic Review. *Journal of Product Innovation Management*, *29*(5), 803–820.

Smith, KM, 2005. Measuring Innovation, in The Oxford Handbook of Innovation, ed. Fagerberg, J., Mowery, D.C., Nelson, R.R., Oxford University Press, New York, US, 148-177.

Soosay, C., and Hyland, P. (2008), Exploration and Exploitation: the Interplay Between Knowledge and Continuous Innovation. *International Journal of Technology Management*. 42 (1/2), 20-35.

Steiber, A., & Alänge, S., 2013. A corporate system for continuous innovation: the case of Google Inc. *European Journal of Innovation Management*, *16*(2), 243–264.

Stufflebeam and Shinkfield (2007). Evaluation Theory, Models, and Applications, Jossey-Bass publisher

Teece, D. J., 2014. A dynamic capabilities-based entrepreneurial theory of the multinational enterprise. *Journal of International Business Studies*. 45(1), 8–37.

Teece, D. J., Pisano, G., and Shuen, A.,1997. Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

Wallin, J., Larsson, A., Isaksson, O., & Larsson, T., 2011. Measuring Innovation Capability–Assessing Collaborative Performance, in Product-Service System Innovation, 207–212.

Weiss, M., Hoegl, M., and Gibbert, M., 2011. Making Virtue of Necessity: The Role of Team Climate for Innovation in Resource-Constrained Innovation Projects. JPIM, 28(1),196-207.

West, M. A., 2002. Sparkling Fountains or Stagnant Ponds: An Integrative Model of Creativity and Innovation Implementation in Work Groups. *Applied Psychology*, 51(3), 355–387.

West, M. A., & Sacramento, C. A., 2011. Creativity and Innovation: The Role of Team and Organizational Climate. In Handbook of Organizational Creativity, 359–386. Elsevier Inc.

West, M. A., Hirst, G., Richter, A., & Shipton, H., 2004. Twelve steps to heaven: Successfully managing change through developing innovative teams. *European Journal of Work and Organizational Psychology.* 13(2), 269–299.

Whyte, W. F., 1989. Advancing scientific knowledge through participatory action research. *Sociological Forum*, *4*(3), 367–385.

Woolley, A. W., 2009. Putting first things first: Outcome and process focus in knowledge work teams. *Journal of Organizational Behavior*, *30*(3), 427–452.

Yin R.K., 2009. Case Study Research, design and methods. Sage Publications 4th edition.

Zedtwitz, M.V., Friesike, S., Gassmann, O., 2014. Managing R&D and New Product Development; The Oxford Handbook of Innovation Management, ed. Dogson, M., Gann, D., Phillips, N., Oxford University Press

9. Appended papers

Paper A

RE-THINKING INNOVATION MEASUREMENT TO MANAGE INNOVATION-RELATED DICHOTOMIES IN PRACTICE

Susanne Nilsson[1], Johanna Wallin[2], Andre Benaim[3], Maria Carmela Annosi[1], Richard Berntsson[4], Sofia Ritzen[1], Mats Magnusson[1]

[1]Royal Institute of Technology, KTH, Sweden

[2]Luleå University of Technology, Sweden

[3]Blekinge Institute of Technology, Sweden

[4]Lund University, weden

suni@kth.se

ABSTRACT

Innovation performance measurement has developed from focusing on issues of control and monitoring towards a more supportive role for managers on a strategic, informative and motivational level. Despite its potential to facilitate innovation management measuring provides a challenge in practice not the least when a company has the ambition to manage both radical and incremental innovation. This paper, based on literature review with empirical illustrations from three case studies, argues that these issues derives from the need to manage a number of dichotomies which are present due to the essential differences associated to each type of innovation. These dichotomies are related to time, uncertainty, flexibility and control. The implications on the design and use of an innovation performance measurement system are explored and analyzed through the lens of dichotomies. The study contributes to the innovation measurement theory and provides basis for an analytical framework aiming to support the design and implementation of innovation performance measurement in practice.

Keywords: Innovation management, Innovation performance measurement, radical and incremental innovation

1. INTRODUCTION

Performance measurement, understood as the ability to measure both effectiveness and efficiency of the actions of a company, has its roots in accounting and traditional management where financial control and diagnostic purposes for measuring dominates (Lebas, 1995; Bourne et al, 2003). Research emphasize the use of measurement also as a strategic tool to motivate and inspire new behaviors as it has shown to have the potential to support team-autonomy and by providing a priority agenda, as well as stimulate a forum for the generation and implementation of creative ideas (Simons, 1990). If appropriately designed, performance measurement can help managers´ mental representations of the business, provide goal and process clarity, as well as encourage extensive scanning behavior (Gimbert et al 2010). Performance information has also shown to affect intrinsic motivation and empowerment through creating meaning and supporting an increased understanding on how a particular action fits within the broader scope of the organization (Hall, 2008). Despite its potential to facilitate management, measurement is considered a challenging area in practice and measuring innovation is particularly challenging as innovation is complex, multidimensional, and unpredictable (Murray and Blackman 2006; McCarthy et al 2006),creating specific requirements on what and how to measure.

ISBN 978-90-77360-15-6

Innovations can be argued to vary along a continuum from incremental to radical where incremental characterizes innovations within a certain paradigm, while radical is associated with innovations that drastically changes existing practices (Dewar and Dutton 1986). The differences in management practices required to support radical and incremental innovation respectively are caused by the need to pursue both exploitation and exploration activities (March, 1991) which require substantially different structures, processes, strategies, capabilities and cultures in the company and which have different impacts on firm adaption and performance (McDermott and O'Connor 2002; He and Wong 2004). These managerial differences provide a particular challenge for companies that see a need to simultaneously manage radical and incremental innovation not the least when allocating and combining resources to support each. Research literature is extensive in describing implications on management when building these different or dual capabilities (Bessant 2011; O´Connor and DeMartino 2006; Gupta et al 2006; Tushman and O'Reilly 1996). The difficulties when managing both radical and incremental innovation can be described as a consequence from the need to manage a number of dichotomies or dualities resulting from the inherent essentially different characteristics of radical and incremental innovation. Dichotomies or dualities refer to polar opposites that often work against one another in an organization i.e. the choice to focus on one of the poles creates a tension and a difficulty to enact both ends of the continuum simultaneously (Poole and Van de Ven 2004).

Considering the close relationship between management and measurement, these dichotomies will provide a challenge for measurement as well. The same research focus would thus be expected to apply also on innovation performance measurement as it needs to be adapted and developed to match management challenges and needs. However, literature is remarkably scarce in discussing implications for measurement. Based on this observation a question in need of investigation is consequently: What are the implications of an explicit ambition to combine radical and incremental innovation for the design of innovation performance measurement?

The aim of this paper is to contribute to the advancement of the innovation measurement theory by assuming the importance of understanding the dichotomies present when simultaneously manage radical and incremental innovation when identifying issues concerning the design and use of innovation performance measurement in practice. Incremental versus radical innovation is in this respect an overarching dichotomy, and though not covering the full area of innovation management literature or the complete picture of innovation, this work explore four dichotomies which are argued to be critical in the design of innovation performance measurement. The dichotomies relate to uncertainty, time, flexibility and control, and are analyzed and discussed in relation to innovation measurement literature.

A description of challenges related to measuring innovation facing three international high technology companies with the ambition to realize both radical and incremental innovation are also included as empirical illustrations. The result is input to an analytical framework that in subsequent studies will provide basis for the design and implementation of innovation performance measurement in practice.

2. METHOD

The study aims to provide a theoretical basis for factors to consider when designing and using an innovation performance measurement system that supports companies with an explicit ambition to combine radical and incremental innovation.

A literature review was an important foundation of this paper, focusing on two main areas: Innovation Performance Measurement and Innovation Management. The measurement area was searched in order to understand state-of-art, in particular for support of innovation management in an industrial setting, and to identify issues specifically concerning how 'measurement of innovation' *support* 'management of innovation'. The search of the second area was directed by the aim to understand management of both radical and incremental innovation and specifically by the understanding that there are many dichotomies underlying the radical versus incremental dichotomy. Thus, the search strategy, including a range of electronic sources and databases, used a broad set of search criteria, continuously converging to dichotomies identified. As the core of the study concerned relation between measurement and management of innovation no full screening of the management literature was made and the ambition was to find critical dichotomies and not "all". Literature search was done repeatedly in the team and identified and selected dichotomies were analyzed by at least two authors.

Knowledge of three of the authors, being employed in international high technology companies has accompanied the literature study, and specifically directed the selection of dichotomies to be of critical importance to the management of innovation. In addition, empirical data reflecting the practical side of the focused areas has been collected from these companies. The analysis of this data is used to illustrate challenges when innovation performance is measured in practice. Data collection has been made through observations, interviews in former studies and through access to formal documentation within the companies.

3. PERFORMANCE MEASUREMENT AND INNOVATION

Several conceptual frameworks for performance measurement based in operations management emphasize the necessity to measure more than financial performance, such as innovation and learning (Neely 2005). The Balanced Score Card is among the most common and well-researched models (Kaplan and Norton 1992) which has inspired similar approaches also within R&D and innovation management (Kerssens-van Drongelen and Bilderbeek 1999; Adams 2007). Other models relate to an innovation process or model (Cordero 1990; Brown and Svensson 1998) or represent auditing approaches (Chiesa 1996; Hallgren 2009). Innovation measurement literature stress the importance to measure a wide number of factors and phenomena including areas like innovation strategy; ideas and ideation; customer and market; organizational learning and knowledge management tools; and organizational culture and leadership (Adams et al 2006; Crossan and Apaydin 2010). Despite the extensive amount of research, measuring and assessing innovation performance to fruitfully manage innovation remains a problematic area in companies (Adams et al 2006; Kianto 2008) which becomes an even greater challenge when considering the need to accomplish both incremental and radical innovation.

Problems in practice are related to understanding what to measure, i.e. to identify the right measures in order to evaluate, not only the result of innovation activities, but also the efficiency of processes in getting new ideas commercialized and to assess the returns on investments (Smith 2005; Adams et al 2006; Christensen et al. 2008). Further complicating these problems are the fact that many companies lack an insight in the right combination of intangible and tangible resources that will enable a strategic development of innovation capabilities leading to competitive advantage.

Measures that support evaluation and selection of innovation projects of different type and nature, and its subsequent resource allocation and process management, constitutes another challenge in practice. For the majority of companies, the models and tools in use to manage their projects and project portfolios are based on traditional financial tools like return of investment and net present value which are less suitable since data on innovation output and outcome are difficult to characterize and predict and become visible, if at all, first at distant in time (Christensen et al. 2008). This is especially true for innovations of radical nature which leads to companies becoming biased to ideas and projects more familiar to existing products and processes i.e. incremental innovation.

Other problems present in practice are related to understanding how to get access to and collect the data and information needed to enable learning and decision making in order to optimally manage innovation. This is due to the fact that important aspects or critical factors of innovation such as knowledge, ideas etc. cannot be measured directly due to its intangible character and because the processes of measuring innovation related activities and intangible assets would require significant changes in internal practices and methods (Edvinsson et al. 2004; Smith 2005). As a result, it has been found that companies seldom track information needed to evaluate and assess innovation in a systematic way and that even those that do have very different methods and perspectives which makes it hard to compare and benchmark innovation performance between companies and organizations (Bourne and Neely 2003; Adams et al. 2006; Tidd 2001).

A consistent finding in research is the importance to link performance measurement with the strategy of the company in order to provide business value (Kaplan and Norton, 1992; Neely 2005; Micheli et al. 2010). Introduction of new performance measures and indicators can if appropriate managed act as a catalyst for implementation of new strategic objectives and enable change management initiatives. Further, performance measurement literature shows the importance of understanding appropriate measurement practices since it is the combination of what to measure with how it is measured that will provide the benefits (Bourne and Neely 2003). It has been found that the different roles of measurement and each measure need careful consideration, especially when a company is involved in processes of substantial transformation as a lack of clarity regarding its intended use will create considerable problems which may eventually become contra-productive (Melnyk et al 2010). Also, the design will depend on the environment in which the organization operates, its links with key stakeholders, and the implications the measurement system may have in maintaining the current, or shaping the future, organizational culture (Chiesa et al. 2009; Micheli et al. 2010; Henri 2006).

Other critical factors to consider are the procedure for identifying and implementing measures. Bourne and Neely (2003) categorized the procedures in three groups; audit driven, considered a bottom up approach; need driven, considered a top down approach where the Balanced score card provides a typical example and model driven where a pre-defined process or model provides the basis to identify measures. Depending on the purpose or preference different companies make use of different approaches.

4. MANAGING INNOVATION DICHOTOMIES

4.1 *UNCERTAINTY*

Uncertainty is not only associated with risk, or the possibility of several outcomes for a situation (Loch et al. 2008), but also to complexity and unfamiliarity in relation to a subject or situation (Bordia et al. 2004). In addition, uncertainty implies a lack of information (McLain. 2009). In development of new products and services the processes strive to reduce uncertainty for maximal performance; however, uncertainty, diversity, or turbulence within an organization are sources of creativity and long-run viability for an organization (Van de Ven 1986). In one way, uncertainty creates a positive tension in which creativity can flourish, but on the other hand it may also be the cause of anxiety and reduce productivity, especially when related to roles and structural changes (Bordia et al. 2004).

Managing both incremental and radical innovation project implies the balancing of certainty, to reduce risk, and uncertainty to foster creativity although for radical the level of uncertainty due to the inherent novelty characteristics will be accentuated. Uncertainty can be related to technical, market and project scope risks (Davila 2000), and to risks related to resource scarcity or lack of knowledge (De Maio et al 1994) and each of these aspects is associated to different strategies and management practices. Considering radical innovation being associated to all types of risks and not the least to a high level environmental and market uncertainty in contrast to incremental innovation it provides a particular challenge for management.

For incremental innovation the level of uncertainty will differ with the development process; it will peak in the initiation stages and become close to zero at the commercialization stage. Radical innovation will not follow the same path, since there is no pre-defined process or dominant design (Abernathy and Utterback 1975). Instead these innovations emerge over time and cannot be predicted in advance and the level of uncertainty remain high even beyond a radical innovation is commercialized since the adoption can take time (O'Connor and DeMartino 2006).

Companies that strive to generate radical innovation need to learn how to expand their search field and how to interpret weak signals in order to identify potential new business opportunities and threats (Teece et al. 1997). For incremental innovation, the direction and objectives are set from start why the search for solutions is preferably performed within known areas (Bessant 2008). The strategic fit is thus not an issue when managing incremental innovation in opposite to radical innovation which may challenge not only the strategies but even the existing business model of a company.

4.2 TIME

One dichotomy that stands out as critical to manage and that will have a large influence also on measurement is how to manage the different time perspectives present when aiming to manage both radical and incremental innovation. Radical innovation typically requires a persistence to invest for more than a decade before it becomes profitable (Gilbert et al 1984; Quinn, 1985) in contrast to innovations of more incremental character. Long-term adaptability thus require risk-taking and seeking cutting-edge innovation to achieve the company's long-term viability and sustaining their competitive advantage. This may generate new businesses and foster long-term financial success. On the other hand, a company needs to generate incremental innovation to be able to survive and ensure financial profitability in the short-term. The literature is in agreement that both perspectives are needed and that the implication is that two different strategies are needed (Andriopoulos and Lewis 2010; Martinich 2004). A mix of products in the product portfolio is needed which strongly influence how decision

making needs to be made in the management of ideas and project portfolio (Corso and Pellegrino 2007). Companies with an explicit strategy to manage both radical and incremental innovation are thus facing an important dichotomy; how to make appropriate allocation of resources to support each type of innovation.

Yet another time perspective in need of proper management is the irregularity of how radical innovation project are developed; the radical innovation process is characterized by an "irregular and unpredictable rhythm" if compared to the more path dependent and ordered incremental development process (Bessant et al 2011). This put demand on the type of measures and not the least on how fast and adaptable the measurement system can be built. Finally, since many traditional manufacturing companies, have identified the development of product related services as one important approach in identifying more radical solutions, the difference in time perspectives between product development and services needs also to be considered. Products are first produced, and then used, whereas services are produced, and used, at the same time (Morelli 2002) which implies challenges when managing and measuring integrated product-service innovations and not only traditional products.

4.3 FLEXIBILITY

Both the difference of level of uncertainty and the different time horizon and rhythm characterizing radical and incremental innovation representatively put demand on the companies to also identify appropriate organizational designs, processes, structure and strategies to support each type (Tushman and O'Reilly 1996; O'Connor and DeMartino 2006). Research is rich in descriptions on how the majority of radical ideas in large established companies have a hard time to reach the market phase (Dougherty and Hardy 1996; Leonard-Barton 1995). Nurturing ideas that takes long time before they (if ever) give financial return, are out of scope for core product areas, does not fit existing operations and that may challenge the current business models require an allowance of a high level of flexibility in a companies' processes and structures.

The sequential models or stage gate models underlying many company's product innovation processes have potential advantages as they can be instruments for developing systematic and easy-to-learn best product innovation practices (Cooper, 1993) and has shown to benefit the development of incremental innovation. However, as sequential models rely heavily on planning and are means of controls through standardization, the creativity and learning required in the development of more radical innovations are at risk. The mechanistic approach brings a focus on process efficiency and does to a large extent ignore how process factors such as flexibility, informality, feedback, and autonomy might influence innovation (Nonaka 1994; Dougherty and Hardy 1996). More flexible, integrative and improvisational models that takes into consideration the more complex and dynamic events present in practice are thus needed. The management practices developed to support the management of radical innovations are based on a fast failure and learn approach to gain insights into what combination of intangible and tangible resources will lead to competitive advantage (McDermott and OConnor 2002).

This flexibility and informality is also emphasized when it comes to the organizational structures i.e. the relations between individuals and teams, internally as well as externally that need to be created in order to create the knowledge needed to support radical innovation. The encouragement of "weak ties" (Granovetter 1973); heterogeneous and informal relations have been found to stimulate more novel and creative solutions and provides thus an opportunity

for radical innovation (McDermott and O'Connor 2002). This stands in large contrast to traditional product development literature which emphasizes the enhancement of existing relations with customers and suppliers through the use of formal cross-functional teams.

4.4 CONTROL

To enable opportunities for both incremental and radical innovation, an appropriate balance in flexibility and stability is thus needed to support both radical and incremental innovation. This needs to be reflected in the use of the lever of controls in the company and the traditional hierarchical mechanisms are seen replaced with alternative models. Opportunities for radical innovation typically emerge from employee engagement and initiatives; skunk works (Peters 1997), intrapreneurs (Menzel et al, 2007; Burgelman 1983) or bottom-up (Birkinshaw et al 2011; Smeds and Haho, 2003) where incremental innovation is a result of more traditional control and planning exercises.

Day (1994) found that companies can, with a principal champion/intrapreneur from the lower levels of the organization, achieve radically innovative results. But these lower level champions need sufficient knowledge and access to information to make the critical decisions, as well as sufficient power and influence to obtain resources necessary. For companies that require substantial resources during development, principal champions from top management are important for to achieve radically innovative results. In other words, successful radical innovation needs both freedom and control; bottom-up initiatives need the support from top management to survive (O'Connor and DeMartino 2006).

Results from a large amount of research studies as well as from international large scale management consulting surveys consistently show that creating an innovation culture is a key success factor for companies when managing their innovation effort, not the least for radical innovation (Booz&Co, 2011; Tellis et al. 2009). Radical innovation, characterized by a high level of uncertainty and risks which may require more than a decade before (if ever!) generating profits is in need of a high degree of creativity and persistence to survive as earlier described why incremental innovations are more dependent on improving and deepen existing competences, skills and relations (Amabile et al. 1996). These dual set of values and norms need to be reflected in the reward and recognition system in place in a company as these systems have shown to have a significant impact on a company's culture.

The difference between radical and incremental innovation in relation to the key dimension of each dichotomy is found in Table 1.

DIMENSION IN DICHOTOMIES	**RADICAL**	**INCREMENTAL**

Uncertainty Technical Market Project scope Strategy Resources	High risk and high uncertainty Market uncertainty will remain high beyond a radical innovation is commercialized New business opportunities and early warning through weak signals of emerging trends May or may not fit existing strategies and may challenge current business models.	Low risk and low uncertainty Market uncertainty will be low during the whole innovation process and very low during commercialization Systematic search within familiar areas Always aligned to strategies and current business models
Time Long and short (Length) Discontinuous and continuous (Rhythm) Rapid and slow (Pace)	May require more than a decade of investment before financial returns are seen Characterized by evolving in a disordered, sporadic and dynamic manner	Typically short and predictable lead times Characterized by a ordered and less dynamic innovation process
Flexibility (vs stability) Process Structure Strategy	More flexible, integrative and improvisational models to manage emergence, based on simple rules Explore and develop parallel and heterogeneous less established 'weak ties' inside and outside the organization Probe, fast failure and learn rather	Operates with a set of routines and structures/procedures Exploit and enhance strong ties - work closely with existing customers and suppliers, in formal cross-functional teams Makes use of advanced project and risk management approaches linked

	than manage risk Strategy evolves through experimentation for market learning and creation	to predefined strategies and processes - stage gate monitoring Strategy, directions and goals are set at the beginning
Control (vs freedom) Roles Leadership	Need bottom up initiatives using informal relations and highly motivated, persistent champions in initial stages Need strong top management support and commitment for implementation in the later stages Feedback, reward and recognition system in place need to support risk taking and persistence	Need formal cross-functional teams from start Reward and recognition system in place need to support short goal achievement

Table 1. Identifying differences between radical and incremental innovation in relation to dichotomies in innovation management.

5. EMPIRICAL FINDINGS

To support the understanding on implications for the design of innovation measurement in the presence of the described dichotomies, companies with an explicit strategy to manage both radical and incremental innovation are used as an empirical illustration.

5.1 VOLVO AERO CORPORATION

Volvo Aero is a company in the aerospace industry developing components to aircraft engines and space rockets. The aerospace industry is a highly regulated industry, primarily with respect to safety and airworthiness criteria. Product development is largely contract-driven, which means that binding contracts are normally signed before development work starts and risk minimization is thus given higher priority than finding innovative new solutions during product development. Incremental innovation projects in partnership with the engine OEM (Original Equipment Manufacturer i.e. General Electric, Rolls-Royce or Pratt & Whitney) thus traditionally have dominated the product project portfolio along with a few more radical technology development projects.

Reduction of technical risks is an absolute requirement for a new product in the aerospace industry. However the risk taking is also related to the business model as the company recently is changing from being a provider of new technologies and products but to also provide advanced service solutions. The company is thus in need to understand how it can manage the different kinds of uncertainties resulting from the different type of project it aim to manage. Implementation of innovation performance measurement is by managers in the company believed to put more focus on innovation and inspire team members to strive for innovative results. However the current measurement system needs to be developed and be more comprehensive, include different factors that affect the innovation capability. But there is also a need for simple metrics so that the measurement can be performed often to show improvements.

5.2 ST JUDE MEDICAL

St Jude Medical is a Swedish site in an international medical technology company with 14000 employees' worldwide. Innovation is today required beyond the implementation of new technologies due to the need to manage complex relations between different medical conditions, technologies and actors in the health care supply chain in order to develop new product and product service systems. The directed change work aiming to develop innovation capabilities in the company is focused on improving the early phases of product development i.e. the front end of innovation along with the stimulation of idea generation in all departments. To support the coordination and enable learning from the experiences achieved in the experimentation of new ways to work, an innovation steering board was created along with the implementation of innovation measurement.

New measures were implemented with the purpose to signal the importance of also identify and develop radical innovation and to support the planned change work in order to understand what works and what seemed less feasible. The identification of new measures were performed by involving the teams in the organization and implemented along with the traditional R&D measures in use. This resulted in the selection of a broad range of measures adapted to the need for each group with some common for all. A number of challenges were identified related to a disagreement in what was required to be changed within different part in the company; going from proposing status quo to the need to provoke new mental models, behaviors and ways of working. Further, the strong link between innovation performance measurement and the existing recognition and reward system in place was revealed and found to be important to change if the measures also would act as a motivator and change tool.

5.3 ERICSSON

Ericsson is a leading company in telecommunication systems and has a long history of technology and business innovation in communications. Having an appropriate balance in exploitation and exploration activities is a clear and shared goal within the company which is also reflected in the Ericsson R&D organization referred to in this study. The organization is producing network management products adopted by various fixed and mobile telecommunication operators. Since these products are placed in a niche market there is a need to further strengthen the ability to innovate in parallel to continuously improve efficiency, speed and quality. The need to improve the decision process for selecting the right set of innovation projects to run in parallel is considered most important and particularly challenging due to the need to utilize internal resources efficient and since critical resources for innovation are few.

A new advanced forward-looking innovation performance management framework is under construction to support the innovation management. The goal is to provide management with leading indicators that can give the organization the agility to sense and respond to potential business opportunities and threats and to evaluate how radical and incremental innovation projects participate in the realization of current business strategies and goals. The information from the measurement system will be used to facilitate the decision making on a continuous and timely basis in order to identify the appropriate balancing and combination of resources to support both radical and incremental innovation. Such use requires the measurement system in terms of its ability to capture different types of internal and external information and to develop an understanding of the cause and effect relationships between the business goals and each innovation type.

6. ANALYSIS

From the literature and the empirical illustrations it is clear that the presence of dichotomies resulting from the management of radical and incremental innovation will have implications to the design and use of the performance measurement system in practice. Research literature is consistent in pointing to the importance of a performance measurement system to be aligned to the strategies of a company in order to provide a business value (Kaplan and Norton 1982; Micheli et al. 2010). For a company that has selected a dual strategy this will have an impact on the design and use of the measurement system since the dichotomies inherent in this strategy will create conflicting demands on what to measure. This will in turn require different types of data and information to be collected and analyzed simultaneously which provide an additional challenge to the problems already are facing companies that attempt to measure innovation (Smith 2005, Adams et al. 2006).

To identify what implication these dichotomies will have on the design and use of innovation measurement, the key dimension of each dichotomy was analyzed in relation to the measurement literature and the empirical illustrations.

All three case companies, from three various industries are all dealing with both incremental and radical innovation development. They all see the innovation performance measurement as an important tool to support and inspire innovation management in line with their business strategies and have initiated a development of such measurement systems although differing in level of ambition and procedures used.

Since measuring performance requires an understanding of both whether “the right thing” is created (i.e. effectiveness) and if “it is done rightly” (i.e. efficiency) (Bourne and Neely 2003; Lebas 1995) innovation as output and outcome vs. innovation as a process emerged as useful categories in the analysis process along with an analysis on implications on measurement based on dichotomies related to critical pre-conditions for innovation.

6.1 Innovation effectiveness – measuring innovation as output and outcome

The level of uncertainty can be argued to be the key difference between radical and incremental innovation; the former representing the highest level be it technical, market or project scope, resources or all uncertainty categories simultaneously. Performance measurement has a long tradition in industry, especially to measure innovation as an output

(number of patents, ideas generated etc.) and has proven to support management when it comes to control for goal fulfillment and learn if the operations of the company are in alignment to top management directions and objectives (Neely 2005). However, designing a valuable measurement system becomes a larger challenge when a company needs to explore into new knowledge fields requiring new ways to organize and work.

Radical innovations inherently will always contain high levels of market and environmental uncertainty why the number of market related measures need to be increased in contrast to incremental innovation. As a response to the high level of uncertainty, experimentation will dominate the development of radical innovations, and the generation of both physical and virtual prototypes and probes to learn about market and technology risks can thus act as a replacement to traditional measures, as shown in the study by Davila (2000). Managers need to allow for a broad range of effectiveness indicators of very different character in their data collection and analysis process i.e. from simple robust quantitative measures in use for known and familiar phenomenon to complex data in order to analyze weak signals and rapidly sporadic events and physical prototypes.

Since the level of uncertainty for a radical innovation will remain high even beyond its commercialization in contrast to incremental innovation, measures related to this stage need to be carefully considered and companies have been found to replace profitability with market growth for their radical innovation as a way to "protect" their radical innovation output from being withdrawn from the market place too early (O'Connor and DeMartino 2006).

Selecting the right ideas and projects that will bring most business value always provides a true challenge the more radical and novel these ideas and projects are to the company (Christensen et al. 2008). This challenge will be further accentuated when the company has the ambition to simultaneously manage a portfolio of both radical and incremental projects. The difference in character between these ideas and projects makes it hard to compare them why building skills in project portfolio management is a requirement in order to understand how to manage such mix of projects. However, existing portfolio tools and methods have been developed to support incremental innovation rather than radical which is reflected in how companies have a tendency to become biased towards incremental innovation due to high levels of uncertainties and risks and the long time before radical innovation bring a financial return (Christensen et al. 2008). Alternative ways to value essential different ideas are thus needed to balance the portfolio of projects (Corso and Pellegrini 2007).

Another common measure in use in companies that inevitably will favor incremental innovation is the criteria that ideas and projects need to be aligned to strategies and existing business models to be considered worth financing. Since radical innovation may or may not fit existing strategies and business models, this requires careful attention when designing the measurement system.

6.2 *Innovation Efficiency – measuring innovation as a process*

The significant differences in level of uncertainty and the different time perspectives inherently to radical and incremental innovation respectively leads to the need to adapt processes, structures and ways of working to support both types of innovations (McDermott and O'Connor 2002; Bessant 2008). The pressure on companies to provide short time profit will lead to an overly focus on process improvement rather than building complementary or new essential different processes and structures which favors the management of incremental

innovation (O'Connor and DeMartino 2006). This is reflected also in the design of the measurement systems which still are dominated by traditional financial and project management measures and indicators to monitor goal fulfillment, strategy alignment and process efficiency (Bourne and Neely 2003; Christensen et al. 2008). These measures have been developed for a long time and are familiar in how they should be interpreted and communicated in opposite for the kind of measures that would benefit radical innovation management. Since the process of radical innovation has an experimental character and is not fully understood the measurement system needs to be designed in order to inform about what actions and combination of resources that would be successful for the company. A broad range of measures need to be put in place to support the experimentation of new ways of working. This requires the identification of complementary measures and indicators as well as data collection and analysis processes to facilitate the more open-ended and improvisational radical innovation process. At the same time it needs to act as a tool for control in order to monitor and diagnose existing ways of working through the use of the traditional metrics to support the improvement and incremental innovation.

One additional feature for innovation efficiency that differs significantly between radical and incremental innovation and which will also have implications on the design of the measurement is that the former require the building of new relations inside and outside the company, preferably of informal and heterogonous character, whereas the latter need to deepen and improve existing relationships (McDermott and O´Connor 2002). Implications to the measurement system are a need to identify measure that can bring information about relations. Also, since measurement systems in general and R&D systems in particular tend to pay more attention to internal process measures at the expense of external (Brown and Swenson 1998) the management of both radical and incremental innovation requires a balance in the external/internal focus to support both.

A highly flexible and `generous´ measurement system, with different types of measures and indicators, allowing for a rapid exchange of one set of measures and yet provide the stability required to monitor an incremental development is thus needed. Since changing one element in the company's innovation system inevitably leads to a need to change others i.e. all elements are interlinked this needs to be taken in consideration when designing and using the measurement system i.e. changing one measure need taking all the others in consideration.

6.3 Measuring Pre-Conditions for Innovation

Research studies as well as international large –scale management consulting surveys show that creating an innovation culture is a key success factor for companies when managing their innovation effort (Tellis et al. 2009; Booz & Co 2011). In parallel performance measurement research has pointed to the importance for measurement to be aligned to the culture of a company culture in order to become a source for innovation and learning (Henri 2006; Chiesa et al. 2009).

Since radical and incremental to a large extent are nurtured by conflicting culture or climate factors which needs to be reflected in the reward and recognition system in a company this will have implications on the design of the measurement system accordingly; measures and indicators to support both set of values and norms need to be implemented. However, if the purpose behind the new measures, even though they are selected to support important aspects of radical innovation is not well-communicated and followed by the adaption of other systems

like the reward system in the organization, the study by Melnyk et al. (2010) shows how these can become contra-productive.

Radical innovation requires strong bottom-up commitment and involvement in the initiation and strong structured, top management support close to commercialization (O´Connor and DeMartino, 2006) whereas for incremental innovation the direction and objectives are set from start (Bessant 2005). This challenges the procedure for measure identification (Bourne and Neely 2003) where a switch between audit and need-driven procedures need to be used to facilitate different stages in the development of radical innovation in opposite to incremental innovation.

The implications on the design and use of innovation performance measurement emerging from the analysis are summarized in Table 2.

DIMENSION IN DICHOTOMIES	**ISSUE IN MEASUREMENT**
Uncertainty Technical Market Project scope Resource Strategic alignment	Radical innovation: • requires a higher number of market and external environmental measures than incremental • need to be measured on sales growth rather than profitability in the commercialization stage in contrast to incremental innovation • requires high amount of data from different sources compared to incremental • need to not be measured using strategic, operational and business model fit as a requirement why the opposite is needed for incremental Prototypes or probes may replace traditional project management measures in the development of radical innovation
Time Long and short (Length) Discontinuous and continuous (Rhythm) Rapid and slow (Pace)	Valuation and selection of idea and projects require different measures: ex. ROI, net present value (for incremental) vs. Opportunity cost (for radical) Radical need to be supported by measures that trace rapid and unexpected events and incremental measures that traces alignment to a predefined path.
Flexibility (vs. stability) Process Structure	Incremental innovation benefit from using the same measures for a long period of time More measures for external communication and for measuring relations needed for radical innovation Radical innovation: • requires a broad number of quantitative and qualitative

	measures that can easily be exchanged • requires measures to support strategy development i.e. what works and what does not why measures that control the alignment to goals and strategies are sufficient for incremental innovation.
Control (vs. freedom) Roles Leadership	Measure identification and implementation for radical innovation require both audit (bottom up) and need driven procedures (top down) why incremental innovation is supported by a need driven procedure alone. Measurements need to be aligned to and support both radical and incremental recognition and reward systems

Table 2. The implications on innovation performance measurement in relation to dichotomies in innovation management

7. CONCLUSION

The study clearly shows how dichotomies present in the companies with an explicit ambition to manage both radical and incremental innovation are generating a number of challenges when designing and using innovation performance measurement. The analysis of what implications the different innovation-related dichotomies put on the design and use of an innovation performance measurement system is found to be rather informative as they bring a fresh perspective on why measuring innovation remains a problematic area in today's companies. The dichotomies discussed in this paper are not claimed to be exhaustive, however we argue they focus on key elements that needs to be taken in consideration when designing a truly supportive innovation performance measurement.

This work presented in this paper is a first step in a research project that aims to develop a deeper understanding on how measurement can become a useful support in companies with an explicit ambition to manage both radical and incremental innovation. It provides the theoretical basis for further investigations and development in practice and theory.

8. ACKNOWLEDGEMENTS

The authors would like to acknowledge the case companies, St Jude Medical, Volvo Aero Corporation and Ericsson, Volvo Construction Equipment, and the Product Innovation Engineering program (a Swedish research and development program for increased innovation capability in organizations financed by Vinnova, www.piep.se). All organizations have made this collaborative work possible through openness and funding.

REFERENCES

Andriopoulos, C. and Lewis, M.W. (2010) "Managing Innovation Paradoxes: Ambidexterity Lessons from Leading Product Design Companies", *Long Range Planning*,Vol. 43, pp 104-122.

Abernathy, WJ, and Utterback, J.M., (1975), ”Patterns of Industrial Innovation”, *Technology Review*, Vol. 80, pp. 41-47

Adams, R., J. Bessant, et al. (2006). "Innovation management measurement: A review." *International Journal of Management Reviews*, Vol 8, No.1 , pp. 21-47.

Amabile, T. M., R. Conti, et al. (1996). "Assessing the work environment for creativity." *Academy of Management Journal* , Vol. 39, No. 5, pp.1154-1184

Birkinshaw, J., Bouquet, C. and Barsoux, J-L. (2011). ‘The 5 Myths of Innovation’, *MIT Sloan Management Review*, Vol. 52, No. 2, pp. 43-50.

Bessant, J., B. V. Stamm, et al. (2011). "Selection strategies for discontinuous innovation." *International Journal of Technology Management* , Vol. 55. No. 1, pp. 156-170.

Bessant, J. (2008). "Dealing with discontinuous innovation: the European experience." *International. Journal of Technology Management*, Vol. 42, No. 1, pp.14

Bessant, J., R. Lamming, et al. (2005). "Managing innovation beyond the steady state." *Technovation, Vol*. 25, No. 12, pp. 1366-1376

Bordia, P., Hobman, E., Jones, E., Gallois, C., & Callan, V. J. (2004). ‘Uncertainty during organizational change: Types, consequences, and management strategies’, *Journal of Business and Psychology*, Vol. 18, No. 4, pp. 507–532.

Bourne, M. Neely, A.,(2003),“Implementing performance measurement systems; a literature review, *Int. J. Business Performance Management*, Vol. 5, No. 1

Brown, M. G. and R. A. Svenson (1998). "Measuring R & D productivity." *Research-Technology Management*, Vol 41, No. 6, pp. 30-35.

Burgelman, R. A. (1983). "A Process Model of Internal Corporate Venturing in the Diversified Major Firm." *Administrative Science Quarterly*, Vol. 28, No. 2, pp. 223-244.

Chiesa, V., P. Coughlan, et al. (1996). "Development of a technical innovation audit." *Journal of Product Innovation Management*, Vol.13, No. 2.,pp.105-136.

Chiesa, V., F. Frattini, et al. (2009). "Performance measurement in R&D: exploring the interplay between measurement objectives, dimensions of performance and contextual factors." *R & D Management*, Vol. 39, No. 5, pp.488-518.

Christensen, C. M., S. P. Kaufman, et al. (2008). "Innovation Killers." *Harvard Business Review*, Vol, 86, No.1, pp. 98-105.

Cooper, R. G. and E. J. Kleinschmidt (1986). "An investigation into the new product process - steps, deficiencies, and impact." *Journal of Product Innovation Management*, Vol.3, No.2, pp. 71-85.

Cordero, R. (1990). ‘The measurement of innovation performance in the firm: An overview’, *Research Policy*, Vol. 19, No. 2, pp. 185-192.

Corso, M. & Pellegrini, L. (2007). ’Continuous and discontinuous innovation: Overcoming the innovator dilemma’, *Creativity and Innovation Management*, Vol. 16, No. 4, pp. 333-347.

Crossan, M. M. and M. Apaydin (2010). "A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature." *Journal of Management Studies*, Vol. 47, No. 6, pp. 1154-1191.

Day, D. (1994). 'Raising Radicals: Different Processes for Championing Innovative Corporate Ventures', *Organization Science*, Vol. 5, No. 2, pp. 148-172.

Davila, T. (2000). "An empirical study on the drivers of management control systems' design in new product development." *Accounting, Organizations and Society*, Vol. 25, No. 4-5, pp. 383-409.

De Maio, A., Verganti, R. & Corso, M. (1994). 'A Multi-Project Management Framework for New Product Development', *European Journal of Operational Research,* Vol. 78, No. 2, pp. 178-191.

Dewar, R.D. and J.E. Dutton (1986) "The Adoption of Radical and Incremental Innovations: An Empirical Analysis," *Management Science,* Vol. 32, No. 11, pp. 1422-1433.

Dougherty, D. and C. Hardy (1996). "Sustained product innovation in large, mature organizations: overcoming innovation-to-organization problems." *Academy of Management Journal* , Vol. 39, No. 5,pp. 1120-1153.

Edvinsson, L., R. Dvir, et al. (2004). "Innovations: the new unit of analysis in the knowledge era: The quest and context for innovation efficiency and management of IC." *Journal of Intellectual Capital*, Vol. 5, No.1, pp.40-58.

Gimbert, X., J. Bisbe, et al. (2010). "The Role of Performance Measurement Systems in Strategy Formulation Processes." *Long Range Planning***,** Vol. 43, No.4, pp.477-497.

Granovetter, M.S. (1973) The Strength of Weak Ties. *American Journal of Sociology*, Vol. 78, pp. 1360–80.

Gupta, A, Smith K, Shalley, C (2006), "The interplay between exploration and Exploitation", *Academy of Management Journal*, Vol. 49, No. 4, pp. 693–706.

Hallgren, E. W. (2009). "How to Use an Innovation Audit as a Learning Tool: A Case Study of Enhancing High-Involvement Innovation." *Creativity and Innovation Management,* Vol.18, No.1, pp. 48-58.

He, Z-L and Wong, P-K. (2004). " Exploration vs. Exploitation: An empirical Test of the Ambidexterity hypothesis", *Organization Science,* Vol. 15, No. 4, pp- 481-494

Henri, J. (2006). "Organizational culture and performance measurement systems." *Accounting, Organizations and Society*, Vol. 31, No.1, pp. 77-103.

Hall, M. (2008), 'The effect of comprehensive performance measurement systems on role clarity, psychological empowerment and managerial performance', *Accounting, Organizations and Society* 33, 141-163

Jaruzelski, B., Loehr, J., & Holman, R. (2011). The Global Innovation 1000 – Why Culture Is Key, Booz & Company, [online] Available at: < http://www.booz.com/media/uploads/BoozCo-Global-Innovation-1000-2011-Culture-Key.pdf> [Accessed 15 June 2012].

Kaplan, R. S. and D. P. Norton (1992). "The balanced scorecard - measures that drive performance." *Harvard Business Review***,** Vol. 70, No.1. pp. 71-79.

Kianto, A. (2008). "Development and validation of a survey instrument for measuring organisational renewal capability." *International Journal of Technology Management***,** Vol.42, No.1-2,pp 69-88.

Kerssens-van Drongelen, I. C. and J. Bilderbeek (1999). "R&D performance measurement: More than choosing a set of metrics." *R&D Management,* Vol. 29, No. 1. pp 35.

Leonard-Barton, D. (1992). "Core capabilities and core rigidities: A paradox in managing new product development." *Strategic Management Journal*, Vol.13. No.1, pp. 111-125.

Lebas, M. J. (1995). "Performance measurement and performance management." *International Journal of Production Economics*, Vol. 41, No. 1-3,pp.23-35.

Loch, C., Solt, M. & Bailey, E. (2008). 'Diagnosing Unforeseeable Uncertainty in a New Venture', *The Journal of Product Innovation Management*, Vol. 25, No. 1, pp. 28-46.

March, J. (1991) Exploration and Exploitation in Organizational Learning. *Organization Science*, Vol. 2, pp. 71–87.

Martinich, L. (2004) "An innovation framework: The foundation for two complementary approaches to innovation management", IEEE/UT Engineering Management Conference, pp. 32-37.

McCarthy, I. P., C. Tsinopoulos, et al. (2006). "New Product Development as a Complex Adaptive System of Decisions." *Journal of Product Innovation Management*, Vol.23, No.19.

McDermott, C. M., & O'Connor, G. C. (2002). 'Managing radical innovation: an overview of emergent strategy issues', *Journal of Product Innovation Management*, vol.6, Number 19, 424–438.

McLain, D (2009). 'Quantifying Project Characteristics Related to Uncertainty', *Project Management Journal*, Vol. 40, No. 4, pp. 60-73.

Melnyk, S. A., J. D. Hanson, et al. (2010). "Hitting the Target…but Missing the Point: Resolving the Paradox of Strategic Transition." *Long Range Planning*, Vol. 43. No. 4. pp 555-574.

Menzel, H., Aaltio, I., & Uljijn, J. (2007). 'On the way to creativity: Engineers as intrapreneurs in organizations', *Technovation*, Vol. 27, No. 12, pp. 732-743.

Micheli, P. and J.-F. Manzoni (2010). "Strategic Performance Measurement: Benefits, Limitations and Paradoxes." *Long Range Planning*, Vol. 43, No.4.pp. 465-476.

Morelli, N. (2002) 'Product-service systems, a perspective shift for designers: A case study: the design of telecentre', *Design Studies*, Vol. 24, No.1, pp. 73-99.

Murray, P. and D. Blackman (2006). "Managing innovation through social architecture, learning, and competencies: a new conceptual approach." *Knowledge and Process Management*, Vol. 13.No.3, pp. 132-143.

Neely, A. (2005). "The evolution of performance measurement research - Developments in the last decade and a research agenda for the next." *International Journal of Operations & Production Management*, Vol.25, No.12.pp. 1264-1277.

Nonaka, I. (1994). "A Dynamic Theory of Organizational Knowledge Creation." *Organization Science*, Vol. 5. No. 1. pp14-37.

O'Connor, G. C. and R. DeMartino (2006). "Organizing for Radical Innovation: An Exploratory Study of the Structural Aspects of RI Management Systems in Large Established Firms." *Journal of Product Innovation Management*, Vol. 23, No. 22

Peters, T. (1997). A skunkworks tale. In: R. Katz, ed. 1997. *The Human Side of Managing Technological Innovation*. New York: Oxford University Press.

Poole M. S. and Van de Ven A.H. (2004) *Handbook of Organizational Change and Innovation*, New York: Oxford University Press,

Quinn, J. (1985). 'Managing Innovation: Controlled Chaos: Big companies stay innovative by behaving like small entrepreneurial ventures', *Harward Business Review*, Vol. May-June, pp. 73–84

Simons, R. (1990). "The role of management control systems in creating competitive advantage: New perspectives." *Accounting, Organizations and Society*, Vol. 15, No. 1-2, pp. 127-143.

Smeds, R. & Haho, P. (2003). 'Bottom-up or top-down? Evolutionary change management in NPD processes', *International Journal of Technology Management*, Vol. 26, No. 8, pp. 887-902.

Smith, KM, (2005), Measuring Innovation, The Oxford Handbook of Innovation, Oxford University Press, New York, US, pp. 148-177

Teece, D.J., Pisano, G. and Shuen, A. (1997) Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, Vol. 18, pp. 509–33.

Tellis, G. J., Prabhu, J.C., & Chandy, R.K. (2009). 'Radical Innovation Across Nations: The Preeminence of Corporate Culture: Radical innovation across nations Corporate Culture', *Journal of Marketing*, Vol. 73, No. 1, pp. 3-23.

Tidd, J. (2001). "Innovation management in context: environment, organization and performance." *International Journal of Management Reviews*, Vol. 3. No. 3

Tushman, M.L. and O'Reilly, C.A. (1996) Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change. *California Management Review*, Vol. 38, pp.8–30.

Van de Ven, A. (1986). 'Central Problems in the Management of Innovation', *Management Science*, Vol. 32, No. 5, pp. 590-607.

Paper B

BECOMING AN INNOVATIVE COMPANY: ASSESSING AN ORGANIZATION'S INNOVATION CAPABILITY FROM THE PERSPECTIVE OF A TEAM

Andre Benaim[1,2], Andreas Larsson[2], Tobias C. Larsson[1] and Jenny Elfsberg[3]

[1]Blekinge Institute of Technology, Sweden

[2]Lund University, Sweden

[3]Volvo Construction Equipment, Sweden

andre.benaim@bth.se

ABSTRACT

Literature points out the need for companies to innovate continuously. Such need requires that companies develop capacities to exploit and improve current work as well as to develop and explore more radical opportunities. This paper is a case study that investigates the innovation capabilities of a multinational manufacturing company by interviewing a group that is mandate to support the development of those capabilities. The data was collected by semi-structured interviews, which were based on the categories of a framework previously developed. The findings speak about the importance of setting clear processes for continuation and implementation of ideas, adequate allocation of resources and management support. The discussion and conclusion are about the importance of the integration of efforts in different organizational levels and some of the future challenges integrating the innovation efforts into a natural way of working.

Keywords*: Innovation capability, continuous innovation, case-study.*

1. INTRODUCTION

The literature on innovation points out the need to develop the capacity to innovate continuously. Börjesson and Elmquist (2011) affirm that innovation capability is a capacity to develop and seize opportunities, i.e. a company is prepared to innovate whenever possible. Continuous innovation implies placing as much attention to the day-to-day work, maintaining production and incremental improvements, as to the development and exploration of more radical opportunities (Bessant et all 2005; Boer et al 2006; Boer and Gertsen 2003; Magnusson and Martini 2008). Boer and Gertsen (2003) note the need to simultaneously coordinate between operational excellence and strategic flexibility, what others refer to as the need to simultaneously exploit and explore (Soosay and Hyland 2008, March 1991, Kim and Mauborgne 2004).

One of the challenges to develop innovation capabilities is being able to "develop alternative routines for discontinuous innovations which can sit alongside those for steady state 'do better' innovation" (Bessant et all 2005). Traditionally, researchers argue that such development happens by the creation of separate companies, projects or teams. However, other researchers suggest integrating both of these aspects within the company capabilities (Lawson and Samson 2001; O'Connor and DeMartino 2006; Bessant et al 2005).

Börjesson and Elmquist (2011) point out that there is little in-depth research about how innovation capabilities are developed in practice. Hence, one of the aims of this paper is to contribute to the research about the development of innovation capabilities in practice. For this reason the paper is based on a case study that explores the current status of the innovation capability within a multinational manufacturing company. The assessment is based on interviews with a group whose mandate is to create context to support the development of innovation capabilities. We want to know: How employees perceive innovation capabilities within their work environment?

2. BACKGROUND

Innovation capabilities are seen by the lenses of the first stage of the MINT Framework and its categories for assessing company's innovation capability (Nilsson et al 2010; Regnell et all 2009). This assessment is not a judgement of whether the company is innovative or not; rather it the perspective of an "innovation team" about the categories that compose innovation capabilities. At this stage the MINT framework considers 6 categories (Fig.1) that are further subdivided:

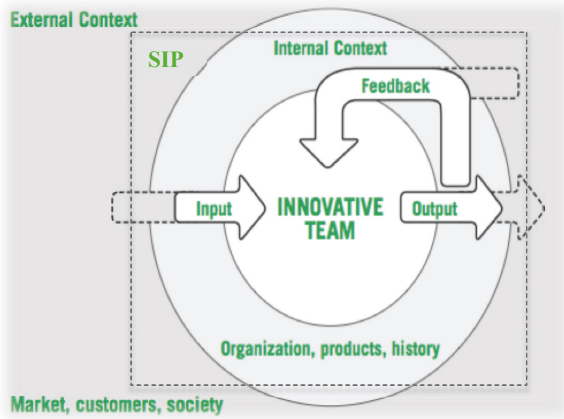


Figure 1 MINT categories adapted from Nilsson et al 2010

1. Strategic Innovation Processes (processes, climate strategy and incentives);
2. Input (resources and innovation task);
3. Output (deliverables, results and effects)
4. Feedback (goal attainment, external and measurement and evaluation);
5. Internal Context (organization surroundings);
6. External Context (user, receiver and stakeholder).

Each category is explained below.

2.1 STRATEGIC INNOVATION PROCESSES (PROCESSES, CLIMATE STRATEGY AND INCENTIVES)

Innovative companies have a process for dealing with ideas (Nanda and Singh 2009). There are a number of suggestions about how to define the different phases that compose innovation processes (Gericke & Blessing 2012), however, need finding, idea generation, idea selection, prototyping and implementation seems to be a generic structure that can be unfolded in more detailed phases or simplified. Moreover, Teece (2014 pp.16) points out that innovative companies are able to adjust their processes to promote learning, coordination and reconfiguration of companies resources; hence, they are able to adapt to changing environments, but are also able to shape them.

Innovation climate often comes closer to innovation culture. Some culture can be defined as the underlying values and assumptions in a group or organization (Isaksen & Lauer 2002). Meanwhile climate is the manifested behavior of the culture. In this sense,

culture can be subjective if considered at the individual level or objective if considered at the collective perception of the categories that compose culture. The literature suggests a number of categories that compose climate. Ekvall's (1996) model suggests that components of the innovation climate are: challenge, freedom, idea support, dynamism/liveliness, trust/openness, idea time, playfulness/ humor, conflicts, debates, risk taking. Lawson and Samson (2010) also suggest empowered employees, tolerance of ambiguity, and communication as characteristics of a innovative culture and climate.

Incentives are also a common category from a general innovation process (Metz et al 2007; Lawson & Samson 2001). Adequate rewards for innovation are essential to build up innovation in teams (Folkestad & Gonzales 2010), hence the rewards are related to the characteristics necessary for innovation such as risk taking or idea generation (Nanda & Singh 2009).

2.2 INPUT (RESOURCES AND INNOVATION TASK)

The literature suggests that adequate resources, as well as resources that are additional to the minimum required for operation (slack), need to be available. Both, adequate resources and slack, relates to time for ideas and learning, financial resources, equipment, human capital and knowledge (Teece 2014, Metz et al 2007).

An additional input is a clear vision and purpose at the organization and team level, as well as the alignment between the two is considered to support innovation capacities (West & Sacramento 2011; Katzenbach & Smith 2005).

2.3 OUTPUT (DELIVERABLES AND EFFECTS)

There are a number of possible outcomes from an innovation process, from the simple incremental to radical improvement to products, services and processes (Crossan & Apaydin 2010). Sawhney et al (2006) suggest that organizations have 12 different areas to innovate such as customer experience, products, brand, platform etc. A team can have deliverables that relate to more than one of those areas. Therefore understanding the deliverables is also mentioned as a relevant capacity from the team level perspective. Katzenbach & Smith (2005) suggest different types of teams according to their deliverables, such as "teams that recommend things", and "teams that run things".

The vision, purpose and tasks need to be translated into goals, which in turn help teams to identify actions and outcomes that are relevant for innovation to happen (Katzenbach & Smith 2005). Agreement on goal, as well and motivating and challenging goals are a characteristic of creative teams (Isaksen & Lauer 2002)

Output also speaks about concrete outcomes not only in terms of offering, but also in terms of learning and changes within roles. If one is to become innovative, roles are also likely to be impacted by experimentation and adapt to new ways of working (Börjesson and Elmquist 2011). One example of such changes is the article from Alexy and Wallin (2013) studying the impact of the adoption of open innovation process in different roles.

2.4 FEEDBACK (GOAL ATTAINMENT, EXTERNAL AND MEASUREMENT AND EVALUATION)

Often the metrics used within companies are not useful for innovation. There is a strong focus on financial indicators, and a lack of an overall framework that also allows measuring processes and organizational properties such as flexibility and openness

(Adam et al 2006). In addition, beyond measuring performance, measurement can be used as a tool to promote and support behavior, in opposition to an accounting perspective (Simons 1990). In relation to innovation, it is considered a challenging area because innovation is complex, multidimensional, and unpredictable, which creates specific requirements on what and how to measure (Nilsson et al 2012; Murray & Blackman 2006). Schreyögg and Kliesch (2007) suggest companies need to develop a "capability of monitoring" in order to assess the validity of innovation capabilities in relation to new activities (Börjesson & Elmquist 2011).

Setting up goals is also an essential piece for feedback and measuring systems. Katzenbach & Smith (2005) argue that setting goals and translating them into action helps the team to be accountable, and also it helps to self organize discussing ways to understand purpose and tasks, choose adequate means and follow up progress.

In addition, feedback can be seen in the context of idea generation as idea evaluation. Idea evaluation can hinder creativity; however there are studies that see a positive relationship between feedback in the form of idea evaluation and innovation performance (Nanda and Singh 2009).

2.5 INTERNAL CONTEXT (ORGANIZATIONAL SURROUNDINGS)

This category is close to the strategic innovation processes (SIP) described above. But while the SIP focus on the activities and context that influences the team work, the internal context focuses on the handover and transference of knowledge or outcomes from the innovation team towards possible receivers within the organization. In this sense, innovation climate, abortive capacity and idea management mechanism are "concepts" that are closely related to internal context.

One aspect of the context is that it can "place" demands and expectations for innovation to happen, which impact those who are supposed to work innovatively. These demands are "external" to innovation teams, and they can originate from within the organization, i.e., originate from the internal context as consequence of management style or the innovation climate, as well as from the external context, such as market demands and changes. For the ideation aspect high demands can inhibit creativity but support the implementation of the innovation within the organization (West 2002).

2.6 EXTERNAL CONTEXT (USER, RECEIVER AND STAKEHOLDER)

Engaging openly with external sources is also a common suggestion for building innovation capabilities and innovative teams (West et al 2004). Folkestad and Gonzales (2010) reiterate the importance of a team looking beyond the organizational barriers, and have a outward focus. Such outward focus implicates on searching for needs as well as perspective and technologies also outside the organization or team. Moreover, such external contact is related to input in activities such as need finding as well as feedback and learning are related to the output and outcomes of processes services or product development and implementation.

3. METHODS

The paper is based on a design approach (Blessing & Chackrabarti 2009) not to explore how successful innovative companies have developed their innovative capabilities, but rather to explore the status of capabilities in a real context. In this sense this is a

descriptive study of the current reality of the innovation capabilities of an organization that aims to become more innovative. The immediate contribution of the paper is to define specific challenges that companies have when integrating innovation into their daily work. Despite being difficult to generalize the findings, given we are studying only one company, nonetheless, they refer to real challenges. Such results can be used to understand challenges companies might face when trying to refine their innovation processes, as well as, the results can be used as input for comparative case–study.

The data was collected by interviewing 9 employees, who are related to a group that is responsible for supporting the development environment in which innovation capabilities can flourish. The interviews were semi-structured and based on a questionnaire structured in accordance to the categories mentioned in session 2: strategic innovation systems, input, output, feedback, internal and external context.

The interviews were recorded and transcribed. After the transcription the data was analysed in a spread sheet (fig.2). First, each interview was colour coded, and statements were separated in different lines. The colour code and statements were placed in the first and second columns of the spread sheet. In the next column, each quote was tagged in the above-mentioned 6 areas. In the last two columns statements were synthesized and classified as being perceived positive or negatively.

The last step was to classify the synthesized statements according to topics in order to visualize any underlying themes across the different categories. Finally, these themes were settled within the original categories of the mint framework.

	A	B	C	D	E	F
1	Numbers	Text	Mint Categories	Parallel Mint Categories	"+ and -" **Andre**'s Synthesis	"+ and -" **Andre**'s Synthesis
43	113	R:We have technology area plan. I thin you can call innovation plan. It s a long term vision which we believe we could evolve to. I think you can call innovation plan, but can you plan innovation. because if you plan what products one is going to have in 20 year that is based on what we know today. hat is a kind of try to look in the future and try to think how to develop technology wise	FB3: Measurement and Evaluation		"+" innovation plan	"-" innovation cant be used to evaluate long term innovation
44	151	:we measure in no way how good the solution is except for qualitiy and failure when we test the product on the field, but I have seen anything that the new solution should be completely new to the market, never seem before because that is a too high risk.	FB3: Measurement and Evaluation		"+" product is tested for quality and failure on the field	"-" no other way than quality and failure is used to measure a quality of innovation

Figure 2 sample of analysis spread sheet

4. FINDINGS

The findings below represent the perception of the interviewee's about the innovation capabilities categories in which the interview were based. They are organized according the general heading of the capabilities. The emergent themes were: general perception, innovation management and risk management, types of innovation, innovation processes, incentives and acknowledgement, resources, time, goals and assignments, ownership, customer connection, documentation, continuity, implementation and feedback, cross-boundary collaboration, measurements. Because some of the themes are present across the categories they are not presented in a consolidated way, but are integrated into the different categories as needed.

4.1 STRATEGIC INNOVATION PROCESSES

The interviewees perceive a clear intention of supporting innovation and wish from top management to improve innovation capabilities. However there are cultural/climate and management issues that are perceived as a barrier. For example, there are many costs associated with innovation. Such costs are perceived as reasonable and often related to quality control, however they reduce the number of viable test and prototypes. The interviewees also point out that the current risk assessment criteria are not conducive for managers to choose innovation. If innovations are going to be evaluated in terms of short-term cost, and comparing the future innovation with current products, it is less likely that innovation is going to be chosen. Developing a business case and ROI for radical and undeveloped ideas was pointed as a challenge.

General perception – The top management intention and support with budgets for exploration projects is perceived positively in relation to the over climate, in some departments respect for ideas that are more radical was mentioned as a negative aspect. Partly the perceived lack of "respect" might originate from the feeling that the culture in general does not support innovativeness. Dealing better with failure was also a point mentioned.

Innovation management – Middle manager is often seen as a barrier for innovation, although interviewees also understand they are under budgetary and time pressure. Their support is essential to get improvements into the products. Different factors promote this situation, the main factors we can deduce from this research are: the manager style, cost associated with innovation, risk management and the pressure to get the work done. According to the interviewees, the drive for reliability and quality can increase the product value, however if not well balanced it can become a misleading criteria for innovation.

Types of innovation – Most of interviewees seem to consider an innovation when an idea has reached the market. It seems that these ideas should have been developed in house. There seem to be a tendency to think of innovation as radical/disruptive, and as technology related. Although data doesn't directly confirm that, most of the examples were connected to technology. Furthermore, considering that the problem solving from daily work requires creativity and innovation, one can assume that when they affirm "we don't work with innovation" means that there is no major breakthrough.

Processes – Overall, the focus on patent and its related processes is clear for the majority of interviewees, although it is said to be bureaucratic, time consuming and does not drive innovation. In addition, there are structures for dealing with ideas beyond the strategic projects decided by "high level managers". One of them is a platform for ideation and dialogue (Benaim et al forthcoming), another are grants for exploration of ideas. Some interviewees claim that there are no forums for ideas, while others perceive the process as just throwing ideas. Furthermore, the request for continuation and implementation of generated ideas (see 4.4 and 4.6) suggests that these processes need to be refined and are still to take roots, and attention to the innovation process is needed.

One factor related to processes is the roles employees play within it. Innovation is perceived to be carried out by some departments more than others. One possible factor for such perception can be due to the perception of innovation as being more related to radical/disruptive technological innovations rather than leaning outcomes, or innovation

in other areas rather than technology. Hence, advanced engineering projects are perceived as focus of the innovation efforts. Moreover, a complementary explanation is that innovation is not yet fully integrated into the daily work, therefore, the perception they can only innovate in specific departments and projects.

Incentives – In relation to incentives, salary and monetary is recognized as an incentive, but it does not seem to be a central piece of the puzzle. In general the engineers are self-motivated by the challenge of finding solutions, "beating" competition, and how the clients are satisfied. Just communicating about things might be enough to get them boosted with energy. There seem to be a craving for feedback as well as acknowledgements. People want to feel that what they are doing is considered relevant. That links directly not only to feedback, but also follow through and implementation of the ideas. They also point out that despite there is a technology award, such incentive is too big and smaller incentives are needed.

4.2 INPUT

In relation to resources time is one of the biggest challenges, with very little time for concept development and no slack. The main barrier is that the daily work runs over innovation. Despite that the nature of the "design" work is creative/innovative in itself, there is a feeling that one is just getting things done. The lack of time to think through ideas and concepts creates a feeling that innovation is not well integrated with daily work, it feels like something extra, something that requires more resources. In addition, the risk management culture, testing costs and the pressure on managers to keep on budget and on time seems to add to this perception of lack of resources and lack of time.

In addition, interviewees stated that are few or no resources to work with innovation. The interesting thing is that there are formal resources for advanced engineering and emergent technologies projects. Furthermore, there is a bottom-up process to get ideas evaluated granting money and time. In addition, there seems to be partnerships with academia going on, but some how those don't seem to add the feeling of resources being deployed on the innovation front. One possible explanation/factor is that such feeling is derived from the perception that innovation is not a priority and lack of time in daily routine run over innovation, as well as from the lack of clarity and learning curve of process that is just starting to get in place. Hence, due to daily project pressures, such a process is not appealing.

In relation to goals and assignments, the employees recognize the request and intention from top management to move forward as an innovative company. Many however say that there are no clear goals and therefore their specific assignment related to innovation is not clear. Lack of focus creates a lack of direction for activities, except in R&D projects. One example is the communication about roles and expectations within the company's innovation platform (Benaim et al forthcoming).

This might seem contradictory, but less pre-defined innovation was also an emergent category that relates to input and goals. The finding here is that although focus is important, the perception that real innovation climate does not predict the outcome from the beginning. So there is a balancing between requirements and solutions description. In some instances features such as engines require constant update not only in terms of performance, but also due to policy enforcements. For instance, coping with policy can be a limiting factor for innovation, as it requires a constant narrow focus. Imagine that

the forthcoming policy will reduce the acceptable levels of CO2 emission; a narrow view can be reducing CO2 emission by improving filter or engine efficiency in order to keep up with policy. However, a broader view of the problem could foster the development of electric engines. Except from advanced engineering projects, engineers feel limited following ways to cope with legislation rather than exploring real design possibilities. Furthermore, requirements and plans also seem to limit innovation. The first, by giving too specific constraints, which can also be interpreted in ways that not always reflect the desired outcome; the second, by the difficulty of predicting what will be novelty before the exploration. In addition, spending resources in catching up with competitors' technology, although it might be necessary on the one hand, on the other limits innovation.

In relation to ownership**,** this category speaks to the perception of those who are "allowed" to innovate and what characteristics are needed to be innovative within the actual context, in a way it relates to the mandate and innovation task individuals and departments have. From the eyes of employees of other departments, while it is good that there are departments and projects working with finding and developing ideas, this seems to give these departments and projects some ownership over the innovative process and take away empowerment from the individuals. Such perception seems to be reinforced by practices like micromanagement, risk management, lack of time and manager support.

From the individual itself, as an interviewee mentioned, "it is a struggle to innovate". It seems that the innovator has to be very determinate and persistent to overcome all the barriers (management support, risk management, time, budget). It happens, but it requires effort on top of the work hours, such as networking and keeping updated with the field.

Finally, a few times the relevance of customer connection was emphasized as well as the point that good innovations have come out of the direct partnership between client/user and designers.

4.3 OUTPUT

Documentation was also mentioned as common practice that carries barriers for innovation. The finding here is that the more bureaucratic work around an idea the harder it is to actually develop it; regardless if the innovation in focus is a daily innovation asked by requirements or whether it is a radical idea. Another perception around documentation is that it ends up not being used.

The speed of the innovation cycles came up often, either to ask for implementation of the ideas, or to say that ideas take time to develop and that need to be taken into account. Some interviewee's pointed that the comparison with the software industry may not be adequate because of the different implications of building a product from prototyping, training costs as well as the length which maintenance and spare parts need to be available. The question that remains is an adequate cycle time if innovation is truly incorporated into the company culture? And, can we make the current cycles more effective?

Continuity and Implementation are major problems for harvesting the creativity and sustaining employees drive. Engineers are eager to see ideas becoming products,

however they don't feel like ideas are given continuity or implemented. Continuity speaks to the further exploration and incorporation of the ideas into the company's portfolio and products. In a way it is related to functional processes for idea development, adequate feedback, and hand over within the company's internal context. Such relation are explored in the items below.

4.4 FEEDBACK

Interviewees pointes out that the amount of sales, documents from marketing reporting customer feedback and the few innovations that are developed in direct contact with the client (by the design engineer) often provide a good feedback. However, there is a wish to have an increased feedback from the marketing department, customers, managers and the advanced engineering department in general. The lack of feedback kills motivation and discourages innovation because there is no reference to whether the work or the idea was good, or even interesting from a strategic point of view. In this sense, feedback is also requested in the form of continuity and implementation. If the idea within the development process is dis-continued, employees want to understand why, and what are criteria for such decision, and what can they learn from it. If the idea is handed over or implemented into product this is also a required feedback. Regardless whether the answer is positive or negative knowing the outcome of one's effort is a kind of "feedback" that fuels motivation.

There are a few measurements in place such as patent count, but most of them are not adequate to measure the innovation process, nor the value of an innovation especially during its early stages. Patents do not how the innovation efforts. In this sense this can be understood that such measurements do not tell how well one (person team department) works, nor how innovative the offerings become.

The difficulty of evaluating an innovation was mentioned. Despite the solution about what to measure not being available, it is clear that business case and risk assessment are not good measures for evaluating radical ideas or ideas in early phase of conceptualization.

Some interviewees also pointed out that some departments have plans that can be used to assess achievements, however participants also pointed out the difficulty of predicting innovation, especially radical ones.

4.5 INTERNAL CONTEXT

Communication of innovative initiatives, collaboration between departments and functions is an issue to be focused on. Employees could benefit from a systemic view to contact similar or complementary initiatives, as well as work with different departments. If an innovative idea has an impact on a different group, it seems difficult get their time and interest to work on or provide feedback about the idea. Part of this difficulty id because each group/departments have their own priorities (and low resources): In addition, the syndrome of "not developed here" seems to be part of the company's culture. There is a perceived need for cross function teams, as well as a way to transfer technologies.

As a positive point Innovation Processes have been developed, however they are not fully functional. This is not surprising given that process and structures are still in development and in an experimental phase. Nonetheless, coaching possibilities and

intentions to use such a process get dispersed. It is evident the request for clarity about the submission of ideas, the criteria for evaluation, and the ownership exploration projects and handover is evident, which is on the radar of the "innovation executive manager". Consequences of lack of clarity of roles and process can make employees afraid that they will get more work if they suggest ideas. One example is the disconnection between the technology working groups and the ideation platform. The first is a group that takes care of ideas and decides on grants for exploration projects, the second is a place for ideation and dialogue. None of the initiatives had a clear process and roles by the time of interviews, nor were they integrated, which increases even more the effort needed to get innovation going.

4.6 EXTERNAL CONTEXT

A common answer for this element was going back to internal customers, and delivering their outputs to innovation platform, which is the department responsible for integrating the different components into the machine. Moreover, the interviewees would refer to the marketing department as having access to final user, and machine owner. The perspective is that the request and needs would arrive to them as design requirements.

5. DISCUSSION AND CONCLUSION

Overall, the one take away is that activities are running in parallel. Although we know the intention is to make innovation part of the daily work, the impressions and the current process feel like a separate activity. That is not surprising since the activities to promote continuous innovation capabilities are in its early stages; however, based on the findings we foresee the main challenges that are related to process for selecting and developing ideas, as well as allocating resources such as money, and employees' time without over loading them with more work. Another challenge is creating mechanisms for alleviating pressure on middle management allowing them to support ideas and teams. Hence, a few findings that seems to be crucial for the improvement of the innovation capabilities within this case study are: time, refined processes that imply on continuity implementation and feedback, as well as management support.

First, the time pressure in middle management and employees rushes the steps related to innovation processes. Time is of the essence for learning, innovation and flexibility. If workers are busy with their tasks they can't be innovative or deal with unforeseen demands (Lawson 2001) and opportunities. Alkpan et al 2010 found no correlation between free-time and innovative performance, however the main point is that time resource is not about open-ended time, on the contrary it is time for innovation, such as time for reflexivity (West et all 2004) or for concept development. Therefore, the open questions here are more likely to be: if individual and teams were given time, would they have the drive, and would they know how to use their time in order to create conditions that are conducive for innovations? In this sense time has two perspectives: one perspective allocating time as a management practice considering as input for teams; the second perspective is the proper use of time by individuals and within teams and projects.

Beyond time, management support is an area for further attention and improvements. Management support increases innovative performance (Alpkan et al 2010). In this particular case, despite the strategic intent of top management being clear, such intent

needs to be translated into managerial actions that support innovative ideas, i.e., the company needs to be able to prioritize innovation (Björkdahl & Börjesson 2012). Such support can be in terms of experimentation, exploration of ideas and risk taking. Baer and Oldham (2006) find that supporting creativity and individual openness to experience have a significant moderating role in relation to the capacity to be creative in time pressure constraints. In situation with no support performance tends to go down under time pressure; meanwhile in situations with support performances increases before it reaches a pike and goes down. Such relationship points out to the importance of adequate time, as well as the relevance of management support.

The final aspect is the need for a refined innovation process. Björkdahl & Börjesson (2012) point out that implementation and idea management are capabilities needed for innovation. Within the findings we can see a clear request for the improvement of such capabilities. There is a lot of intrinsic motivation and the open question is: how to design the adequate outlets so the motivation can be translated from insight and creativity towards implementation? In addition to process to get ideas moving, refined innovation processes also include adequate forms of task assessment, feedback and measurements structures that help to evaluate and learn from the innovation efforts in teams beyond the classical financial and outcomes measurements.

Finally, it is also clear that the work for developing innovation capabilities is double-sided, and it is of importance to think in different levels and in an integrated manner. It seems that if we are to move beyond skunk work and best guesses, into a form of organization that consciously uses its processes to continuously develop innovation, one is ought to think about the interface between the capabilities within the different levels: organizational, team and individual level. Individuals and teams need to learn how to use innovation processes in their daily work, as well as in parallel projects. At the same time the organizational support and clear pathways to promote idea development needs to be in place to support the team. Tackling individual and team issues without organizational support is like asking for a soccer team to play in a baseball field; Developing organizational structures without and integrating teams is like developing bridges without access ramps; it is possible to live with both situations but they make life a lot harder.

REFERENCES

Adams, R., Bessant, J., & Phelps, R., (2006) ”Innovation management measurement: A review”. International Journal of Management Reviews, Vol.8, No. 1, pp. 21–47.

Alexy, O., Henkel, J., & Wallin, M. W. (2013). From closed to open: Job role changes, individual predispositions, and the adoption of commercial open source software development. *Research Policy*, Vol.*42,* No.8, pp. 1325–1340.

Alpkan, L., Bulut, C., Gunday, G., Ulusoy, G., & Kilic, K. (2010). Organizational support for intrapreneurship and its interaction with human capital to enhance innovative performance. *Management Decision*, Vol.*48,* No.5, 732–755.

Anderson, N.R., and West. M.A. (1998), Measuring Climate for Work Group Innovation: Development and Validation of the Team Climate Inventory. Journal of Organizational Behavior Vol.19, no.3: pp. 235–258.

Baer, M., & Oldham, G. R. (2006). The Curvilinear Relation Between Experienced Creative Time Pressure and Creativity: Moderating Effects of Openness to Experience and Support for Creativity. *Journal of Applied Psychology*, Vol.*91* No.4, pp. 963–970.

Benaim, A., Larsson, A., Larsson, T.C. & Elfsberg, J. (Forthcoming) Nord-Design Conference 2014, Finland

Bessant, J., Lamming, R., Noke, H. and Phillips. W. (2005), Managing Innovation Beyond the Steady State. Technovation Vol.25, no. 12: pp.1366–1376.

Blessing, L.T.M., & Chackrabarti, A., (2009) DRM, a design research methodology: Springer

Boer, H., and Gertsen. F. (2003), From Continuous Improvement to Continuous Innovation: a (Retro)(Per) Spective. International Journal of Technology Management Vol.26, no. 8: pp.805–827.

Boer, H., Kuhn J. and Gertsen F. (2006), Continuous innovation. Managing dualities through co-ordination, CINet Working Paper WP2006-01.

Boer, H., Caffyn, S., Corso, M. and Coughlan. P., (2001), Knowledge and Continuous Innovation: the CIMA Methodology." International Journal of Operations & Product Management Vol.21, no.4: pp.490–502.

Björkdahl, J., & Börjesson, S. (2012). Assessing firm capabilities for innovation. *International Journal of Knowledge Management Studies* Vol.*5, No.* 1/2, pp.171–185.

Börjesson, S., and Elmquist, M. (2011), Developing Innovation Capabilities: a Longitudinal Study of a Project at Volvo Cars. Creativity and Innovation Management Vol. 20, No. 3: pp.171–184.

Crossan, M. M., & Apaydin, M. (2010), A multi‐dimensional framework of organizational innovation: A systematic review of the literature. Journal of Management Studies, vol.47, No.6, pp. 1154-1191.

Ekvall, G. (1996). Organizational climate for creativity and innovation. European Journal of Work and Organizational Psychology, Vol.5, No1, pp. 105–123.

Folkestad, J., & Gonzalez, R. (2010). Teamwork for Innovation: A Content Analysis of the Highly Read and Highly Cited Literature on Innovation. Advances in Developing Human Resources, Vol.12, No1, pp. 115–136.

Gericke, K., & Blessing, L. (2012). An analysis of design process models across disciplines. Marjanovic D., Storga M., Pavkovic N., Bojcetic N. (eds.), Proceedings of 12th International Design Conference–Design, Drubovnik, Croatia

Isaksen, S. G., & Lauer, K. J. (2002). The climate for creativity and change in teams. *Creativity and Innovation Management*, *11*(1), 74–86.

Katzenbach, J. R., & Smith, D. K. (2005). The discipline of teams. Harvard Business Review, July-August, pp.162–171.

Kim, W.C., and Mauborgne, R. (2004) Blue Ocean Strategy. Harvard Business Review, October: pp. 1-10

Lawson, B., and Samson. D (2001) "Developing Innovation Capability in Organisations: a Dynamic Capabilities Approach." International Journal of Innovation Management Vol.5, no.3: 377–400.

Lawson, M. B. (2001). In Praise of Slack: Time is of the Essence. *The Academy of Management Executive (1993-2005)*, Vol.15, No. 3. pp.125–135.

March, J. G. (1991) "Exploration and Exploitation in Organizational Learning." Organization Science Vol. 2, no. 1, pp. 71–87.

Metz, I., Milé, T. & Samson, D. (2007) Development of an Integrated Innovation Capability Model, in: Milé, T., (ed.), Building Innovation Capability in Organizations: An international Cross-case Perspective, Imperial college. Chapter 2 pp. 19-49

Murray, P. & Blackman, D., (2006), Managing innovation through social architecture, learning, and competencies: a new conceptual approach. Knowledge and Process Management Vol.13, No.3, pp. 132-143.

Nanda, T., & Singh, T. P. (2009). Determinants of creativity and innovation in the workplace: a comprehensive review. International Journal of Technology, Policy and Management, Vol.9 No.1, pp.84–106.

Nilsson, F., Regnell, B., Larsson, T., & Ritzén, S. (2010). Measuring for Innovation. Applied Innovation Management, No.2 pp.1–30.

Nilsson,S., Wallin, J., Benaim,A., Annosi M.C., Svensson R.B., (2012) Re-thinking innovation measurement to manage innovation-related dichotomies in practice", CINet Conference.

O'Connor, G. C., and DeMartino, R. (2006), Organizing for Radical Innovation: an Exploratory Study of the Structural Aspects of RI Management Systems in Large Established Firms. Journal of Product Innovation Management Vol.23, no. 6: pp.475–497.

Regnell, B., Höst, M., Nilsson, F., and Bengtsson H. (2009), A Measurement Framework for Team Level Assessment of Innovation Capability in Early Requirements Engineering. In Bomarius F., Oivo, M., Jaring, P., Abrahamsson P. (Eds.): Product-Focused Software Process Improvement, 10th International Conference, PROFES 2009, Oulu, Finland Vol. 32, pp.71–86.

Sawhney, M., Wolcott, R. C., & Arroniz, I. (2006). The 12 Different Ways for Companies to Innovate. Image, 47(3), 75–81.

Schreyögg, G., & Kliesch-Eberl., M., (2007) How Dynamic Can Organizational Capabilities Be? Towards a Dual-Process Model of Capability Dynamization. Strategic Management Journal Vol. 28, No. 9: pp. 913–933.

Simons, R., (1990), The role of management control systems in creating competitive advantage: New perspectives." Accounting, Organizations and Society Vol. 15, No. 1-2, pp. 127-143.

Soosay, C., and Hyland, P. (2008), Exploration and Exploitation: the Interplay Between Knowledge and Continuous Innovation. International Journal of Technology Management Vol.42, no. 1/2: pp. 20-35

Teece, D. J. (2014), A dynamic capabilities-based entrepreneurial theory of the multinational enterprise. Journal of International Business Studies, Vol. 45 No.1, pp. 8–37

West, M. A. (2002), Sparkling Fountains or Stagnant Ponds: An Integrative Model of Creativity and Innovation Implementation in Work Groups. Applied Psychology, Vol. 51 no.3, pp. 355–387.

West, M. A., Hirst, G., Richter, A., & Shipton, H. (2004), Twelve steps to heaven: Successfully managing change through developing innovative teams. European Journal of Work and Organizational Psychology, Vol. 13, No.2, pp. 269–299.

West, M. A., & Sacramento, C. A. (2011). Creativity and Innovation: The Role of Team and Organizational Climate. In Handbook of Organizational Creativity (pp. 359–386). Elsevier Inc.

authors

Andre Benaim (corresponding author) axb@bth.se

0046(0)708291882

Department of Mechanical Engineering, Blekinge Institute of technology, SE 371 79 Sweden

Tobias Larsson . tobias.larsson@bth.se

0046(0)455385525

Department of Mechanical Engineering, Blekinge Institute of technology, SE 371 79 Sweden

Andreas Larsson - andreas.larsson@design.lth.se,

0046(0)462228182

Department of Design Sciences, Lund University, Faculty of Engineering, P.O. Box 118, SE-221 00 Lund Sweden

Jenny Elfsberg - jenny.elfsberg@volvo.com

0046(0)735585635

Volvo Construction Equipment

Paper C

NordDesign 2014
August 27 – 29, 2014
Espoo, Finland / Melbourne, Australia

Building a pathway for innovation: Lessons learned from developing an online platform

Andre Benaim[1,2], Andreas Larsson[2], Tobias C. Larsson[1] and Jenny Elfsberg[3]

[1] *Department of Mechanical Engineering, Blekinge Institute of Technology*
andre.benaim@bth.se
[2] *Department of Design Science, Lund University*
[3] *Volvo Construction Equipment (VCE)*

Abstract
Companies are constantly being pressured to innovate in order to stay competitive in the short run and have new offerings in the long run. One way of boosting innovation is to develop idea support systems that go beyond the traditional methods and tools. Through a qualitative study, this paper explores the lessons learned from developing an online platform for idea generation, and discusses it in terms of innovation process, climate, and capabilities. The results show that the platform itself is not enough for innovation. The structure and work processes around the platform are as important, which implies the need to design processes and procedures that allow an idea to develop, providing, focus, idea feedback and role clarity.

Keywords: Innovation, front-end, capability, climate, measurement, online platform

1 Introduction

Innovation is central to gaining competitive advantage and keeping the company alive in the long run. The company's main capabilities need to be continuously refined; however, they might create core rigidities [1] that prevent innovation to happen. Companies are challenged to identify, develop and incorporate innovative ideas for the long-term, while still innovating within the current production processes and products in the short-term [2-6][15].

Developing a front-end idea generation platform can help to explore ideas for on-going projects, as well as create a key resource for the development of novel insights and ideas for future projects. A multi-national manufacturing company (VCE) created an online platform with an associated process to collect and develop ideas at the front-end of innovation. This paper describes the challenges and lessons learned from the development of the online platform, considering various parts of the idea lifecycle. In addition, the paper discusses the implications of the platform in relation to innovation capabilities, climate and metrics.

Innovation processes are commonly described as a set of stages or phases. The number and names of the phases vary, but idea generation, concept development, prototyping and implementation are usually a part [7][8]. Furthermore, elements like resources, such as time and management support as well as the need for psychological safety, motivation, rewards, and internal and external idea and knowledge sharing are mentioned [25][34-35][37].

Innovation capability can be seen as the capacity to successfully explore new ideas [10-11][6] and turn them into innovations on the market. It includes the capacity to learn, share, create and assimilate knowledge [6][9]. Continuous innovation and dynamic capability theory consider innovation capability to be related to learning [3-6]. The former focuses on the capacity of learning and knowledge sharing in order to make incremental and radical improvements, whereas the latter derives from competence and resource based theory [14]. Both theories also emphasize the influence of culture and climate. Innovation climate is understood as the patterns of behaviours and attitudes that are likely to facilitate innovation and is considered a cultural aspect of an organization. It has a subjective side - individual perceptions, as well as an objective side - collective perception. In this paper we reflect on the platform in relation to Ekvall's model [12-14].

Finally when it comes to measurement, the metrics used within companies are seldom useful for innovation. There is an overreliance on financial indicators, as well as a lack of an overall framework that allows measurement of processes and organizational properties such as flexibility and openness [16]. However, measurement can be used as a tool to promote and support behavior, as opposed to an accounting perspective [17]. In relation to innovation, it is considered a challenging area because innovation is complex, multidimensional, and unpredictable, which creates specific requirements on what and how to measure [18][21], Schreyögg and Kliesch [19] suggest companies need to develop a "capability of monitoring" in order to assess the validity of innovation capabilities in relation to new activities [6].

2 Methods

Four sets of data were gathered during the study. For the first two, the data was collected primarily through participatory observation [30] on meetings and workshops. The first set was collected during tool development meetings (two online workshops and one two-day workshop in person). A company representative responsible for the project, the platform designers and one representative of the research team were present. Platform versions as well as their strength and weaknesses were discussed. Follow-up interviews were conducted in order to clarify and confirm the precision of the information presented in the platform description. The second set was gathered by participating in two annual workshops and monthly meetings with the innovation support group. The group was created to support activities related to the development of the innovation climate within the company and members allocated 10% of their time to do related activities. The group consisted of engineers from different departments and sites around the globe. This set of data allowed for insights into questions, day-to-day use and impact in relation to the last two versions of the platform. The third set is based on interviews with the innovation support teams at the company which focused on assessing the innovation climate in general. Interviews were semi-structured and open-ended, and they were based on the categories of a previously developed framework [23][29]. They helped to get an insight in the general context and challenges in the company. Finally, the last set of data was based on five progress reports for top management from 2010-2012, which allowed a look back into past activities, related results and reflections, and to compare the described challenges with the documented ones.

3 Overview of the platform

One contextual aspect that gave origin to the platform was a new set-up within the organization. Originally, the organization was site-oriented; now function and products were spread around the globe, and so were the teams. For this reason, the platform was originally envisioned to be a place to exchange and build on each other's ideas and information, a social

network for the employees' activities, interests and ideas. In addition, another aim was to increase interaction in order to spark creativity that would possibly lead to innovative projects and further refine the innovation climate. Moreover, the purpose of the tool was to become the main way through which bottom-up innovation happens. This did not mean that informal and in-person teams were discouraged; on the contrary, they were welcome, but needed to be visible in the tool to enable global collaboration and avoid redundant activities. The idea was to create a lean and fast formal pathway and procedure to develop ideas to become innovations. It was already understood that passionate small teams could create promising solutions, proven over the years in "skunk works", and now was the time to promote such collaborative work in the approved innovation process in addition to the current portfolio.

3.1 Version 0.5

Version 0.5 was built to run one Innovation Jam in 2010 [20]. The topics for the Jam were selected by the executive management team and supported by experts in the company. The platform layout had an introduction to the topics, called injection, with a small description and additional documents for reference and inspiration. Everyone was invited to share ideas: an announcement was spread on the company intranet, aiming to bring everyone onboard. There were also two webcasts from executive management where the importance of innovation was emphasized, encouraging all employees to contribute. The Jam happened in a very specific time frame. After this period no input could be added; the discussion and ideas would proceed to be evaluated by an employee who is an expert in the topic. The expert would analyze, synthesize and suggest ideas for further evaluation and development. The first Jam resulted in 184 ideas, about ten were selected as "winning ideas". For all these ideas further exploration was initiated and funded, and at least some of the ideas were developed into functioning prototypes. The executive manager reports that when the support group was assigned to follow up the investigation projects, the success rate increases [33].

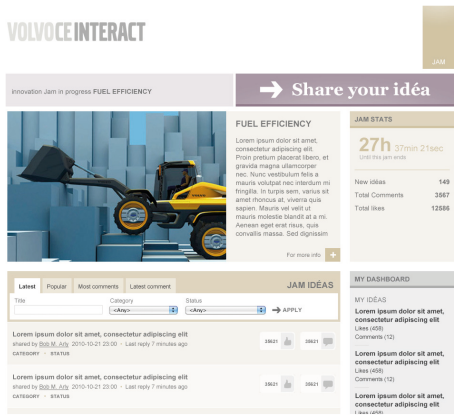


Figure 1: Version 0.5 Jam discussion

3.2 Version 1.0 2011

Encouraged by the results, the Jams continued and were further developed into an innovation area. During the jams it was understood that clear communication about the idea process was needed and a seed/sprout/flower description was created. Every posted idea in the innovation jams was a seed that could develop to a sprout or a flower according to its maturity. Only ideas related to the innovation jam topic were considered and evaluated. Specialists and executive management selected about ten ideas for further exploration.

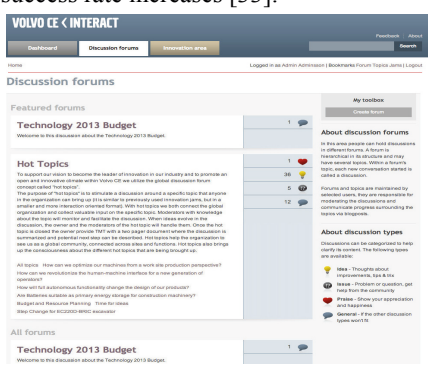


Figure.2: Version 1 topics in discussion area

The results of the two Jams performed in this period were encouraging. However, there was no clear owner/receiver to the output of the Jams (or topics). Hence, challenges within this version related to what happens with the ideas that are shared or posted, within both the

discussion and innovation forum. There were also questions about the criteria for the rating (seed/sprout/flower), and who is responsible to develop it. A process and design challenge was that the difference between sharing ideas and comments within the innovation and discussion area was not clear.

The third Jam had over 500 employees from 11 different sites, gathering 320 postings and 68 ideas. The typical ideator on the platform contributed with more than one idea. Over 50% of the visitors on the portal where new users and around 65% of the users provided new ideas, feedback and "likes". Nine projects were selected by the support group and further investigated. One member of the support group was assigned as investigation project owner, with the responsibility to assign an investigation project team and follow up on the progress. Two ideas were explored and developed, one into a functioning prototype and the other into a concept that is part of the future strategic plan [32].

A discussion area was added in parallel to the innovation area and the whole platform was named Interact. The purpose of the new area was not only to gather ideas for innovation, but also to enable a "virtual coffee room" to enable chats in the company's global community and to share company information and trigger discussion. Participants could post anything at anytime. Discussion forums could be created by anyone. Some discussions were initiated by the top management, e.g. about the budgeting process. Other forums reflected current strategic areas and technology development. To make Interact more technology-oriented a forum called 'Hot Topics' was created. Here, technology specialists could bring up their areas of expertise and get input from colleagues around the world. The person leading the discussion were selected as a moderator and would after the 'hot topic' time period ended create a summary document that was provided to the executive management team.

One challenge within this version was that the selected owner of the pre-established topics did not feel accountable for bringing the discussions forward and the contributors did not feel encouraged to continue to spend time on the platform/project. In addition, questions arose about what would happen with the ideas that were shared or posted. Furthermore, it was unclear to users what was expected to happen next and the difference between sharing ideas and comments within the innovation and discussion area was not solidly established.

3.3 Version 2.0 2013

During the exploration of possible user personas, encouraged by the sharing within topics that were promoted by employees, it was decided to experiment with an open-ended platform that had easy accessibility, rapid posting and no pre-established frame of topics. Every starting post was considered a potential idea that could become an innovation. The Jams were put aside and the page layout had no areas. The "topics" in the forums were to be more flexible and so the layout was organized using tags and the user decision to follow specific tags. Those tags would create a feed on a page and could be visualized as an independent topic. Both tag-creators and followers could get notifications in addition to the screen feed. The supporting group was assigned to keep an overall picture and support ideas to develop by indicating its level of maturity. Tagging an idea with the third stage meant that the idea would be ready to be evaluated by a parallel group who was working with assigning grants for "small" exploration projects. Challenges within this version relates to function of the tagging system in the platform; since participants would never use the same tag to discuss similar topics, identifying and following up on topics was hard and it was also difficult to distinguish new and old discussions. In addition, hand-over to the exploration groups and final ownership was not clearly assigned.

4 Findings

In this specific context the company was able to rely on internal motivation of the employees, once supportive conditions were good; however, the points described below add to creating the successful condition for the implementation of the platform and refinement of innovation capabilities and climate.

4.1 Focus and contribution period

An immediate take-away was that an attitude of "everyone contributes when they feel inspired" does not work; instead, a focused and structured method for input is needed. Focus and time delimitation was done within the Jams or in hot topics promoted by employees; both activities created a time frame with a rhythm for postings. The dialogue area, on the other hand, had a more general topic and less defined time period, and did not attracted much input. It therefore seems that delimited focus and contribution time impacted the liveliness of the platform positively. Focus is important to spark creativity and provide direction. The literature about team-work and open innovation considers focus a strong requirement for success [36]. Another format to concentrate work that might be explored is for employees to work in co-located or virtual teams and input the results of their activity into the platform for feedback or further development.

4.2 Idea feedback and continuity

The project representatives and support group expressed satisfaction with the jam activities and number of ideas developed within both versions. Dissatisfaction was more related to feedback and continuity. During the interviews one could sense the demotivation in their tone of voice when speaking about feedback and continuity related to the ideas generated. They said that even though the activity was good, feedback was not given to all contributors. "I don't know if my ideas were good or bad, if I should invest on them or if it is a dead end" [31][28]. This lack of response stalled the idea process and could even have negative impact on the innovative climate in the culture. If ideators don't know if their idea is appreciated, they might feel like they have wasted their time. In relation to the open-ended areas in version1.0 and 2.0, one user of the platform said that his frustration with the platform was that no one replied to his post. The platform owner reported to top management that the users need to know "that no idea will go to waste" [32][33].

Feedback is more likely to be received by a team on mid-term and final assessment hence it relates to concept development and selection phases. Continuation speaks to a flow in the process that achieves an outcome, even though this outcome might be rejection. In this sense, feedback and continuity was a challenge in both versions. The support team is aware of this challenge and argued that they need success stories. One of the reasons is that such stories would show employees that innovation could actually happen through this platform, i.e. there is continuity and implementation for the ideas. Such continuity would also work by giving the platform validity, as well as a showcase against peer scepticism. In addition, process and roles to provide feedback also need attention.

4.3 Underlying innovation process

A clear innovation process is the foundation of the platform. It is about what happens in the different phases of idea generation, development and implementation that will lead to innovations. The experience with the platform seems to indicate that clear processes are required in two ways. The first way is about defining which the tools and skills will be required by the different roles at different stages of using the platform; and a point that derives from this process perspective is "who is responsible for doing it" (see roles).

The second way in which clear process are required stems from the need for continuity and feedback. It is also related to the perception that creating innovation is difficult, and that only people with high stamina and drive manage to pull it through. When talking about the general innovation climate a support team member said that on some occasions it feels "like throwing ideas" [31], and that "you must be forceful to see ideas implemented into a project". Another member points out that, facing time pressures and bureaucratic challenges, the process for sharing ideas should be clear and accessible. "People should know where to go with the idea" [31]. From the moderator side the support team "needs to experience that the work is done after the ideas are selected" [33]. Therefore, it seems that having clear processes and roles facilitates both the work of the platform support group and potential users to understand what is required from them.

In the Jam, the stages were clear. Idea generation, evaluation and selection were around pre-defined topics. On the open-ended areas there was a request for generic contribution and a general promise of coaching through a development process that could lead to tangible outcomes. However, the criteria for transitioning between stages (seed sprout and flower) and owners were not sufficiently defined. The same clarity of criteria and process was missing in terms of continuity. During the last two versions there was the possibility to receive grants and time for exploration. However, the connection and procedures to do so was not well communicated and enough defined to be accepted by the line organization.

4.4 Clarity of roles: supporting and receiver and others

The roles aspect is intimately connected within the underlying innovation process, as different process aspects require a specific actor with an adequate skill set. More than one role can be attributed to a single actor; however, the expectations towards who plays which roles need to be agreed upon.

Within the Jam in version 0.5/1.0 the roles were clear. There was an event in which people would be called to participate, focused and probably on a topic of interest for their work, passion or both. Experts would have the role of analysing and selecting ideas. The challenge here was that experts were not available or interested; a turn-around was to try to engage with the idea owner to evaluate the discussion, but in both cases peers justified they had no time (or were not allocated time by line managers) and that they had other priorities. This example illustrates the need of clarifying key roles and have them anchored in the process for effective continuity and feedback.

Within version 1.0/2.0 the supportive team was required to "adopt" ideas, helping them to develop. This is one step that establishes a clear receiver. However, the supporting team expressed difficulty in coaching the ideas in relation to two aspects. One was related to posting they felt they had nothing to contribute with, and would pass by "not adopted". The other was about the hand-over ideas that reached maturity (see clear process). The supporting team also had questions related to their role. For example, they were aware that it was not good to leave a post unanswered, but "what do I do with a comment no one replied to, and I have nothing to say?" Or, "how can say that I disagree without shooting the idea down?" These kinds of questions indicate that they are trying to grow in their roles, and that they need support and clarity about the possible actions that they can take to facilitate dialogue within the platform. This kind of question suggests that they view support as "content related advice". Suggestions like helping the person find experts, information or other employee's interested were given; however, there were still barriers to its adoption. It also shows how

important it is for the supportive team to be acknowledged in the broader organization, in order for it to be possible for them to ask experts to support in the coaching work.

During the check-in meetings about Version 2.0, the support group reported they checked the platform regularly but that there was not much movement. They reported that people did not know about the tool and they suggest improving the communication channels about it. In terms of roles the underlying request was about who spread the word. The supporting group spread the word about the platform through informal channels, but there was no one assigned for such role. It seems that the support group expected someone else to "advertise" the platform as it happened in the Jams; meanwhile others in the management team expected the support groups to communicate on their sites.

Furthermore, scepticism about the possibility to innovate within the company and time-related issues might create a complex set of barriers for participation, as well as, for the engagement of the support group [32]. At this time, supportive processes like grants for idea exploration were being put into place but criteria, procedures and assigned roles connecting to the idea platform were loose. For this reasons, even though a more detailed investigation is needed, it seems that both clarity of process and roles was one of the main factors that contributed to the differences in the first and second version of the tool.

4.5 Time: overwork and priorities.
Interviewees also mentioned time-related challenges like back-to-back meetings and fully allocated hours with no slack; as well as working overtime. Considering that this is likely the perception of other employees, who have no time allocated for innovation, it is to be expected that without an incentive or a push they will not prioritize sharing their ideas on the platform.

During the interviews, the support group members pointed out that even though the wish to promote innovation is clear, innovation was not a priority within the company. Their 3 main focus tasks are current projects, maintenance and efficiency-related initiatives. Hence, one possible explanation for the non-use of the platform is simply that it is not a priority given time constraints. Hence, if the employees are on a tight time line and with specific priorities, and unless the platform either speaks to their priorities, show immediate benefit to their work, or speaks to their passion, participation in the platform will likely be low [25].

5 DISCUSSION

The platform in itself showed good potential for improving innovation climate and capabilities. There is a potential for gathering ideas and enabling discussion. We believe that such aspect can be supported by refining roles and strengthening processes.

5.1 The relation to innovation climate and innovation capability.
In relation to innovation climate, a number of its elements are present in the platform. The Jam and hot topics have shown potential to attract comments that can be channelled into dialogue and idea development. The possibility of having an idea selected and funded for further investigation affirms the freedom teams and individual employee have to search for avenues that are not decided top-down. Time availability, priorities and overwork, as well as, the need for feedback and continuity within the ideas posted, are currently a threatening aspect to the actualization of the platform as an innovative tool.

In relation to innovation capabilities, literature points out the need for internal (as well as external) networking and creating structures and expectations that support the development of

innovations, such as, innovation related process and ways of accessing and budgeting are being build into place [24]. It seems that the development of the platform and related process is going on that direction.

The company has been experimenting with and developing the platform "model" as a hub from which ideas can be developed [22]. In terms of attracting users for idea generation the literature says that both intrinsic and extrinsic motivation are important, as well as reasons for contributing [25]. Within the studied context employees have intrinsic passion for discussing and developing ideas. [28] Hence, one of the main challenges is to align extrinsic motivation by providing time and adequate priorities for the tool to be used and innovation to happen.

The roles related to the process are also relevant. Literature points out the relevance of those roles that bring information from the outside, connect ideas and people, or know the procedures to get things done, among other [22][26-27]. Such roles, if not formally assigned, might give a good indication of the activities and behaviours needed to be taken within the platform. In addition, further refinements related to the innovation process within the tool are likely to influence the outcomes, as well as show management support.

The fact that people log in to see what has been posted and get inspired, means that knowledge is being shared and interest exists. The current study cannot confirm the integration of knowledge for the employees who just follow the discussion. Positive results exist in relation to the capacity to explore new ideas, such as functional prototypes, patent, and a concept that is adopted in future technologies. Hence the effectiveness of the platform seems to depend on how successfully continuity is established.

5.2 The possible relation to Innovation Metrics

It is a beneficial aim to have the platform contributing to build an innovation climate and capability. However, such processes take time and within the day-to-day interaction with the platform, how can one tell that there is progress?

By its nature the platform provides checkpoints to measure activities related to innovation. For example, on the quantitative side, one can explore whether ideas are being shared and how many. A qualitative analysis can explore the depth and meaningfulness of such exchange and related activities. Another entry point for innovation measurement is to check whether the ideas discussed are being developed up to a point where they can be used to apply for exploration grants, as well how many of those are being developed into actual NPD projects. In the long term, one can even check the impact by following how many ideas generated in such platform are actually implemented into current or new products. In addition, such measurement points can tell a bit about how well a company can incorporate (absorptive capacity) and change, incorporating the ideas generated into their main work stream overcoming core rigidities and organizational inertia [19]. Another measurement point can be analysing the profile of projects that move from exploration up to NPD process, we can have a more precise view on the risk-taking capacities.

Using this specific platform has the limitation to measure points that are restricted to the development and ideas outside the current strategic planning of the company. Despite this, it is an essential measurement that can speak to how well a company taps into their employees' creativity and insights. The exception of this rule would be for future focus topics that are introduced based on the strategic planning, within a Jam for example. Therefore, such metrics points would be blind towards the general innovation climate and capabilities within projects.

6 Conclusion

The findings in this paper need further depth and breath for them to be validated and generalized. In synthesis, the number of inputs is higher when there is a specific topic in focus and a delimited time frame. That does not exclude the possibility to have open-ended dialogue supported by a tagging system as way of providing focus. However, it does say that such collaboration needs more other capturing methods and ignition than the platform. In conclusion, more than establishing the "platform structure" is needed in order to impact organization innovation climate and capability. The findings seem to indicate that despite the intrinsic motivation, this internal drive flourish with feedback and continuation of ideas suggested, as well as, adequate time to innovate. Moreover, clarity of process and roles also play its part. In addition, clear expectation and defined processes, focus, roles that are built up adequately to the needs of the platform support its development.

Acknowledgement

We would like to acknowledge the support, feedback and collaborative work with VCE, in special Linn Andersson and the iCoaches. Also acknowledge Kodomera and Mikael Svensson, for the insights on the design and user perception of the platform. The financial support via KK Foundation research profile Model Driven Development and Decision Support and company partners is greatly acknowledged

References:

[1] Leonard Barton, D. "Core capabilities and core rigidities: A paradox in managing new product development". *Strategic Management Journal*, Vol.*13* (S1), 111–125. 1992

[2] Bessant, J., Lamming, R., Noke, H. and Phillips. W. "Managing Innovation Beyond the Steady State." *Technovation* Vol.25, No.12, pp.1366–1376, 2005

[3] Boer, H., & Gertsen. F. "From Continuous Improvement to Continuous Innovation: a (retro)(per)spective" *Int. J. Technology Management*, Vol.26, No.8, pp.805–827, 2003

[4] Boer, H., Kuhn J. and Gertsen F., "Continuous innovation. Managing dualities through co- ordination", *CINet Working Paper WP2006-01*, 2006

[5] Boer, H., Caffyn, S., Corso, M. & Coughlan. P. "Knowledge and Continuous Innovation: the CIMA Methodology." *Int. J. of Operations & Product Management* Vol.21, No.4, pp.490–502. 2001

[6] Börjesson, S., & Elmquist, M., "Developing Innovation Capabilities: a Longitudinal Study of a Project at Volvo Cars." *Creativity and Innovation Management* Vol.20, No.3, pp. 171–184, 2011

[7] Garud, R., Tuertscher P., and Van de Ven A.H., "Perspectives on Innovation Processes." *The Academy of Management Annals* Vol.7, No. 1: pp.775–819, 2013

[8] Gericke, K., & Blessing, L., "An Analysis of Design Process Models Across Disciplines." 12th *Int. Design Conference, Dubrovnik Croatia, pp.171-180,* 2012

[9] Björkdahl, J., and Börjesson, S., "Organizational Climate and Capabilities for Innovation: a Study of Nine Forest-Based Nordic Manufacturing Firms." *Scandinavian Journal of Forest Research,* Vol.26, No. 5; pp. 488-500, 2011

[10] Francis, D., and Bessant J., "Targeting Innovation and Implications for Capability Development." *Technovation,* Vol.25, No. 3: 171–183. 2005

[11] Assink, M., "Inhibitors of Disruptive Innovation Capability: a Conceptual Model." *European Journal of Innovation Management* Vol.9, No. 2: pp. 215–233, 2006

[12] Isaksen, S.G., and Lauer, K.J., "The Climate for Creativity and Change in Teams." *Creativity and Innovation Management,* Vol.11, No. 1: pp.74–86. 2002

[13] Ekvall, G., "Organizational Climate for Creativity and Innovation." *European Journal of Work and Organizational Psychology,* Vol.5, No. 1 (1996): pp.105–123, 2002

[14] Björkdahl, Joakin, and Sofia Börjesson. "Assessing Firm Capabilities for Innovation." *International J. of Knowledge Management Studies,* Vol.5, No.1/2, pp.171–185, 2012

[15] Lawson, B., & Samson. D., “Developing Innovation Capability in Organisations: a Dynamic Capabilities Approach.” *International. Journal of Innovation Management,* Vol. 5 no.3: pp.377–400, 2001
[16] Adams, R., Bessant, J., & Phelps, R., ”Innovation management measurement: A review”. *International Journal of Management Reviews*, Vol.8, No1, pp. 21–47, 2006
[17] Simons, R., "The role of management control systems in creating competitive advantage: New perspectives." *Accounting, Organizations and Society* Vol.15, No. 1-2, pp. 127-143, 1990
[18] Nilsson,S., Wallin, J., Benaim,A., Annosi M.C., Svensson R.B., “Re-thinking innovation measurement to manage innovation-related dichotomies in practice”, CINet Conference, Rome, Italy, 2012
[19] Schreyögg, G., & Kliesch-Eberl., M., “How Dynamic Can Organizational Capabilities Be? Towards a Dual-Process Model of Capability Dynamization.” *Strategic Management Journal,* Vol.28, No. 9: pp.913–933, 2007
[20] http://www.kodamera.se/kundcase/volvo-ce accessed last on May 2nd 2014
[21] Murray, P. & Blackman, D., "Managing innovation through social architecture, learning, and competencies: a new conceptual approach." *Knowledge and Process Management* Vol.13 No.3, pp. 132-143, 2006
[22] Leifer, R., O'Connor G.C.,, Rice M.,. “Implementing Radical Innovation in Mature Firms: the Role of Hubs.” *The Academy of Management Executive (1993-2005)*: pp.102–113, 2001
[23] Regnell, B, Höst, M., Nilsson, F., Bengtsson, H., “A Measurement Framework for Team Level Assessment of Innovation Capability in Early Requirements Engineering.” *Product-Focused Software Process Improvement*, V.32, pp.71-89, 2009
[24] O'Connor, G.C., “Major Innovation as a Dynamic Capability: a Systems Approach” *Journal of Product Innovation Management,* Vol.25, No. 4: pp.313–330, 2008
[25] Antikainen, M., Mäkipää, M., Ahonen M., “Motivating and Supporting Collaboration in Open Innovation” European Journal of Innovation Management. Vol.13, No. 1, pp.100–119, 2010
[26] Kelley, Tom. “The Ten Faces of Innovation.” *Academy of Management Learning & Education*, pp.30-33 (spring-summer) 2006
[27] Reid, S.E., & Brentani, U.D., “The Fuzzy Front End of New Product Development for Discontinuous Innovations: a Theoretical Model.” *Journal of Product Innovation Management,* Vol.21, No. 3, pp.170–184, 2004
[28] Volvo Construction Equipment (2012) Report on Innovation Climate interviews
[29] Nilsson, F., Regnell, B., Larsson T., Ritzén S. “Measuring for Innovation” *Applied Innovation Management* No.2, 2010
[30] Bryman, A. Social Research Methods, Oxford 3rd edition 2008
[31] “Anonymized” Interviews VCE Nov-Dec, 2011
[32] Interview set with Project executive manager, and platform designer, 2014
[33] Report documents to Top Management Team (TMT) 2010-2013
[34] Edmondson, A.C., & Nembhard, I. M. “Product Development and Learning in Project Teams: The Challenges are the Benefits”. *Journal of Product Innovation Management*, Vol.*26*, pp.123–138, 2009
[35] Amabile, T. M. , “Componential Theory of Creativity”, working paper 1–10. 2012
[36] West, M. A., & Sacramento, C. A. “Creativity and Innovation: The Role of Team and Organizational Climate”, In *Handbook of Organizational Creativity*, pp359–386, 2011
[37] Kelley, D. J., O'Connor, G. C., Neck, H., & Peters, L. “Building an organizational capability for radical innovation: The direct managerial role”. *Journal of Engineering and Technology Management*, Vol.*28, No*. 4, pp.249–267, 2011

Paper D

20th International Conference on Engineering Design (ICED 15)
July 27-30, 2015, Milan, Italy

Implementing Innovation Metrics: A case study.

Andre Benaim[1,2], Jenny Elfsberg[3], Tobias Larsson[1], Andreas Larsson[1,2]

[1] Blekinge Institute of Technology, Sweden
[2] Lund University, Sweden
[3] Volvo Construction Equipment, Sweden

1 INTRODUCTION

Companies recognize the importance of becoming innovative to remain competitive on a global market. A great deal of attention has been put on developing innovation capabilities, which is the ability to act upon innovation opportunities in two ways: on the one hand, exploring new avenues for products, markets and offerings. On the other hand, improving current offerings and operations (Björkdahl and Börjesson 2012; Boer et al 2001). These two ways are often called exploration and exploitation, or organizational ambidexterity (Kim and Mauborgne 2004; Nagji and Tuff 2012).

While aiming to perform and integrate exploitation and exploration activities into daily work, one might wonder if the ongoing activities are taking the company in the right direction, i.e., "How do we know we are making progress?" and "Are we really becoming more innovative?" Such questions reveal the need for an innovation performance measuring system, simply put it asks for Innovation KPIs (Key Performance Indicators). This paper explores the implementation of an innovation metric system within a case company.

1.1 Context

Why would a company ask for innovation metrics? In this particular case the original request was to find one specific metric that would tell the company whether they were more or less innovative than their competitors. Several benchmarking studies and internal investigations were performed before the decision was made to not look at the competition or scientific data analysis, but instead pilot a metric system that corresponds to all the crucial factors to secure innovative capability and work with the stepwise improvement based on the assessment results. The work was initiated in 2009 and during 2014 two pilot assessments were performed.

Within this particular case study, one of the motivations to working with innovation, beyond the general need of becoming innovative was the insight that there is a vast innovative potential to tap within employees. Many employees, not only within R&D, have a passion for working with innovative products and a bottom-up approach allows to complement and challenge innovative strategies by the identification of opportunities that otherwise would have been lost. If it is to have an impact, such an integrated approach of innovation requires pathways that let the creativity flow from ideation to implementation. The case company has already started working on such pathways (Benaim et al 2014a), but in those early stages they were still unsure whether or not they were actually creating the conditions for being innovative.

In large companies innovation is often directed to R&D departments. This is a classical divide in which companies work as if they had two separate entities, one working on production and the other on innovation and NPD. However, innovation capabilities can also be thought of as complementary to daily work, for example, by setting aside a specific work space and time to innovate in between the daily routine, or by being expected to innovate within it (Lawson and Samson 2001, Lund 2014).
In addition, many companies are dominated by a risk-averse, short-term focused and bureaucratic culture that makes it difficult to drive semi-radical and radical innovation, while small incremental innovation steps are often quite easy to bring forward (Assink 2001). Having a systematic measurement system in place is a way to raise awareness, and drive and monitor progress beyond the

incremental innovation space. Moreover, companies with long development cycles have challenges in terms of measuring innovation according to output or outcomes. First, not all outputs will be successful outcomes in the market. Innovation related work is iterative and learning from failure is a natural part of innovation (Elmquist and Le Masson 2009; Sarasvathy 2001). Second, within long development cycles it is not useful to wait until the product is industrialized to determine whether or not the team was working in an innovative way. Third, in large physical artifact-based manufacturing companies it is hard to work with beta releases, as is commonplace in the software industry. Further, manufacturing companies cannot easily discontinue a product without facing consequences for several years. Once the product is in the market, the company is bound to offer maintenance and spare parts for typically about 10-15 years.

Therefore, an innovation measuring system that allows the company to see whether the conditions for innovation are being met is expected to be a way to drive the necessary changes in the organization and continuously strengthen the innovative capability.

1.2 Challenges of Implementing Metrics for Innovation

Innovation performance measurement has a positive impact on innovation capabilities by fostering new ideas, offerings and working routines (Saunila 2014). It can also help to diagnose, motivate, promote learning and strategy implementation related to innovation (Chiesa et al 2009; Godener and Söderquist 2004). However, it is rare to find articles about the process of implementation and its hurdles (Bourne et al 2003). Currently, companies are unsatisfied with their performance innovation system (Dewagan and Godse 2014). Within the case company the innovation related measurements do not lead to innovation (Benaim et al 2014b). Although the importance of innovation measurement systems is recognized by the literature, its implementation is not as simple as it seems. A current challenge is to agree about what to measure and how to make it practical (Nilsson and Ritzén 2014).

A few challenges are presented when implementing metric system. There is a natural NPD bias when selecting measures. This bias can be counterbalanced by looking at categories such as flexibility or innovation structures (Adams et all 2006). Another challenge is the use of the metric system to evaluate ideas too early, i.e., without the proper exploration it will be hard to define the potential of certain ideas (Langdom, 2008). In addition, people can feel limited in their creativity or that the metric system is a bureaucratic exercise (Chiesa et al 2009; Saunila 2014), which undermines the benefits of metric systems. Some of the practical challenges relate to the general evaluation and interpretation of the data retrieved (Nilsson and Ritzén 2014; Neely et al 2000; Bourne 2003). Another challenge is that the results itself can be merely informative, however people need to take action and know how to use the results of the evaluation (Stufflebeam and Shinkfield 2007). Other challenges with implementing measurement system are presented when: there is a disconnection between strategy and department or teams goals; strategy is disconnected from resource allocation; feedback is tactical instead of strategic; there is resistance to change (Bourne et al 2003).

One aspect to point out is that the frameworks often focus on the organizational level or are intended for innovation management. However, innovation in R&D is developed within teams (Zedtwitz et al 2014). From the innovation climate perspective Anderson and West (1998) suggest that the appropriate level of climate analysis is the proximal group because it is unlikely that a shared climate exist at organizational level. Therefore, we explore the team perspective for this measurement work.
For the reasons mention above this paper explores the question: How to develop and implement an innovation measuring system?

2 METHODS

The methodology is based on design research (Blessing and Chakrabarti 2009) and the paper is a prescriptive study that focuses on the implementation of a measurement system in its early stages of testing. Therefore, concrete use situations and challenges related to the implementation framework need to be identified as they emerge. For this reason, the research requires a qualitative approach, hence the use of design research guided by a participatory action research approach used within a case study (Bryman 2008;Yin 2009; Whyte 1989; Coughlan and Coghlan 2002).

The company case is a multinational manufacturing company developing heavy machinery. The

reserachers worked with project and executive managers as informants and partners, as well as with a team called iCoaches. The team's mandate is to support the development of innovation capabilities and the implementation and testing of the measuring system. Since it is a single case, the findings are not generalizable but they indicate possible real uses and challenges of measurement implementation. The method used to guide the system implementation is called Measuring Innovation in Teams (MINT) (Nilsson et al 2010), which is a research-based framework that parallels the steps and areas suggested by literature as explained in section three. Overall, this paper draws its findings from the activities related to selection and refinement of metrics, and their implementation and use.

The implementation and results of the early steps of the measurement process were described by Benaim et al (2014b), which resulted in a picture of innovation capability. The validation of the initial picture and brainstorming of possible innovation metrics were explored through six workshops, involving 120 persons. The workshops involved iCoaches and ground employees from different departments since they were the target group. The suggested indicators were collected and listed. Afterwards, duplicates were merged and language refined. The selection was done in interaction with department members. For the metric implementation data was gathered by survey and direct input when applicable.

In addition to field notes, participant observation and the results documented during the workshops, the research data was collected by a survey that asked about the selection developed and whether the results were sufficient or useful to understand how the results impacted each department. A semi-structured interview followed in order to explore the survey results. In total, nine participants replied to the survey and five were interviewed, those numbers compose 50% of the teams involved in conducting the implementation. After the second round of measurement the results were discussed during a workshop with the implementation group (iCoaches) and the managers. Participants insights during and results from the workshop, such as changes in measures, implementation practices also support the findings described below. Complementary interviews were conducted with the executive manager in order to get more insights related to implementation challenges and general learnings.

3 THEORETICAL BACKGROUND IN INNOVATION MEASUREMENT

This section introduces theory and main elements related to innovation measurement systems. When talking about performance measurement from a managerial perspective, Chiesa et al (2009) list 7 objectives that are clustered in three main categories; diagnostic, motivational and interactive (learning and coordinating). In addition, measurement systems can be used to correct initiatives and implement strategy (Chiesa et al 2009; Godener and Söderquist 2004).

When it comes down to becoming innovative, what are the aspects that one should consider to measure? The suggestions are numerous (Björkdahl and Börjesson 2012; Adams et al 2006; Langdon 2008). Despite that the frameworks and categorizations have differences and nuances particular to each framework and its background, it is possible to find common elements. Often these elements are broken down in smaller subtopics until there is a (set of) indicator(s). For example, Adams et al (2006) in their literature review synthesize seven general categories and related subcategories: Inputs (people, physical and financial resources and tools), Knowledge management (idea generation, knowledge repository and information flows), Innovation strategy (strategic orientation and strategic leadership) Organization structure and culture, Portfolio management (risk and return), Project management (project efficiency, tools, communications and collaboration), and Commercialization (market research, market testing, marketing and sales).

3.1 What to measure in teams

When considering the team level the categories mentioned above can still be useful. However, what are the categories that are specific to team innovativeness? Some authors explore team innovation by relating it to team performance (Bain et all 2001; Sivasubramanian et al 2012; Hoegl and Gemuenden 2001). Performance is composed of concepts like efficiency and efficacy, and sometimes it includes speed to market. Efficiency relates to how well a team can deliver on budget and on time, and the efficacy relates to whether a team delivers what is expected of them (Hoegl and Gemuenden 2001). This relation is intermediated by teamwork quality, which is a construct that involves elements such as group cohesion, balance of member contributions, communication and coordination of activities

(Hoegl and Gemuenden 2001). It can be argued that teams that have a high teamwork quality have a better performance; therefore they have a positive impact within innovation projects (Hoegl and Gemuenden 2001).

Another way to relate team performance and team innovation is through the concept of team climate. Weis et al (2011) find a positive relationship between team performance and innovation climate in resource-limited projects. Anderson and West (1998) outline the team climate for innovation in four factors: Vision, Participation safety, Task Orientation and Support for innovation, and later on adding reflexivity (West 2002). Innovation climate is also mentioned by Isaksen and Lauer (2002), where the authors suggest climate categories such as: challenge and involvement; freedom: trust and openness; idea time; playfulness and humor; conflict; idea support and risk taking. In addition, at the team level elements such as psychological safety and team diversity, among others, come into play (Isaksen and Lauer 2002; West 2002).
One aspect to take note of is that different kinds of teams have different correlations with innovation climate and, therefore, a particular climate characteristic may have a different correlation with innovation and performance depending on which kind of team it is measured in. For example, on the one hand, research teams had a positive correlation between elements like task orientation and support in relation to innovation and performance. Meanwhile, NPD teams had a positive correlation for goal clarity and attainability of objectives (Bain et al 2001).

In a literature review about predictors of team level innovation, Hülsheger et al (2009) looked at team innovation in terms of input and process predictors. In the input category, the authors found a weak, but positive relation between traditional characteristics such as team size, diversity, team longevity. Also, they found a strong correlation between task and goal interdependence. The authors also found a strong relationship to the majority of the process predictors (Vision, Task orientation, Internal and external communication, support for innovation), a weak relationship for participation safety and a low relationship for task and relationship conflict.

A number of papers talk about individual characteristics and their implication on teams (Chen et al 2013). Some of them relate to how different cognitive styles influence teamwork (Miron-Spektor et al 2011), which may shed light on team composition indicators or possible actions around one aspect of team diversity. Openness is anther individual/group characteristic that can influence a team (Davison and Blackman 2005)

Another perspective is considering the innovation process at the team level. An innovation process has a number of stages (Langdon 2008; Gericke and Blessing 2012; Dewanga and Godse 2014) that could be used to measure team innovation providing timely assessment and feedback. It is important to understand what happens within the process, because each phase of the innovation process has its particular needs (Dewanga and Godse 2014; Langdon 2008). This perspective brings questions about how to measure the effectiveness of activities related to opportunity identification and analysis, as well as idea generation and selection.

At the team-level, all of these frameworks involve identifying antecedents, predictors and moderators, however the frameworks are not relating these characteristics to measuring innovation in teams. Furthermore, when it comes to measuring frameworks it seems that they are developed to follow up on results, or used to pinpoint the categories that should be explored without explaining how. One perspective we take in this work is that we aim to develop an innovation measurement system that includes ways to support teams to understand their context and to reflect on next steps.

3.2 How to measure?

Performance measures have been developing to go beyond audit and financial control measures. In its evolution, a number of frameworks have been developed that are useful to provide categories that are relevant to performance (Bourne et al 2003). The choice of an appropriate R&D measurement metric depends on the user's needs in terms of comprehensiveness of measurement, type of R&D being measured, available data and amount of effort the user can afford to allocate to the exercise (Adams et al 2006). That implies that innovation measuring systems need to be adapted to their context and possibilities (Bain et al 2001). So how to start?

We have synthesized five steps from the literature. The first step is: Choosing the approach. There are

three primary ways of designing a measurement system (Bourne et al 2003). One is need-led, in which stakeholders and customer needs are put into focus. The second one is audit-led, in which a bottom up approach identifies the current status and needs challenging the status quo. The third is a model approach in which a model is used to prescribe the important elements to be measured. Another distinction is between a consultant-led and a facilitator-led approach. In the first, the consultant does most of the implementation, analysis and "follow up" work. In the second, the work is conducted more by the management (and team members) in collaboration with the consultant in a facilitating role.

The second step relates to the Set-up of measurement system. The alignment of the measurements to strategy is often mentioned as a relevant aspect (Neely et al 2000) Furthermore, for measurement to provide its potential benefit, staff needs to be involved in its design and implementation (Meyer, 1994; Hallgren, 2009). Bourne et al (2005) conclude that engagement in innovation performance provides a positive impact. An interactive use of measurement, where managers personally involve themselves in a frequent analysis dialogue and knowledge-sharing throughout the organization, needs to be encouraged (Simons, 1990; Bourne et al 2005; Nilsson and Ritzén 2014 p.185). Russ-eft and Preskill (2009) have suggested that an evaluation is likely to be used when: a) the intended use of evaluation is identified and planned at the beginning, b) the intended users of the evaluation are identified and prioritized, and c) stakeholders are involved in the process of evaluating.

The third step is about Identifying and using indicators. Integrate different classes of indicators is a strength of measurements systems (Neely et all 2000). Janssen et al (2007) find that the mix of objective and subjective indicators help to increase the conceptual uses of the performance measurements, i.e. the increase the knowledge base used to support learning processes. One way to think about indicators is to connect them to the activities and outputs related to the innovation process itself. Dewagan and Godse (2014) suggest that innovation performance measurement systems have to support the identification of key KPI according to appropriate innovation dimensions. The distinction between results indicators (also know as lagging or past indicators) and indicators that determinants of results (leading or future indicators) (Neely et al 2000; Parmenter 2010). The former focus on diagnose and access performance. The latter focus on planning activities (Parmenter 2010).

The fourth step is: Data gathering, analysis and report. When analyzing how high performing units behave in comparison to average performing, Bourne et al (2005) find that high performing units gather data from different sources rather than only from the measurement system. For example, through observation in meetings and attention to dialogue and other interactions. In addition, communicating and reflecting about the results consistently (Russ-eft and Preskill 2009) is part of this step. "In high-performing business units, the simple control approach was used to verify performance at the end of the period, but the main drive for performance came from continual interaction with the performance data" (Bourne et all 2005). Therefore, in order to make the maximum out of measuring systems, active and continual communication, as well as, observation and interaction to check the information described on the system is a helpful practice. Within the case study an software "app" was used to display the gathered results electronically.

Finally, the fifth step is to take Actions and Re-evaluate measurement system. The measurement work doesn´t stop with reporting; Evaluating further needed actions is a next step. In high effective units action is taken according to the understanding of the problem, and it consider also multiple aspect of importance beyond the company targets (Bourne 2005). Moreover, measurement should be periodically re-evaluated and obsolete measurements deleted (Neely et al 2000).

Within the case study presented on this paper, the implementation and testing of the measurement system was based on the MINT Framework in an audit led way, with some characteristics of a model approach. Practically, it means that the implementation of MINT involves assessing and developing a snap shot of the current innovation capabilities, communicating the results and deciding on short and long-term goals and related measures, that will challenge the status quo, as well as, aligning the work with strategic intent and the envisioned ways of working more innovatively. The framework also considers that the indicators are dynamic and context specific (Nelly et all 2000). It includes several dimensions such as process, climate and outcome measures. However, the implementation process is not limited to these categories.

4 FINDINGS AND DISCUSSION

This section has reflections and observations about the implementation process trying to outline some of the implications. We highlight metric selection, the purpose and use of indicators, as well as, the role of leadership and empowerment. In addition, we also highlight a few other main challenges.

4.1 Metric selection

Overall 3 approaches to metric selection were identified. Some of the participants took a more experimental approach. 1) Some implementation team members pointed out that at this stage the implementation was seen as a test, and having one measurement was better than none. The idea was to practice and implement the measurement system and keep refining the metric. 2) Others suggested they have put some thought into it, and have considered which information would be relevant for them to know. 3) A few said it was difficult and their main question was how to make sure that the indicators give meaningful and desired result. We suggest that a balance between the first two approaches (test and relevance) is adequate. Trying to find the perfect indicator is difficult and can delay implementation. Overall, most participants were satisfied with their metrics. Some mentioned that some insufficiency was due to the low number of responses, and that gathering data from manager gives a small number of responses and it does not represent the ground level. The learning here is to remember to keep the connection to working levels.

4.2 Uses of the indicators

Four uses of the indicators were identified: 1) **To implement strategy - Promote a behavior** - A participant used the metrics to keep themselves in "check", reminding them to run the activities related to it. It is a drive force, "it keeps me going". It also helped to see whether the goals were achieved. Finally, it also supports manager to understand the role of iCoach and see progress. In addition by doing the proposed activity they were able to identify other challenges and learn about their assumptions. "We thought it would be easy to set small investigation –even if we had financing, we have not as much time". 2) **To diagnose - Monitor trend** – Some metrics were used to follow up activities, others to confirm an impression/perceived trend. In this case metrics were used to monitor an aspect that might be potentially risky to have low. For example, the department that selected a indicator like this has the impression that as time goes by there are less resources for need-finding and general external input. The idea here is to verify whether this impression is true, and raise a flag, if the trend is confirmed. 3) **To learn by experimenting with metric system** – Some of the participants were really taking the exercise as an opportunity to test working with measurement system (as pointed out in section 4.2). Here the approach is "lets try to use this opportunity and see whether we can make it work for us". 4) **To reflect on practice**: Another experimental learning aspect happened with the sharing and comparison of the results. During the first assessment despite participants looked mainly to their own scores. After the second assessment, a workshop was conducted for participants to debrief the results. Since in this case the indicators and scales were the same for all groups comparison was easy. A meaningful conversation started about the behaviors that lead to those particular results. Participants had a natural interest in those behaviors related to high and low scores.

4.2.1 The innovation indicator - small purposes and sufficient measure

Participants questioned to what extent an indicator can tell them how innovative they are. Indeed, most measures cannot answer this. Often they can only tell how one is performing in relation to one aspect that is relevant for being innovative. Hence, the importance of having multiple, small and specific purpose for the selected indicator, which should be related to a specific context.

In addition, a few interviewees reported that results were better than they expected, but still they didn't feel like they were being innovative. This then opened questions about what is a good reference point and sufficient target: "Does it mean that we are performing well or that we had low expectations?"

4.3 Metrics and indicators content

The metrics content selected by the teams and departments in focus related to time for exploring ideas, costumer and external connections, and climate and management support according to their needs as reported by Benaim et al (2014b). Some examples are metrics related to unplanned time, number of

customer visit or number of cross-function meetings. These metrics are related to climate and contingent aspects of innovation.

Metrics connected to the idea management platform (Benaim et al 2014a) focused on number of ideas and the idea's development stages (gates) within the platform. One indicator was selected to track the formation of groups to rapidly explore ideas. Attention was also placed on measuring the spread and awareness about the innovation channels among employees. For instance, a metric asked about the clarity of the innovation process, and whether employees knew where to look for clarification. Output measures, such as number of new features incorporated in products, and articles published were also measured. Such indicators start to address process related dimensions.

There is a strong selection of indictors around innovation budget distribution, as well as, indicators for number of projects dealing with a higher percentage of innovative features; a few indicators about the alignment between project and strategy were selected. These indicators can speak to portfolio and strategy alignment.

The focus on general and higher level indicators that focus on department or organizational level is noticeable; such change is discussed in section 4.5. So far, only two measurements were performed, and a few uses could be outlined (see 4.2), however, little can be concluded about the impact of the selected metrics. The impacts and changes promoted by the use of indicators as well as the changes in the indicators themselves should be followed in a more detailed and longer study, in which the relation to innovation capabilities should be in focus. Up to the second measurement small changes were made to the wording of the indicators to achieve clarity and a more standard set between departments was selected to allow comparison.

4.4 Leadership and Empowerment

The literature quite often mentions leadership and empowerment as an enabling factor for teams to perform. In the case company, this is also noticeable in the amount of work that management and academic partners do behind the scenes to create the setting. They are in constant interaction with top management clarifying questions, reporting progress and making the overall case for innovation and its measurement. The metric implementation management team also played an important role creating psychological safety and empowerment within the team. One example is in the last workshop when participants were directing their questions to the executive manager regarding what their task and deliverable was. Participants were asking what management expects from them. The reply was "what is it that you want to tell the management". Despite that it has been mentioned a number of times that the indicators are supposed to be "what is relevant for the team" they still needed clear leadership and empowerment. Moreover, the project management is also important given the physical distance between participants and the little time they have in their stretched routines. It helps to keep the dynamic and timing going creating the space for measurement and discussion to happen.

4.5 Challenges

We could identify at least 3 challenges selecting and implementing the measurements in this case. The organizational level in focus, legitimation of the exercise, and the use of the visualization tool. In relation to the level in focus: The measurement system was going to be implemented at the project team level; however, executive management changed this orientation to department level. The main reason was that employees work in several different projects on several different sites. Therefore, measuring project teams would become very complex and scattered; some teams are the same for weeks and others are for some years. Some teams are small, co-located and focused, while others have many team members across the globe. In addition, departments are led by line managers that are reporting to directors and the directors to top management. By having the assessment on department level it is possible to get hold of the departmental working climate and one can see how well line managers are encouraging their employees to think outside the box and look for new solutions. The frequency of measuring also supported the level change since measuring something two times per year would not make a difference for most of the teams. Open questions for further research are: Is it enough to have metrics on department level? And, is it actually impractical to measure teams?

In addition, the multiple goals and responsibilities of the supporting group might have been a problem

in defining the focus. From being a support group doing activities to promote innovation climate, they became responsible to promote and monitor activities on the idea management platform. At the same time they are also responsible for measuring their departments, on top of their design-engineer work. Within such a broad scope all measurement seemed to make sense, and group boundaries got blurred. Perhaps a clear focus on defining the team boundaries and specific purpose could have been helpful. It is interesting to note that the product planning department has overall and more organization oriented measurements. The responsible reported they reached a personal conclusion that very few indicators would say how innovative they are. One example of such an indicator is number of features adopted into products. In fact that conclusion might be true and relevant for their level of measurements, it shows a reflection and understanding of their innovative goals. However, other groups/departments might require different indicators that are more closely related to their work.

Legitimacy and engagement of management was also a challenge is some cases. Despite of some strong support of members in top management, other would not see the exercise as a priority or relevant. The same was true for the layer of management underneath, which sometimes was required join meeting with top management to show that the initiative was supported. In addition, managers would seem to be more inclined to support the exercise according to position of their managers. This is another reason to move the responsibility of measures a few layers above project teams.

Finally, in relation to sharing information, very few used the tool support to do their report, and the input on the app was done because it was “mandatory”. Challenges with the software were not surprising; in a workshop participants pointed out that more training and a few adjustments in the app would have done the trick. Some of the challenges of the app were described as: a) Frequent app crash, b) Visualization of correct quarter and year was not intuitive - One had to be careful to display the right time frame, c) The tool was not ready to use - wi-fi connection and log-in problems prevented immediate access, d) Infrequent use makes hard to remember how to use it, e) Aggregation on hierarchical layer had problems. Participants used their own spreadsheet to follow up, because it allowed making notes and other details next to the data that relate to a particular result.

Results of the implementation were shared with managers. In some cases data from two departments were gathered together, managers presented with the country result asked to have beyond the country data, the specific of their departments. Their reaction was to take in the information. And beyond that a few asked for the next steps. A question for exploration is: How to define and act on those steps?

CONCLUSION

The uses of indicators show potential for the metric system to achieve its function. In terms of practical implications our findings reinforce the need to select smaller purposes for the measurement. There is an indication for the need to hold more than one level at a time, making metrics relevant for the teams, as well as at the management level. Regarding implementation, strong leadership and dialogical skills are key within large companies to engage and overcome resistance to change, including political issues are often a big factor. Engagement of managers proved was also a stepping stone for the implementation to happen. However, it seems that one cannot wait to have a buy-in and that have something on the ground is a way to secure its continuity. The next steps are to consolidate the groups being measured, and explore how these indicators can be reflected into action. Further research could explore the contents of the metrics and its rationale and implications, as well as, whether the measurement actually promoted insights and behavioural changes that impact the ambidexterity in terms of innovation process and climate. Further research can also explore whether team innovation metrics should be developed after or in parallel to an organizational level approach.

ACKNOWLEDGEMENTS

We would like to thank the participants of this study for their time and commitment. In addition to the financial support from KK Foundation and company partners via the research profile “model driven development and decision support”.

REFERENCES

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

Anderson, N. R., and West, M. A. (1998). Measuring climate for work group innovation: development and validation of the team climate inventory. Journal of Organizational Behavior, 19(3), 235–258.

Assink, M. (2006). Inhibitors of disruptive innovation capability: a conceptual model. *European Journal of Innovation Management*, *9*(2), 215–233

Bain, P.G., Mann, L. and Pirola-Merlo, A. (2001). The Innovation Imperative: The Relationships Between Team Climate, Innovation, and Performance in Research and Development Teams. Small Group Research, 32(1), 55–73.

Benaim, A., Larsson, A., Larsson, T.C. and Elfsberg, J. (2014a), Building a Pathway for Innovation: Lessons learned from developing an online platform. Nord-Design Conference 2014, Finland, 662-671.

Benaim, A., Larsson, A., Larsson, T.C. and Elfsberg, J. (2014b), Becoming an Innovative Company: Assessing an Organization's Innovation Capability from the perspective of a team, CINet 2014, Budapest.

Björkdahl, J., and Börjesson, S. (2012). Assessing firm capabilities for innovation. International Journal of Knowledge Management Studies, 5(1/2), 171–185.

Blessing, L.T.M., and Chakrabarti, A., (2009) DRM, a design research methodology: Springer

Boer, H., Caffyn, S., Corso, M., and Coughlan, P. (2001). Knowledge and continuous innovation: the CIMA methodology. International Journal of Operations and Production Management 21(4), 490–502.

Bourne, M., Neely, A., Mills, J., and Platts, K. (2003). Implementing performance measurement systems: a literature review. International Journal of Business Performance Management, 5(1).

Bourne, M., Kennerley, M., and Franco-Santos, M. (2005). Managing through measures: a study of impact on performance. Journal of Manufacturing Technology Management, 16(4), 373–395.

Bryman, A. (2008) Social Research Methods, Oxford University Press, 3rd edition.

Chen, G., Farh, J.-L., Campbell-Bush, E. M., Wu, Z., & Wu, X. (2013). Teams as innovative systems: Multilevel motivational antecedents of innovation in R&D teams. Journal of Applied Psychology, 98(6), 1018–1027.

Chiesa, V., Frattini, F., Lazzarotti, V., and Manzini, R. (2009). Performance measurement of research and development activities. *European Journal of Innovation Management*, *12*(1), 25–61.

Corso, M. (2002). From product development to Continuous Product Innovation: mapping the routes of corporate knowledge. *International Journal of Technology Management*, *23*(4), 322–340.

Coughlan, P., and Coghlan, D. (2002). Action research for operations management. *International Journal of Operations and Production Management*, *22*(2), 220–240.

Davison, G., and Blackman, D. (2005). The role of mental models in innovative teams. *European Journal of Innovation Management*, *8*(4), 409–423.

Dewangan, V., and Godse, M. (2014). Towards a holistic enterprise innovation performance measurement system. *Technovation*, *34*(9), 536–545.

Elmquist, M., and Le Masson, P. (2009). The value of a "failed" R&D project: an emerging evaluation framework for building innovative capabilities1. R&D Management, 39(2), 136–152.

Gericke, K., and Blessing, L. (2012). An analysis of design process models across disciplines. International Design Conference–Design 2012, Dubrovnik - Croatia, 171–180.

Godener, A., and Söderquist, K. E. (2004). Use and impact of performance measurement results in R&D and NPD: an exploratory study. R&D Management, 34(2), 191–219.

Hallgren. (2009) How to Use an Innovation Audit as a Learning Tool: A Case Study of Enhancing High-Involvement Innovation. *Creativity and Innovation Management.* 18. (1). pp. 48-58.

Hoegl, M., and Gemuenden, H. G. (2001). Teamwork Quality and the Success of Innovative Projects: A Theoretical Concept and Empirical Evidence. Organization Science, 12(4), 435–449.

Hülsheger, U.R., Anderson, N., and Salgado, J.F. (2009). Team-level predictors of innovation at work: A comprehensive meta-analysis spanning three decades of research. J. of App. Psychology,94(5), 1128-1145.

Isaksen, S.G., and Lauer, K.J., (2002) The Climate for Creativity and Change in Teams. *Creativity and Innovation Management,* Vol.11, No. 1: pp.74–86.

Kim, W. C., and Mauborgne, R. (2004). Blue ocean strategy. Harvard Business Review.

Langdon, M. (2008). Innovation Metrics. White Paper, 1–21.

Lawson, B., and Samson, D. (2001). Developing innovation capability in organisations: a dynamic capabilities approach. International Journal of Innovation Management, 5(3), 377–400.

Lund, K., and Glav, R. (2014) Strategies for managing micro-level contextual ambidexterity**-** *combining exploration and exploitation in R&D, CINet 2014 conference proceedings, Budapest, 595-610.*

Meyer, C. (1994) How the Right Measures Help Teams Excel. *Harvard Business Review*, 72, 95–103.

Miron-Spektor, E., and Erez, M. (2011). The Effect of Conformist and Attentive-to-detail members on Team Innovation: Reconciling the Innovation Paradox. Academy of Management Journal, 54(4), 740–760.

Nagji, B., and Tuff, G. (2012). Managing your innovation portfolio. Harvard Business Review, (May), 4–12.

Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M., and Kennerley, M. (2000). Performance measurement system design: developing and testing a process-based approach. International Journal of Operations & Production Management, 20(10), 1119–1145.

Nilsson, F., Regnell, B., Larsson, T., and Ritzén, S. (2010). Measuring for Innovation. *Applied Innovation Management*, *2*, 1–30.

Nilsson, S., Wallin, J., Benaim, A., Annosi, M.C., Svensson, R.B., (2012) Re-thinking innovation measurement to manage innovation-related dichotomies in practice, CINet Conference, Rome, Italy, 2012, 886-904.

Nilsson, S. and Ritzén, S. (2014) Exploring the Use of Innovation Performance Measurement to Build Innovation Capability in a Medical Device Company. *Creativity and Innovation Management*, 23(2), 183–198

Parmenter, D., (2010) Key Performance Indicators, Developing Implementing and Using Winning KPIs, 2nd edition, pub. John Wiley and Sons

Ritzén, S., and Nilsson, S. (2013). Designing and implementing a method to build Innovation Capability in product development teams (pp. 1–5). Presented at the International Conference on Engineering Design.

Russ-eft and Preskill (2009) Evaluation in organizations, Basic Books Publisher

Saunila, M. (2014). Performance Management through Innovation Capability in SME. Finland, PhD thesis

Sarasvathy, S. D. (2001). Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. Academy of Management Review, 26(2), 243–263.

Simons, R., (1990), The role of management control systems in creating competitive advantage: New perspectives." Accounting, Organizations and Society Vol. 15, No. 1-2, pp. 127-143.

Sivasubramaniam, N., Liebowitz, S. J., and Lackman, C. L. (2012). Determinants of New Product Development Team Performance: A Meta-analytic Review. Journal of Product Innovation Management, 29(5), 803–820.

Stufflebeam and Shinkfield (2007). Evaluation Theory, Models, and Applications, Jossey-Bass publisher

Teece, D. J., Pisano, G., and Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

West, M. A. (2002). Sparkling Fountains or Stagnant Ponds: An Integrative Model of Creativity and Innovation Implementation in Work Groups. Applied Psychology, 51(3), 355–387.

Weiss, M., Hoegl, M., and Gibbert, M. (2011). Making Virtue of Necessity: The Role of Team Climate for Innovation in Resource - Constrained Innovation Projects. JPIM, 28(1),196-207.

White, W. F. (1989). Advancing scientific knowledge through participatory action research. *Sociological Forum*, *4*(3), 367–385.

Yin R.K., (2009), Case Study Research, design and methods. Sage Publications 4th edition.

Zedtwitz, M.V., Friesike, S., Gassmann, O.(2014), Managing R&D and New Product Development; The Oxford Handbook of Innovation Management, ed. Dogson, M., Gann, D., Phillips, N., Oxford University Press