Progress always beats perfection

...a nice philosophy for us doers...
Acknowledgements

Without Tobias Larsson’s encouragement, push and limitless patience I would never have gotten this far into research. The fact that Tobias didn’t give up on me, despite I did multiple times, makes me grateful beyond words. Tobias even makes me believe I want to and can go a lot further.

Generous feedback, critical questions and insightful input from Christian Johansson, Tobias Larsson, Andreas Larsson and Reno Filla took this work to a lot higher level than I would have managed on my own. The quality and the reading experience ended up this good thanks to them.

Many insights came through collaboration with others. With Tobias Larsson, Mikael Johnsson, Chad Fluent and a few more I learned about innovation teams and innovations enablers. With Tobias Larsson, André Benaim, Mikael Svensson and a few more I gained insights about idea sharing and innovative capabilities of both individuals and organizations. Some other great people added perspectives in my learning journey; Tamara Carleton, William Cockayne, Larry Leifer, iCoaches and Emerging Technologies research engineers are the most important to mention in relation to this work.

Volvo Construction Equipment has been the research context and object during these years and at the same time a great employer. The research has been conducted as part of the BTH hosted research profile Model Driven Development and Decision Support, financially supported by the KK Foundation.

My dear parents and siblings have played significant roles in forming me into this rebellious troublemaker that never, ever give up. Mikael Karlsson, Sophia Lindgren and Cecilia Söderman are the most loyal and honest friends one could ever wish for (you deserve champagne paid by me – always). My beloved Klas, Maja and Märta – you are my energy, motivation and inspiration.

THANK YOU ALL
Abstract

Large, mature firms that during many years have operated in stable and predictable business environments tend to have clear, predictable and linear product development processes with well-defined roles and responsibilities for everyone involved. The ways of working in such an organization are much different from how entrepreneurial start-up companies operates, with a lot less formalized system, more relying on transparency and dynamic collaboration – for their survival. When the business environment dramatically change for large, mature firms their formalized ways of working need to be complemented with dynamic and entrepreneurial mindset. Longevity for companies can be ensured through organizational ambidexterity; meaning to simultaneously exploit current technologies on current markets through incremental improvements and explore new technologies and future markets to ensure future competitiveness. The purpose with this thesis is to build a deeper understanding of how exploration capabilities can be re-injected into a large, mature firm without disturbing the exploitation work, the fit-for-purpose daily business. This thesis summarizes the research performed by the author, as industrial PhD student and responsible for the initiative to improve the company’s innovative capability. The work started in 2009 and includes several components, inserted into the company in a subtle way; the measuring innovation component was added in 2014 and provided data that made it possible to see the effects of the initiative. Conclusions from this work is that the tested approach was demanding for the core team, improved the innovative capability of the company and led to awareness that organizational ambidexterity is necessary. The effectiveness of such an initiative would increase with earlier implementation of innovation measurement and more involvement, education and engagement of line managers.

Keywords: Innovation, idea sharing, measuring innovation, time for ideas, innovative capability, innovation teams, innovation coaches, innovation engineering, ambidexterity, exploration
Thesis Disposition

This thesis comprises an introductory part and the following appended papers:

**Paper A:**


**Paper B:**


**Paper C:**

Related Work

The following publications have not been included in this thesis:


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APPENDED PAPERS

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

PAPER B Becoming an innovative company: Assessing an organization’s innovation capability from the perspective of a team

PAPER C The implementation of innovation metrics: A case study
1. Introduction

In this chapter a high-level background to the research area and a motivation for the selected research area provided. Further a description of the corporate context of the research is included as well as a guide for the reader in order to help making this work useful for others.

1.1 Background and motivation to the research area

The author selected to focus the research on the early phases of the product development process and the corresponding methods, tools and strategies. One way of describing the research area is “Innovation Engineering”, which even though it is not an established domain within research, it is mentioned by several in recent literature and is a good match for this research work. Innovation Engineering is here described as a combination of the innovation domain and the engineering domain with focus on methods, tools and strategies for the early phases of the innovation process. The focus of this research is on the actual work performed in the fuzzy front-end of product development and involves the competence domain of engineering design.

An ambidextrous organization have ability to simultaneously perform explore and exploit activities in a way that protects both today business and future business. Innovation Engineering research puts focus on the explore side of organizational ambidexterity. For explore activities an entrepreneurial mindset is desired and for large organizations this is often referred to as “intrapreneurship”.

This thesis is focused on understanding and supporting large, mature organizations to improve the innovative capabilities through development and implementation of methods, tools and strategies. It is assumed that it is particularly difficult to strengthen the innovative capabilities for large, mature organizations that have sustained their competitiveness by driving efficiency and optimizing their ways of working with incremental improvement of their existing solutions for many years.

The motivation for the selected research areas is: (1) research have engaged a lot in efficiency improvements and there is a need to provide engineers with better fitted methods, tools and processes for innovation
work, (2) large, mature firms are dependent on and biased towards near-term exploitation activities and an strengthening their exploration capabilities should be possible to do in a small scale, subtle way that does not disturb the urgent deliveries, (3) exponential technologies, such as digitalization, electro-mobility and automation, are rapidly changing business environment of many industries. Both the internal ways of working and the markets are shifting. The technology shifts together with global challenges, such as urbanization and climate change, impact human behaviour, society and industry. The changed conditions puts pressure on companies and individuals to adjust their ways of working to contribute, stay competitive and attractive.

Engineers in large, mature firms are often trained to perform well-defined and time limited work tasks requested and controlled by project managers following the Idea-to-launch process, see examples described by Cooper and Edgett [1]. Research and Development (R&D) organizations strive to drive efficiency and educate their engineers to utilize well-known, reliable and optimized methods and tools - all predictable in amount of work effort, lead-time and approximate fulfilment of project targets. With companies adopting the combination of exponential technologies the engineering discipline is facing a new era where the end state is less predictable, the requirements are more uncertain, and their engineering skills need to be upgraded continuously with new competences added to their already gained experience.

1.2 Corporate context - a large, mature and technology-based firm

The research was conducted within a leading international manufacturer with an over century long history and around 14,000 employees worldwide. The research was conducted by the author as industrial PhD student in parallel with a leadership role in the Research and Development (R&D) function in the company. The company’s long history with a wide range of products and services offered in about 140 countries is based on complex, physical products with services as additional offerings tied to hard products. The business model of the company is a transactional sales model, with additional service agreements. The long-term ambition of the company is to transform from the transactional to a more relationship based business model, the
The company strives to become a provider of complete product-service-systems.

The R&D organization consists of approximately 2000 employees worldwide, with technology centres in Europe, Asia and North America. The workforce is organized in a structure where departments reflect hardware and the software development is for each hard component is included. For instance, the driveline systems development department consist of a transmission team, an axle team, a system team and a software team.

Within the R&D organization a small and centralized Advanced Engineering (AE) team is responsible for the company’s knowledge value stream, preceding several product value streams as described by Kennedy [2]. The team led by the author had the responsibility to define the future of the company through technology and customer need exploration, collaboration with external industrial and academic partners including applied research. The responsibility of the team was defined as the explorative part of the knowledge value stream (the Explore Phase of the AE process) and the author also led a more broadly defined work to strengthen the innovative capability of the company.

1.3 Reader’s guide

This thesis consists of seven chapters and three appended research papers. Chapter 1 introduces the research area and motivation, the corporate context and the reader’s guide. In chapter 2 the research approach is described; including problem clarification, research aim and research question. In this chapter the methodology is also summarized. Chapter 3 covers the main knowledge domains that are related to this work. Chapter 4 provides brief descriptions of the three appended papers; Paper A, B and C, the authors contribution to them and their contribution to this thesis. In chapter 5 the activities in the company are described, including company specific needs and challenges. This chapter can provide the reader with example insights that can help to manoeuvre similar initiatives in other types of organizations. Chapter 6 is the discussion chapter where the findings of this thesis are described in a more general perspective, intending to contribute to the innovation engineering knowledge domain. Finally, chapter 7 provides a short conclusion of the
work summarized in this thesis and describes ideas for potential future work.

The appended papers were published in 2014 and 2015. The author of this thesis was leading the work within the company, collaborating with the academic partners and contributing in the research based on her responsibility in the company and her interest in the research area. There was at that time no intention from the author’s side to pursue academic research, but in the continued work a deeper interest grew to understand not only the actual case in the company, but also corresponding academic research. Starting from the appended papers the author continued to perform research in parallel with implementing the company’s innovation system until end of 2017. Effects of the implemented components in the system have been observed and evaluated thanks to the large amount of empirical data from tools and interviews.
2. Research approach

In this chapter the research approach is described, starting with problem background, problem clarification and assumptions, followed by the research questions and the research methodology.

2.1 Problem background

The overall purpose of this research is to gain knowledge about how mature, stagnated organizations can improve their organizational ambidexterity and innovative capability without disturbing any of the ongoing work targeting near-term start of series production. Additionally, it is of interest to understand the positive and negative effects of measuring an organization’s innovative capability, and how to effectively do it.

The work summarized in this thesis is performed in an industrial context, mainly within the company’s R&D organization, in parallel with the iterative implementation of an innovation framework including strategy, methods and tools to strengthen the company’s innovative capability. The company has been through several organizational changes, budget and employee reductions, and also changed the executive leadership several times throughout the duration of this work, for example, from 2009 to 2017 there have been four different company presidents and three different heads of R&D.

The studied company’s performance is measured by quarterly financial results, mainly based on the outcome of exploit activities which implies that the initiative to strengthen exploration capabilities does not disturb the “running” business operation. This is important contextual information since that formed the approach to be small scale, low budget and subtle. A drastic comparison might be to perform a critical organ surgery on a patient while he or she is not only alive, but also doing routine tasks with normal performance.

The problem, which this thesis addresses, is that successful companies that during a long time have prioritized exploitation activities and
neglected the need to support exploration activities have lost their capabilities to successfully perform exploration activities. In such situation there is a need to re-establish organizational ambidexterity, but that need to be done in a way that does not cause disturbance to the pressured delivery work. How that re-establishment can be done, how exploration can be inserted into the system “on-the-go” is the problem this thesis is addressing.

This work is, as previously mentioned, performed in the research area of innovation engineering; which is centred around the explore part of engineering design. This is where radical innovation takes places through new technologies, new business models and entrepreneurial behavior. The focus of the author is the actual engineering work within the development process, with limited engagement in the extensive innovation management research area.

In this work it is assumed that the process with related methods and tools for the conventional exploitation activities remains untouched. The assumption is that those are well-functioning and fully independent of the exploration activities. This is not entirely true but provides a helpful limitation in the research work.

2.2 Research methodology

DRM, Design Research Methodology, proposed by Blessing and Chakrabarti [3] have been applied as the guiding methodology for this work. DRM as research methodology suits this particular case well because the research is performed in parallel with actual need-based development and implementation work in the company.

The initial literature studies were performed to build an understanding of how a company should operate to have organizational ambidexterity and strong innovative capabilities. Also, literature on methods to improve innovative performance was reviewed. Academic publications, articles in trade magazines and specialist books were included in the literature study and done in parallel with benchmarking of other large, mature companies. In 2009 dialogue with academia was established and soon after that collaboration was initiated. After having gained sufficient understanding to get started with the work, the development and implementation of the
support system commenced, resulting in the company's tailor-made innovation model. The team decided early on to not wait for the perfect solution, but instead insert small innovation related initiatives, learn from them and adjust.

The team observed how the inserted initiatives impacted the organization, gathered empirical data in numerical and interview formats and adjusted the initiatives based in the insights. The combined development and implementation of the support system was initiated in 2009 and have been slightly adjusted continuously since then. Most empirical data is collected from the online idea sharing tool and the innovation measurement system during 2014 to 2017. The way the work was conducted in the company, it was assumed that DRM was the most suitable research methodology, hence applied in the appended papers. Other research approaches were later considered, such as Action Research, described by Avison et al [4] and Case Study Research, described by Yin [5]. Because of the company context, the particular case study and the dual roles of the author as both industrial PhD student and responsible for the innovation strengthening work in the company led to the conclusion that DRM was the most helpful methodology.

DRM consist of four stages (see Figure 1): Research Clarification (RC), Descriptive Study I (DS-I), Prescriptive Study (PS) and Descriptive Study II (DS-II). The stages are linked in a main process flow, but several iterations between the different stages can be needed. The Research Clarification (RC) is where literature studies about the subject of interest help the researcher to find his or her research aim and goal. With research aim and goal in place the researcher can formulate criteria to be able to measure how successful the research is in reaching the goal. The Descriptive Study (DS-I) follows the RC stage where clear research aim and research goal are defined. Now the researcher can go deeper into the subject and through identifying the most crucial factors to address he or she can go deeper into the details in literature studies and support the descriptive study with own observations and empirical data, all with focus on describing the existing situation. Following the DS-I stage is the Prescriptive Study (PS) where the desired situation is defined. By elaborating with the previously identified crucial factors various scenarios can be described and with that insight the researcher can decide a possible way of taking the research object from the existing situation to the desired
situation in the most effective way. The selected influential factors become part of the systematic design support that is the result of the PS stage and will be tested in the following. The Descriptive Study II (DS-II) is where the researcher investigates the impact of the support developed in PS stage. Empirical data provides answers to the research questions that were defined in the Research Clarification stage and it is both natural and expected that iterations takes place between the different stages.

Figure 1: DRM, adapted from [3]

By utilizing the DRM framework, the work can be described as visualized below. There have been several iterations between the stages and the initial Research Clarification stage has been revisited several times, also after the finalization of the DS-II work. The appended papers are published in 2014, 2015 and 2015 and even though this thesis is leaning on those papers the research activities have continued during 2016 and 2017, including gathering of additional data and further development of the innovation system in the company.
The focus of the work is centred on one main research question and three sub-questions.

The main research question is:

**RQ:** How can a large, mature firm strengthen its innovative capability without disturbing the delivery oriented organization?

Additional to the main RQ, the following sub-questions are posed:

**RQ1:** How can measuring of innovation performance help to establish exploration abilities?

**RQ2:** How do employees in a large, globally distributed organization respond to implementation of a process and a tool for online sharing of ideas?

**RQ3:** What factors ultimately influence employees’ interest and ability in participating in voluntary innovation work in a large, mature firm?
2.4 Research environment

This research has been performed in the area of mechanical engineering with focus on Innovation Engineering as a part of the KK-foundation research profile “Model Driven Development and Decision Support” in collaboration with the company where the author is employed.

2.5 Data collection

The major part of the collected data in this work is gathered through interviews with employees at the company. In addition, statistical data automatically generated in the idea sharing tool were utilized. Data from the assessments of the company’s innovative capability have also been included in the research.

Interviews with employees have been performed with different purposes and therefore differently designed. The interviews performed during 2009-2011 were focusing on understanding the status and the needs of the global organization. All sites where covered and people with different roles were interviewed; such as project managers, department managers, design engineers, test engineers, gate auditors and individuals in the team responsible for innovation and exploration. Below are the guiding questions that the interviews were based upon, of which a majority were performed over telephone or Skype, some in one-on-one dialogues and some in group settings. A total of 100 employees were interviewed in this format during 2009 to 2011.

1) Do you think we have an innovative climate?
2) Can you please explain your answer?
3) What would you and your team need to be more innovative?
4) Do you think the line managers can take responsibility to create innovative climate?
5) What is needed for line management to be able to take responsibility for innovative climate?
6) Other thoughts or ideas on how we can make us more creative and innovative? What is needed? What is missing?

With the online sharing tool launched in 2011 statistical usage data was automatically generated and reviewed on a monthly basis. This
information triggered interviews and dialogues with the main purpose to improve the tool, but at the same time provided data that could be utilized for research.

The preparation to implement the innovation measurement methods provided a lot of data utilized in the appended papers, and from the pilot assessment in 2014 and beyond reliable data could be gathered. The assessment was done once in 2014 as a pilot assessment, two times in 2015, two times in 2016 and annually from 2017. Due to adjustments of some metrics the comparison between assessments were not straightforward, manual work was required. Besides the numerical results from the assessments survey responses in free text format gave insights in employees’ experiences and opinions related to innovation.

During the development and implementation of the different tools and methods, several cross-functional workshops were performed, followed by review and reflection meetings and anonymous surveys.

The online idea sharing tool and the innovation assessments provided both statistical data and substantial written documentation, many times triggering interviews with participants to understand more. Several M.Sc. thesis works have been initiated and supervised by the author during the research period, with the purpose to get objective analysis of the work. Thesis work focuses have been idea sharing (online and real life), the iCoach work, engineers’ experience of the idea process and manager’s mindset regarding innovation. The thesis work contributions have helped the research with objective outside perspective, added to the in-depth internal perspective that came natural for the author in her company role. The combination of outsider and the insider perspectives generated a broader picture for the research and for the continuous development of the company internal work.

2.6 Literature reviews

The literature reviews were carried out in different phases and with different main focus depending on the maturity of the research. Initially, the literature study approach was only selection of focus area. From the start the focus was on understanding what is required for a company to be innovative including what different enabling factors are required. Next
focus area was to understand how measuring innovation can be done. Further into the actual research work the literature reviews helped in defining the research area properly, based on insights gained and described in the appended papers and in zooming in on the research questions.

Keywords considered to be relevant in the database research were: “organizational ambidexterity”, measuring innovation”, “idea sharing”, “entrepreneur”, “fuzzy front-end”, “innovative capabilities”, “explore”, “design thinking”, “innovation engineering”. Even though “innovation management” was not the focus of the work, several publications related to innovation management were reviewed. Because the research was performed in a corporate context, with a need to educate and communicate with the broader organization continuously the literature review included both academic and non-academic publications, all relevant to the selected research domain.
3. Knowledge domains

3.1 Product development and engineering design

Ulrich and Eppinger [6] suggest that successful product development results in products that can be produced and sold profitably, at least in for-profit organizations. Furthermore, they claim that product development performance can be assessed along the following five dimensions: (1) Product quality, (2) Product cost, (3) Development time, (4) Development cost and (5) Development capability. Products are defined as physical artefacts and normally offered solutions on the markets are combinations of the physical artefacts and intangible solutions. The term PSS (product-service systems) better describes what companies are developing and integrating in their sales today, stepping away from the transactional sales of tangible products and instead offering complete systems including combined products and services.

In the following table, adapted from Ericson et al [7] the difference in characteristics between products and services are listed.
Table 1. Different characteristics between products and services, from Ericson et al [7]

<table>
<thead>
<tr>
<th>Product</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical / Tangible</td>
<td>Non-physical / Intangible</td>
</tr>
<tr>
<td>Production and distribution performed prior</td>
<td>Production, distribution and consumption</td>
</tr>
<tr>
<td>to purchase, separate from consumption</td>
<td>done simultaneously</td>
</tr>
<tr>
<td>A thing</td>
<td>An activity or process</td>
</tr>
<tr>
<td>Core value produced in factory, concrete</td>
<td>Core value produced in interactions,</td>
</tr>
<tr>
<td>interface transaction based</td>
<td>floating, non-concrete relationship based</td>
</tr>
<tr>
<td>Transfer of ownership</td>
<td>No transfer of ownership</td>
</tr>
</tbody>
</table>

Cooper’s [8] “Stage-Gate” System, also known as the “idea-to-launch” NPD process is a linear process taking the project from idea to market launch through multiple development stages and decision gates. This deterministic way of conducting product development was introduced in the 1990’s and has become the standard for product development. The linearity of the process is visualized in the figure below and is often described as a waterfall model.

Figure 3. Linear stage-gate process schematics, adapted from Cooper [8].

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The product development stages can be defined as follows, according to Becker [9]: (1) generating concepts, (2) scoping what a particular concept may take, (3) generating a business case and detailed planning for execution, (4) doing development work, (5) validating that the design work meets the needs, (6) releasing a product and (7) supporting a product.

Some objections to the stage-gate process implementations, mentioned by Becker [9] are:

- They are slow and have high overhead
- The emphasize more form than substance in discussion and decisions
- They treat all projects and products the same
- They kill innovation
- They treat all choices as “one off” decisions

With activities serialized in the waterfall manner there is a risk of “over-the-wall” behaviors with multiple handoffs or a disconnected view of customer needs, but with a pragmatic interpretation of the stage-gate process these problems can be mitigated. This is suggested by Cooper [10], [11] in his updated applications of the “Idea-to-Launch” process where spiral development loops (build-test-feedback-revise) are integrated in the stage-gate process in order to achieve a flexible, adaptable and scalable process.

In 2001 the Agile Manifesto [12] was presented by Beck, driven by the need for an alternative to documentation driven, heavyweight software development processes. The Manifesto, with four values and twelve supporting principles, has become a commonly used framework upon which software companies base their development processes. In the following table the four values of the Agile Manifesto are described.
Table 2. Agile development values, adapted from Beck [12]

<table>
<thead>
<tr>
<th>Individuals and interactions</th>
<th>Over</th>
<th>Processes and tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working product</td>
<td>Over</td>
<td>Comprehensive documentation</td>
</tr>
<tr>
<td>Customer collaboration</td>
<td>Over</td>
<td>Contract negotiation</td>
</tr>
<tr>
<td>Responding to change</td>
<td>Over</td>
<td>Following a plan</td>
</tr>
</tbody>
</table>

The agile manifesto should not be seen as the opposite of the linear stage-gate process, but rather a way to secure that the items on the left are more valued than the items on the right. Agile development is also the basis for the increasingly popular scrum methodology, where iterative increments allows for more dynamic, customer-centric development, where adjustment of the solution can happen throughout the process thanks to the involvement of the customer. This methodology is commonly used by software developers but is becoming increasingly common for combined hardware and software development projects.

Both linear and iterative development processes as the ones described above are examples of what is defined as Engineering Design by Dym et al [13]: systematic, intelligent processes in which designers generate, evaluate and specify concepts. The concepts can be for devices, systems or processes whose form and function achieve client objectives or user needs while satisfying a specified set of constraints.

Regardless of how this work is performed, the design problem reflects that the designer has a client (or customer), who in turn has in mind a set of users (or customers) for whose benefit the design artefact is developed.

The design process itself is a complex cognitive process, why the wording “design thinking” describes well what is going on in the work process where iterative loops of divergent and convergent thinking leads to successful design. The convergent thinking leads to verifiable facts based on knowledge, while the divergent thinking leads to more questions and new potential concepts.
According to Dym et al [13], good designers have the following skills:

- They tolerate ambiguity
- They have a system perspective
- They are able to handle uncertainty
- They make decisions
- They think and act as a part of a team
- They think and communicate in the several languages or representations of design (verbal/textual, graphical, shape, features, mathematical/analytical, discrete numbers)

Furthermore Dym et al [13] conclude that design teams are more likely to be successful with a high level of diversity, leading to different ways of thinking. Factors previously mentioned in literature are gender, ethnicity, years of experience, technical discipline and geographical distribution are factors to consider together with the different personality types.

Personality types can be assessed in many ways and two of the most common are MBTI and DISC. Myers-Briggs Type Indicator (MBTI) tool, constructed by Briggs and Briggs Myers based on Carl Jung’s research, defines 16 different personality types based on psychological preferences in how people perceive the world around them and how they make decisions [14]. The DISC profile, published by Wiley [15], is a non-judgemental behavior assessment tool based on theory which centres on four different behavioral traits: dominance, influence, steadiness, conscientiousness.

Well-composed design teams with sufficient diversity moves seamlessly and consciously between different modes, diverging and converging dynamically as needed in order to find the most desirable, viable and feasible solutions. Hasso Plattner Institute of Design, d.school [16], at Stanford University describes design thinking in the following five modes:

- Empathize: human-centric need-finding brings understanding of needs, problems and opportunities in the user context
- Define: based on the outcome from the Empathize phase a specific need, problem, challenge, opportunity is selected to be focused on
• Ideate: teams with high level of diversity generate ideas together, going for quantity rather than quality in a positive creative manner
• Prototype: building different types of prototypes based on selected and combined ideas, both considering user experiences and the functions drives different forms of prototypes
• Test: the conceptualized ideas are tested and evaluated

Note that the design thinking team moves between the different modes in any order, being mindful of the process and allowing iteration and rethinking to happen as needed. The design thinking approach combines the classic engineering process with the combination of humans’ functional, emotional and social needs.

3.2 Innovation life-cycle

As demonstrated by Moore [17], the life-cycle of innovation can be described as a natural evolution from early market stage where the new solution is initially adopted by few, followed by market growth, mature market, declining market and finally end of life.

![Innovation lifecycle](image)

Figure 4. Innovation lifecycle adapted from Moore [17]

Innovation lifecycle visualized in Figure 4 can be described as follows. In the early market stage (1) the new innovation meet customer needs in an unprecedented way and early adopters choose the new solution instead of the dominating market leading solution. Early adopters lead the way for followers recognizing the satisfaction of the early adopters and the market for the new, different solution grows – this is the growth stage (2). When
most competitors not yet have adopted the new solution the competitive advantage makes margins healthy, revenue and volume growing and in the mature stage (3) the companies offering the new solution continue to grow sales volumes through selling more to existing customers and taking market shares from competition. This stage is followed by the declining stage (4), where market conditions changes due to that competition adopts the market leading solution, growth and margins declines and technological and business innovation are ways to drive competitiveness. Here it is tough to win market shares and branding, pricing and additional features are ways to drive the business. Acquisition and consolidation of companies takes place in order to benefit from volume advantages, when the total market volume is predictable and fluctuations reflect the economy cycle. The declining stage can last for many years, low R&D investment and low margins is a stable and predictable stage, but it will be followed by the “end-of-life” stage (5) where it is only a question of time for new disruptive innovations to enter the market place and make existing solutions obsolete. As long as disruption is not happening companies can make good money in this stage by harvesting the brand, optimizing distribution channels and leverage on customer relationships.

The time spans of the stages are dependent on products and markets, but still this way of describing innovation lifecycles offers a logical and pedagogic way of explaining why product renewal and innovation is important for companies’ long-term survival.

Take the example with smartphones, where new model platforms are launched every second year and software is upgraded monthly, often automatically. Then take the example with heavy machinery or aircraft jet engines where model platforms have a lifespan of 20-30 years and software updates avoided as much as possible unless there are bugs that need to be fixed. An economic perspective of these differences is presented in the figure below. Consumer electronics is sold in large volumes and the return on investment happens faster than for low volume products, like for example large heavy machinery. The timescale of the innovation life-cycle is corresponding with and the sales volumes and varies with product and market characteristics.

When applying the above schematic to real business one can see how the timeline differs depending on industry and market. One frequently mentioned example is Apple’s iPod with iTunes in the music
consumption industry. Another well-known example is the disruption of photography industry due to digitalization, and a new meaning to the “Kodak moment”, described by Lucas and Goh [18]. In the mobile phone industry, the famous Nokia story with the “burning platform”, described by Alcacer et al. [19] tells about how the industry was disrupted through the introduction of the iPhone, the world’s first smartphone. Netflix disrupted the movie rental business, AirBnB disrupted the hotel business and is the world’s largest accommodation provider in 2018, and Uber is the fast growing taxi company without even owning any cars.

The speed of the life-cycle is varying with industry, product and market and often there is not only one single path for the different phases; take headphones for listening to audio media for example, where there are many solutions available in parallel. The products are ranging from the simplest wired earplug versions with an extremely low cost to Bluetooth connected, noise cancelling, high-end sound quality headphones and even versions considered luxury fashion goods. All of these exist in parallel, sometimes even sold in the same store, with much different pricing and different addressed customer bases.

Innovation is complex and difficult to deal with, every organization with ambitions to stay competitive long-term need to understand how to innovate in its own, unique way for the future without sacrificing the business of today. There is not one failsafe solution to manage innovation and there is no chance to stay competitive long-term with no conscious way of managing innovation.

3.3 Organizational ambidexterity

The term “ambidexterity” is derived from Latin and means “both right” or “both favorable”. Tushman and O’Reilly [20], describes how organizational ambidexterity enables both exploitation of existing business and exploration of new business. The exploration is not intended to be separate from the larger organization as for example a stand-alone start-up unit, but instead reconfiguring existing resources and developing new capabilities. Exploitation and exploration activities are different in strategic intent, critical tasks, competences, structures, control/rewards, cultures and leadership roles; in the following table, these are compared.
Table 3. Exploit v. explore activities

<table>
<thead>
<tr>
<th>Exploit</th>
<th>Explore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost, profit focus</td>
<td>Innovation</td>
</tr>
<tr>
<td>Efficiency improvement</td>
<td>Growth</td>
</tr>
<tr>
<td>Incremental innovation</td>
<td>Spurs new product &amp; breakthrough innovation</td>
</tr>
<tr>
<td>Strong at operations</td>
<td>Strong entrepreneurship</td>
</tr>
<tr>
<td>Formal structure, well-defined process and governance</td>
<td>Loose in control and process, adaptive structure</td>
</tr>
<tr>
<td>Control for margin and productivity improvement</td>
<td>Controls for milestones and growth</td>
</tr>
<tr>
<td>Values efficiency, quality and current customers</td>
<td>Values risk-taking, speed and experimentation</td>
</tr>
<tr>
<td>Top-down leadership</td>
<td>Visionary and involving leadership</td>
</tr>
<tr>
<td>Often with certain outcome</td>
<td>Often with uncertain outcome</td>
</tr>
<tr>
<td>Linear process</td>
<td>Iterative process</td>
</tr>
</tbody>
</table>

Smith and Tushman [21] suggest that the organizational ambidexterity need to exist at the top of a company, otherwise the balance cannot be achieved and sustained. They define balanced strategic decisions as:

- Decisions that are distributive in that they involve the division of resources between the existing product and the innovation and
they are balanced when, over time, they support both products, and

- Decisions that are integrative in that opportunities, linkages, and synergies that might arise from the exploitative and exploratory activities are recognized.

Similarly Carmeli and Halevi [22] claim that the executive leadership have a critical role in the complex process of being both explorative and exploitative. The executive management team need to strategically decide how they want to invest in the two different domains and this strategy must be communicated both internally and externally. Executive teams balancing strategic contradictions such as exploration and exploitation need to adapt the strategy over time; in times of decline organizations often pursue an exploitation orientation by various strategies such as restructuring and downsizing to improve efficiency, but having such orientation long-term is a dangerous approach. In good times attention and resources need to be shifted towards exploration. An executive management team need to actively and dynamically steer the balance between explore and exploit; or the company will find itself too much focused on the stable, predictable exploitation work.

There are companies that successfully balance their efforts between what generates profit today with what could generate profit in the future. Sometimes they are just lucky and sometimes there is a conscious and systematic way of working that creates such ability. There are also examples of companies that have failed to balance exploration and exploitation. Some cases where company leadership have been aware of emerging and potentially disruptive innovations, but seemingly risk adversity or misjudgement of the speed of change made them decide to not invest sufficiently and through that the companies went out of business. One example of this unfortunate lack of ambidexterity is the Finnish cell phone maker Nokia, which was tremendously successful and clearly dominant in the cell phone industry but was unable to respond fast enough to the introduction of smartphones. The Nokia case is studied and described by several authors; previously mentioned outside research described by Alcacer et al [19] and a story from the inside by Häikiö [23]. Another example is the American imaging technology company Kodak, with a long history of innovations in photography and imaging that was unable to make a transition to digital photography, even though the
competence was available internally and external consultants advised differently. The Kodak case, which gave a new meaning to the “Kodak moment” have been studied and documented by many, for example Lucas and Goh [18] performed a study on how a firm responds to a challenge from a transformational technology that poses a threat to its historical business model and how the ability to adapt is influenced by the organizational culture. The Swedish manufacturer of mechanical calculators Facit AB is another example where the ability to respond to disruptive technology was lacking, the shift from mechanics to electronics demanded huge and rapid changes in all parts of the company, from competence shifts to industry structure, which Facit failed to make happen. This case is studied and documented by Sandström [24] and others.

For companies to successfully achieve sufficient and well-balanced organizational ambidexterity, they need to find a way to further promising ideas to proven concepts and start to generate new income, without risking the current business. Tushman and O’Reilly [18] suggest that this ability need to exist on all levels in a company, side by side co-existing explore and exploit capabilities that are equally important and respected, but executed in different ways. This is called contextual organizational ambidexterity and correctly managed such approach will secure that the company is kept profitable today, tomorrow and in the future. Through multi-level selection processes organizations can adapt in the face of technological and market changes.

One successful example of these processes have been observed by O’Reilly et al [25] at IBM, where emerging business opportunities (EBO) generated more than $15 billion in growth between 2000 and 2005. IBM’s EBO process was established as a remedy to its inability to meet its revenue growth goals and a foundational insight was that the company’s portfolio of businesses could be divided into three horizons: (1) current core businesses, (2) growth businesses, and (3) future growth businesses - with each type having unique challenges and requiring different approaches.
To be a candidate for an EBO at IBM following criteria must be met:

- Strategic alignment with the corporate strategy
- Cross-business leverage
- New source of customer value, new domains, new business models
- $1 Billion plus revenue potential within 3 to 5 years
- Market leadership
- Sustained profit, competitors not commoditize the new concept

Once the EBO is established the corporate strategy group act as its agent and partner and meet monthly to review progress and support. The key principles IBM established for success of an EBO are:

- Active and frequent senior level sponsorship
- Dedicated A-team leadership
- Disciplined mechanisms for cross-company alignment
- Resources fenced and monitored to avoid premature cuts
- Actions linked to critical milestones, not financial metrics of their line-of-business
- Quick start, quick stop - speed is essential

Even though exploit and explore activities require different ways of working and different project governance Mattes and Ohr suggest [26] that the relationship between exploitation and exploration is not the oppositional but instead orthogonal, see following figure.
The example with IBM’s EBO’s is one way of securing organizational ambidexterity, but not the only way of doing it. Several examples compared by O’Reilly and Tushman [27] provide insights in what features are needed to establish ambidexterity as a dynamic capability. Leaders’ ability to articulate strategic intent and vision justifies the need to both exploit and explore, but more important is the leaders’ ability to manage the inherent tensions associated with incompatible organizational architectures. The organizations dynamic capabilities to simultaneously explore and exploit can only be established when the strategic leadership acts, behaves and decides in a way that embraces both exploit and explore activities, a leadership that adapts to a changing environment.
Nagji and Tuff [28] conclude from analyzing innovation investments and returns that firms that outperform their peers tend to allocate their investments in a certain ratio:

- 70% to safe bets in the company’s current core
- 20% to less sure things in the adjacent spaces
- 10% to high-risk transformational initiatives

Furthermore they observe that an inverse ratio applies to returns on innovation. This provides arguments for companies to invest in innovation for both adjacent and transformational spaces and requires different ways of working. In the same study Nagji and Tuff [28] conclude that following features are necessary to ensure success with the transformational initiatives:

- Team should include a diverse set of skills and be able to deal with ambiguous data
- Teams should be separated from day-to-day operations
- Funding should come from outside the normal budget cycle
- Pipeline management should focus on the iterative development of a few promising ideas, not the ruthless filtering of many
- Metrics should recognize nonfinancial achievements in early phases

Renando [29] describes in his blog the three different approaches to organizational ambidexterity; structured, punctuated and contextual. They can be explained in the following way:

- **Structured**: physical separation of the two functions of exploration and exploitation. Examples are large organization’s separate innovation centres and incubators
- **Punctuated**: the two are separated by time, often involving long periods of exploitation punctuated by short bursts of exploration. Examples are event based innovation initiatives, such as “innovation jams”, “hackathons” and “bootcamps”
- **Contextual**: here the separation is in every individual and based on the task at hand. Every employee understand that both exploit and explore activities are important work and is able to adjust his
or her approach thanks to broad enough capabilities and leadership support

Which of these approaches is most effective depends on the context and company culture, but for all three it is necessary to have a company leadership that realize that organizational ambidexterity is important for the company’s long-term survival.

3.4 The entrepreneur

According to [30] the definition of entrepreneurship is the capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit.

The entrepreneurial personality traits can be described in many ways, Kerr et al [31] suggest that it is a combination of the “Big 5” from the 1980’s, self-efficacy, innovation and locus of control. The Big-5 model is a multidimensional approach towards defining personality, through measuring openness, conscientiousness, extraversion, agreeableness, and neuroticism. These “macro-traits” are more precisely described by John et al [32] and summarized in the table below, where entrepreneurs seem to be more open to experience, more conscientious, similar for extraversion, less agreeable, and less neurotic.
Table 4. The entrepreneur according to John et al [32]

<table>
<thead>
<tr>
<th>Trait</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness to experience</td>
<td>Describes the breadth, depth, originality, and complexity of an individual’s mental and experimental life. A typical entrepreneur is more open to experience than average people.</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>Describes socially prescribed impulse control that facilitates task- and goal-oriented behavior. A typical entrepreneur is more conscientious than average people.</td>
</tr>
<tr>
<td>Extraversion</td>
<td>Implies an energetic approach toward the social and material world and includes traits such as sociability, activity, assertiveness, and positive emotionality. A typical entrepreneur expresses more extraversion than average people.</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>Contrasts a pro-social and communal orientation toward others with antagonism and includes traits such as altruism, tender-mindedness, trust, and modesty. A typical entrepreneur is less agreeable than average people.</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>Contrasts emotional stability and even-temperedness with negative emotionality, such as feeling anxious, nervous, sad, and tense. A typical entrepreneur is less neurotic than average people.</td>
</tr>
</tbody>
</table>

Furthermore, an entrepreneur shows more self-efficacy, keener eye for innovation and an internal locus of control. Self-efficacy means a strong belief that he/she can “do it”. A person with an internal locus of control conceptualizes that their own decisions control their lives.

Pinchot [33] describes the term *intrapreneurs* as innovators in large organizations functioning as in-house entrepreneurs, running projects as independent innovators would, but with the benefit of having an entire corporate organization as its playground. Intrapreneurs can help the company to secure its innovative capabilities and renew its product and
service offerings, with passion and persistence despite the established organizational system’s bias towards exploit activities.

Yetis-Larsson et al [34] suggest that the former company internal innovation work is already partly replaced by open online communities where entrepreneurs conduct networked research and development work. The innovative capability increases thanks to the widened diversity, with company internal and freelance entrepreneurs are working on multiple teams, taking on mediating roles, engaging in sharing environments, networking via social media, engaging in distributed work, and networking across the virtual and real life boundaries. The social capital is built and used in the networked community and drive business and innovation for large firms and start-ups participating in the collaborative eco system. Yetis-Larsson et al [34] further suggests that the combination of virtual and physical networking is crucial to create the environment where value can be created. Furthermore, the quality of the networked research and development work is depending on the nature of the community; an open sharing environment where distributed team work takes place results in higher value for all engaged community members.

3.5 Measuring innovation

The selected method for assessing the company’s innovative capabilities is a measurement framework developed by Nilsson et al [35], focusing on setting up company specific innovation metrics. With candidate measurements for four dimensions, the people involved in the work at the company can develop the tailored measurement system that fits their context. The MINT framework has been tested in software development within telecom, aerospace, med-tech and public sector. The author of this thesis and her team selected the MINT framework because it includes the categories needed to measure a company’s performance and was possible to tailor to the specific company context. The framework can be seen picture below.
Trías De Bes and Kotler [36] suggest that innovation metrics can be grouped in four categories; those that measure:

- the results of innovation from the economic standpoint
- the intensity of innovation within a department, business unit or organization
- the efficacy of innovation activity and investment
- how widespread the creative culture is in an organization

The economic metrics measure the positive or negative results of innovation using variables from the company’s economic-financial statements. Those are the old way of assessing company’s innovation performance and while these metrics are relevant, the innovation performance evaluated only in this category say nothing about the innovation performance.

The intensity metrics measure the quantity of innovation activities that are going on in the organization, without taking into account the results from those. Number of ideas generated, number of inventions, number of innovation activities as well as number of innovations in products,
customer experiences, processes or business models are included as well as the percentage of sales that goes into R&D.

The effectiveness metrics seek to measure profits in relation to the use of resources with the objective to maximizing innovation outputs while minimizing inputs. Success rate in new products, Time to market, average investment per project, number of years as the industry leader are metrics used in this category.

Finally, the culture metrics refers to aspects related to the creative culture of the organization, measuring how widespread innovation and creativity are within the organization as a whole. In this category examples of metrics are number of ideas produced and assessed per employee per year, time spent on innovation, number of departments engaged in innovation. Whatever metrics a company uses it is important to apply the findings, learn from that and adjust if necessary.

The innovation system to be assessed is according to Kaplan [37] covering organizational culture, critical capabilities, innovation efforts and profitable growth. Kaplan suggests that one only know that we are doing the right things if we continually assess, prioritize and improve what we do and how we do it. His suggested approach to assess the company’s innovative performance covers the following areas:

- Strategy and business model
- Leadership
- Processes
- Structures
- People
- Metrics, incentives, recognition and rewards
- Enabling technology
In an innovation scorecard described by Rowan Gibson [38] companies like BASF, Rolls Royce and Roche are compared in the following dimensions, with a scale from 1 to 10:

- Innovation Culture
- Strategic Innovation Focus
- New Products
- Managed Growth
- Product Margin
- Investment in Innovation
- Innovation Brand Impact
- Innovation Peer Review

One can find numerous examples of how companies are assessing their innovative performance, from “hard” factual KPI’s, often related to finances to more “soft” state-of-mind oriented employee surveys. When it comes to creativity, which is one of several enablers to innovation.

Göran Ekvall [39] defines 10 dimensions to measure the amount of creativity in an organization. Ekvall’s 10 dimensions have been used as a basis for several innovation and creativity surveys and include:

- Challenge
- Freedom
- Idea time
- Dynamism
- Idea support
- Trust and openness
- Playfulness and humor
- Conflicts
- Debates
- Risk-taking

In a later work Isaksen et al [40] further refined Ekvall’s work and created a questionnaire to assess organizational climate in relation to creativity. The questionnaire is named SOQ, Situational Outlook Questionnaire, and covers the following dimensions that are assumed to create climate.
Table 5. Situational Outlook Questionnaire, adapted from Isaksen et al [40]

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visions and goals</td>
<td>Strongly held images of what a team wishes to achieve</td>
</tr>
<tr>
<td>Strategies</td>
<td>The kinds of approaches and processes used to accomplish the team's visions and goals</td>
</tr>
<tr>
<td>Leadership</td>
<td>The style, quality, and effectiveness of the leader helps to set the tone for the team</td>
</tr>
<tr>
<td>Work Setting</td>
<td>The physical set up in which the members of the team work</td>
</tr>
<tr>
<td>Individuals</td>
<td>The personality traits, experiences, and background of the members of the team</td>
</tr>
<tr>
<td>Type of work</td>
<td>The nature of the work itself</td>
</tr>
<tr>
<td>Work Organization</td>
<td>How tasks are organized and carried out. How decisions are made</td>
</tr>
<tr>
<td>Context</td>
<td>The relationship between the team and the organizational as a whole</td>
</tr>
<tr>
<td>Values and Norms</td>
<td>Commonly held beliefs, assumptions and practices</td>
</tr>
</tbody>
</table>

3.6 Online sharing of ideas

The concept that ideas get better when shared is not particularly novel, already in the 1650s The Grand Café in Oxford gave birth to the enlightenment era, much thanks to the introduction of coffee and tea, replacing alcoholic drinks. This is described by Steven Johnson [41]. In his research he found recurring patterns on environments where creativity and idea creation prospers, both in society and in nature. Steven Johnson suggests that an idea is a new network, inside the brain where new configurations of neurons are created, and in the outside world with new networks of people, new networks of solutions, new networks of ideas that create valuable innovation.

All the way from the era of enlightenment in the 17th century in England until today ideas have been born out of chaos. When scientists are being asked about when their breakthrough ideas happened they tend to remember that they had an eureka moment, but Dunbar [42] found in his research that most of the breakthrough insights happen when ideas are being discussed, perspectives are being shared in a network of people.
Bjelland and Wood [45] points out the importance of committed management when they reflect upon observations of the former president and chief executive officer at IBM Sam Palmisano. He clearly saw the importance of technology exploration and customer need-finding when he claimed that innovation happens in the intersection of invention and insight. Based on the belief that innovations are created by fusion of new developments and new approaches to problem solving the open, global, collaborative and multi-disciplinary innovation system build the foundation of the successful concept called IBM’s Innovation Jams. Online collaborative conversations around specific topics lead to generation of multiple ideas, where some are selected for continuation and some are leading to new businesses. The IBM Innovation Jam tool is today an online platform that any company can purchase for their own Innovation Jams.

The Jam concept is adopted by many companies in the world, successful in the cases where companies invest the required amount of preparation work, facilitation work and post-jam work, but most important for success is that the company culture have events as a natural part of their development process. Bjelland and Wood [43] refers to how Paul Horn, retired from IBM and serving as a scientist in residence at New York University, describes the jamming process as a kind of brainstorming process which requires a large amount of ideas, ideas of all sorts, including the crazy ones, in order to force the participants to think out of the box.

Several online idea sharing tools are available for purchase, often these tools comes with a well-defined, stepwise process. One is provided by the company Hype Innovation, globally present provider of innovation management software and services. The idea generation tool provided by Hype Innovation is structured in three steps:

- **Step 1:** Selecting strategic innovation areas, connected to business objectives to engage management and participants
- **Step 2:** Idea campaigns, time limited focused challenges that are systematically set up in the tool and owned by sponsor
- **Step 3:** Participation and engagement, posting and reading ideas through any device, structured in categories and connected to the strategic innovation areas
Many other online idea sharing tools can be mentioned, the Belgian consultancy company Board of Innovation provides a list of examples [44], but despite the extensive availability of online idea sharing tools the author and her team concluded that none of the available solutions at that time responded to the company’s need to have an open platform inviting everyone to sharing insights, problems and ideas in a non-linear, not predetermined way.

3.7 Securing time for ideas

Google is famous for its 20% rule, which was first highlighted by the founders Larry Page and Sergey Brin in 2004. The idea with the 20% rule was that employees should secure time for ideas, so in addition to their regular projects they can work on what they think will most benefit Google. Google News and Gmail are mentioned as products created within the 20% time and even if the 20% rule was not for real, Google seem to have a way to systematically secure continuous innovation in all layers of the organization, as described by Steiber and Alänge [45]. Here, innovation is not a small initiative from the side, surviving despite lack of management commitment, instead Google secures continuous innovation in all layers and dimensions of the company. The top management and the board are innovation-oriented and change-prone, as well as the broader organization also is. Middle management empower their people, coaches their people and remove obstacles for innovation. The organization is semi-structured and ambidextrous and the performance metrics are related to innovation. Google is a company biased towards continuous learning and continuous innovation, and possibly most importantly prone towards change.

LinkedIn is also a company where time for ideas is prioritized and protected through their innovation event called “Hackday” that happens regularly and their program [in]cubator [46] where the employees have a chance to work exclusively on their Hackday idea for 1-3 months to bring it towards production.
The [in]cubator opportunity is open to everyone in the company and proposals need to consist of:

- Description
- Team members
- Timeline
- Proof of concept or prototype
- Success metrics
- Risks, competitors
- Technical details

The initiative is developed based on other companies incubator initiatives and the three key prerequisites to motivation; autonomy, mastery and purpose, described by Pink [47]. In the selection process there are only four judging criteria:

- Impact: what value does this project bring to LinkedIn?
- Feasibility: how hard is it to build? What are the risks?
- Timeline: can v1 be done in 3 months?
- Team ability: can this team pull it off?

Similar internal incubator concepts can be found in other companies and the LinkedIn employee and Hackday master Prachi Gupta lists [48] the following advice to companies that want to establish something similar:

- Design a program cadence that works for you
- Get Executive and management sponsorship
- Create a place for sharing ideas and collaboration
- Have dedicated workspace for teams away from their regular desk
- Find out what works for the culture in your organization

While many companies similar to LinkedIn and Google have structured their ways to drive innovation within the companies including inviting partners to participate in their innovation efforts there is another trend that might impact innovative capability in another way. Anderson [49] describes how the so-called “Makers” are self-employed entrepreneurs, originating in the DYI (Do-It-Yourself) movement less dependent of the established system of part suppliers, manufacturing facilities and
assembly plants because of 3d printing, crowd computing, usage of “Makerspaces” and other new technologies and ways of working. The Makers challenge the old orthodoxy and completely new ways of providing products and services to customers are being created. It is clear that the previously desired job security and stability that used to attract engineers to large corporations is not sufficient for engineers to stay if they can’t work on what they feel passionate about. Companies that want to continue to be innovative need to create room for that individual drive and open collaboration.

3.8 Line managers importance to innovation

As result of his analysis of the Honda City development project Nonaka [50] suggests an approach called “Middle-Up-Down-Management”, in order to accelerate information creation. The case study observed how the project team was given autonomy and was simultaneously forced to challenge long-held assumptions. In order to create a sufficient number of alternative concepts the team needed to be extremely heterogeneous with respect to jobs, orientation and behavior. The leadership was actively driving the diversity as well as the dynamic working habits, meetings were never held at the same time and places, strong team collaboration on the level where the team act like one united body was reinforced and high level of information sharing was necessary to be able to reach the challenging goal. In this study the executive leadership were convinced that organizational management is no longer necessary if each individual properly performs what is expected. With a clear goal and high level specified roles the project team work autonomously towards the challenging goal. In a company where strict structure and hierarchical project execution models have been the major way of working it is important to invest time in unlearning the control based approach. To go from a control based leadership to a trust based leadership without active support to the team to adjust will cause lack of clarity and fear. Nonaka concludes that the role of middle management is to combine deductive (top-down) and inductive (bottom-up) management in order to support innovation. Middle management is equipped with the ability to combine strategic macro information and hands on micro information and serve as agents for change in the organization’s self-renewal process.
Brand [51] describes how 3M fosters a leadership where managers respect the knowledge of every employee and are able to give well-balanced freedom and constraints to teams. 3M have fostered a culture that is biased towards innovation through three specific and unique approaches that spurs the innovative spirit:

- **Seed Capital**: Inventors in the company can request seed capital from their business unit managers; if their request is denied, they can seek funding from other business units. Inventors can also apply for corporate funding.
- **New Venture Formation**: Inventors recruit their own teams within 3M, reaping the benefit of 3M’s many networking forums. The recruits can evaluate the inventor’s track record before signing up. However, if the product fails, everyone is guaranteed their previous jobs.
- **Dual career ladder**: Scientists can continue to move up the ladder without becoming managers. They have the same prestige, compensation, and perks as corporate management. As a result, 3M does not lose good scientists and engineers only to gain poor managers, a common problem in the manufacturing sector.

Similar to Google, 3M engineers and scientists can spend up to 15% of their time pursuing projects of their own choice, free to look for unexpected, unscripted opportunities, for breakthrough innovations that have the potential to expand the business. 3M have established structure, system and culture to enable the employees to think and do things differently, supported by the company leadership.

### 3.9 Innovating in teams

The innovation process described by Tidd and Bessant [52] includes the following four stages to be performed by the team: (1) Search - how can we find opportunities for innovation, (2) Select - what are we going to do - and why?, (3) Implement - how are we going to make it happen?, (4) Capture - how are we going to get the benefits from it?

The team conducting the work in the innovation process should not be just any random team, put together based on availability and chance, but instead tailored to effectively perform innovation work. Johnsson [53]
compares in his work different definitions of high-performing and self-managing work groups and teams, their specific characteristics, effects and methodologies and suggests that the performance of a team conducting innovation work is impacted by: (1) number of team members (maximum 6-7), (2) the personalities in the team, (3) the competences, (4) the diversity, (5) the mindset and the following 20 innovation enablers:

1. Awareness
2. Capabilities
3. Climate
4. Collaboration
5. Culture
6. Dedication
7. Economy
8. Education
9. Empowerment
10. Entrepreneurship
11. Human resources
12. Incentives
13. Knowledge
14. Knowledge management
15. Management
16. Mindset
17. Need
18. Processes
19. Strategy
20. Time

Wheelan’s [54] research on team development is important input in all types of team creation and team development. The team will go through different development stages and if the team is aware of this process it can proactively manage the different stages, mitigate set-backs and faster come to the high performing stage. For example, the faster the team members establish trust among themselves the sooner they will reach a stage where different opinions are expressed and constructive conflict generates better results. The trust is established through openness, through team member getting to know each other, which can be directed by the team leader, the team sponsor or the facilitator.
McDonough [55] describes how cross-functional teams are more likely to be high performing compared to teams built from one single function, due to the different competences and perspectives. The members in high performing teams talk and listen in roughly equal measure, they connect directly with one another without need for organized meetings or through a team leader and they periodically break, explore outside the team and bring information back to the team.

Johnsson’s [53] previously mentioned Innovation Enablers are all important to the innovation team and the following six seem to be most important according to Johnsson’s work: Collaboration, Dedication, Mindset, Entrepreneurship, Knowledge and Knowledge Management. Furthermore, the most important Innovation Enablers varies in the different phases of the innovation work; in the initial phase collaboration and dedication seem to be most important, in the middle phase collaboration, knowledge management and mindset seem to be the most important ones and in the final phase the two most important factors seem to be dedication and mindset.

The term “T-shaped” originates from the 90’s and has since then become a popular term to describe the characteristics of the new generation of preferred employees and also the desired qualities of a high-performing team. The T represents the combination of deep knowledge / system understanding in one discipline and the broad boundary crossing competences such as teamwork, communication, critical thinking and perspective. Rogers and Freuler [56] describes how the increasingly desired “T-shaped engineer” can be prepared for work-life at university. Below are some examples of how they see that the education system needs to adjust:

- Shift from disciplinary to interdisciplinary
- Increased development of teaming skills
- Greater consideration of the social, environmental, business, and political context
- Improved student capacity for lifelong learning
- Emphasis on engineering practice and design throughout the curriculum, rather than theoretical focus
The IDEA CEO and president Tim Brown [57] describes the T-shaped individuals as the backbone of IDEO’s collaborative culture and explains how they in their talent management process look for people who are “T-shaped”, with a principal skill that describes the vertical leg of the T, for example mechanical engineers or industrial designers, and they are also able to explore insights from many different perspectives and recognize patterns of behavior that point to a universal human need, that is the horizontal piece of the T.

Companies that have embraced the T-shaped team approach seem to be more successful with innovation than others; examples are Procter & Gamble, Nike and Apple.

Dugan and Gabriel [58] describe how DARPA continue to create breakthrough innovations, such as precision weapons and stealth technology, internet, automatic voice recognition and compact GPS. Dugan and Gabriel, with experience from DARPA describes that the model that ensures the continued success of DARPA consist of the following three elements:

1. **Ambitious goals**, the DARPA programs are always pushing the boundaries to solve real-world problems of create new opportunities. An urgent need for a solution seems to create focus and inspire greater genius.

2. **Temporary project teams**, consisting of world-class experts from industry and Academia, intensively collaborating over a short time period. The project leaders are carefully selected based on field expertise and exceptional leadership skills. The projects are intense, with sharp focus and a finite time frame. This makes them attractive to the highest calibre talents and the nature of the challenge inspires unusual levels of collaboration.

3. **Independence**, meaning that DARPA selects and runs projects independent of other governmental entities. The organization does not get stalled by hierarchy or governance structure and can move fast and take bold risks, which makes the projects attractive to the best and brightest.

Project leaders within DARPA are also different from industry traditional project management roles. They are focused on managing constant flux,
which means change is natural both in terms of project contents and in terms of talents - a continuous learning journey to find the solutions to challenging problems.
4. Summary of appended papers

This chapter provides the abstract of the appended papers, their relation to the thesis and the contribution of the thesis author as one co-author.

4.1 Paper A:


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.

Relation to the thesis

This paper contributes to the thesis as early insights in how online sharing of ideas can be implemented, including what motivates and demotivates users to contribute, how the company culture influence the usage of the tool and what surrounding support is needed to make the tool useful and utilized. Together with the co-authors the implementation of the online platform was observed and analyzed in isolation from the company context and insights from that helped in the following versions of the online idea platform.
Contribution

Benaim, Larsson and Larsson were able to have an outside perspective, performing interviews with different users in the company, including the author and her team. The author were able to connect the outside perspective with the inside context and in her on-going development work adjust the tool and support system based on insights gained from the research. The author’s contributed in this paper by sharing observations on how different generations of the idea sharing tools were utilized and the feedback received from the users. The tool was implemented in an experimental, iterative manner and the author could see how to adjust in the next version, implement that adjustment and observe the impact of those changes at the same time as other important factors, such as line management involvement and clear process, could be identified and prepared for implementation.

4.2 Paper B:


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.
Relation to the thesis

This paper contributes to the thesis with insights related to how to measure a company’s innovative capability. Even though this was early in implementation work in the company and the first assessment was a pilot it gave important understanding about how the following steps need to be taken. Insights gained in this paper pointed out the importance of providing the involved employees with clear directive and the impact of different levels of management support. The implementation in the company was done in a manner that would not disturb any on-going new product development projects and this condition gave the researchers a very clear insight about the struggle for individuals driving innovation initiatives to obtain time, attention and support for their activities. Together with the co-authors the first attempt to measure innovation was observed, providing insights that helped adjusting the following assessments and also added perspectives to the continued research.

Contribution

Benaim, Larsson and Larsson, being external from the company, could compare the specific case with other companies and related research and point out the potential weaknesses with the “do not disturb” approach. The author as insider needed to adapt the method to fit in the context, with the given limitations, and drive the wanted changes. Instead of pointing out the problems with the company approach the author could actively engage herself and the team in supporting and encouraging the involved employees. The combination of the external, academic research perspective and the real-life condition led to research results that enabled adjusted approaches in the continued work in the company and insights for other cases in the future. The author was able to observe reactions, discussions and other contextual implications of the implementation of the innovation measurement system. The added insights from the broader dialogues additionally to semi-structured interviews by academic researchers gave broader and deeper insights about the direct and indirect effects in the global organization. Also in this paper the research is based on observations and insights from an experimental implementation of a tool and iterative adjustments to improve in a following version,
innovation engineering philosophy utilized to develop better innovation engineering capabilities. The observations and insights gained both by the academic and the industrial research perspectives provided useful data for the research and the published paper at the same time as the company internal solution could be improved.

4.3 Paper C:


Abstract

The paper explores the implementation process of an innovation measurement system prototype to support a heavy machinery multinational company to secure their innovative capability. In general, companies recognize the importance of becoming innovative to become, or remain, competitive on a global market. The case company decided to pilot a measurement system that corresponds to the crucial factors to secure innovative capability and work with the stepwise improvement based on the assessment results. The methods are based on design-research approach and participatory action research. Interviews, surveys and observation were used, as well as, workshops were conducted to develop and follow up the implementation innovation measurement system. The findings explore topics and open questions related to metric selection, purpose and use of the selected indicators, as well as challenges related to the implementation of the metric system. Some of the conclusions question the viability of measuring project teams, as well as, it suggests the need for further research to clarify whether team metrics need to be developed in parallel to organizational ones.

Relation to the thesis

This paper contributes to the thesis with further insights related to how to measure a company’s innovative capability and how the by the author proposed innovation model corresponds with the metrics. In this work the authors were able to confirm the importance of developing company-
specific metrics, with involvement from the broader company. This paper contributes to the thesis by providing indications that the metrics do not need to be scientifically proven to be useful in driving change. The selected metrics help to drive actions, monitor progress, provide experimental data to learn from and be the basis for reflections. If the wanted change begins to happen it seem to be useful metrics. The gained understanding described in this paper gave enough indication for the company internal team to continue to drive the implementation of the innovation assessment system.

Contribution

By participatory research and company work Benaim and Elfsberg designed company-internal, cross-departmental workshops to gather a gross list of suggestions for company-specific metrics. Through collaboration with T. Larsson a selection of the company specific metric system was done and the team deployed it. Throughout the work interviews and surveys provided research data. Larsson A. and Larsson T. both supported the development of the paper with theoretical background and general academic expertise. The author’s contribution to this paper was that she in a similar manner as in previously mentioned paper was deeper involved in the daily, global development work and could add to the time-constrained semi-structured interviews observations and insights with her research peers. Also, in the role as both an industrial PhD-student and one of the interviewees, the author had the possibility to observe the inner life of the company as well as the objective observations and conclusions together with the academic research colleagues. Due to the complex organizational structure, the global distribution of the workforce and the continuous change going on in the company it was beneficial to have the insider perspective – some cases of misinterpretations could be mitigated thanks to the broader, holistic perspective of the author.
5. Insert innovation

In February 2010 the company’s executive management team approved a framework named “innovation model” with the purpose to strengthen the company’s innovative capability. The author and her team were nine months earlier tasked to find a way to capture untapped ideas in the global organization and have the best ideas developed into innovations generating profit for customers and for the company.

The innovation model was defined after performed benchmarks, literature studies and collaboration with academia. Implementation started with the global R&D function as a first step; with the intention to include the entire company in a later stage.

The framework was defined in a way that it addressed the entire development process from ideation to innovations available on the market generating revenue. Clearly the company leadership had as main purpose with the initiative to increase number of internal ideas transformed to valuable innovations. The company’s definition of innovations is “new solutions adding value to the customers”, which ideally would involve most functions in a company; but to make the initiative tangible the scope was limited to the R&D function in the start and the established product development processes were supposed to be kept unchanged, with no disturbance from the initiative. The author of this thesis led the work with the innovation model as part of her responsibility to drive exploration and innovation for the future of the company. This was one part of the Advanced Engineering organization, responsible for the Advanced Engineering process. See following Figure of the Advanced Engineering process (knowledge value stream) in the company.
5.1 The Innovation Model framework

The nine essential factors included in the Innovation Model framework are listed below.

1) Innovative culture
2) Sharing ideas
3) Future goal
4) Clear innovation process
5) User oriented
6) Clear leadership
7) Committed management
8) Inspiring working environment
9) Time for ideas

The nine factors in the innovation model are selected as the essential ones to enable innovative capability in a company and are described below.
1. **Innovative culture**

This factor involves the tangible working climate that is influenced by how employees treat each other, formed by shared perceptions and attitudes related to the organization. This also involves the more intangible corporate culture based on employees' shared beliefs and assumptions about the organization’s expectations and values, which are stable and more difficult to change. An innovative culture embraces diversity and creativity and make sure ideas and interactions take place frequently even when work load is high. The innovative culture also welcomes problems and celebrates failures because those can be learnt from. In an innovative culture the leadership is willing to take calculated risk and bet on promising, uncertain opportunities, accepting that failures will happen on the journey towards success. An innovative culture embraces experiments, iterations, collaboration and people in the organization understand that many insights and ideas are needed in order to get hold of the best ones. Negativity, criticism and blame are not common in an innovative company culture.

2. **Sharing ideas**

This factor involves the understanding that ideas become better when insights and ideas are shared and built on by people contributing with different perspectives and different ways of thinking. When it comes to innovation it is certain that the future lies in collaboration rather than isolation. One individual’s insight or idea can be combined with others’ and additional ideas are generated by interactions. In an increasingly complex and rapidly changing world, different perspectives are needed to build innovations that create differentiating advantages. This factor triggered the implementation of the company’s online idea sharing tool, first version launched in 2011.

3. **Future goal**

This factor points out the importance of having a direction, a future envisioned end state, to strive towards in order to make progress. At the time for this framework no long-term target existed and since this is an important factor to drive meaningful innovation the author and her team
developed an attractive vision considering both customer needs and new technologies. Innovative companies make sure to have a desired and challenging future to strive towards and always consider the long-term perspective in parallel with the short-term. It is necessary to imagine what will happen in 10, 20, 30 years even if everyone understand that nobody is able to predict the future. The vision, the direction and the attempt to shape the future improves a company’s ability to be innovative.

4. Clear innovation process

This factor relates to the need for employees to know where to go when they have ideas that they want to explore. With a clear and simple, agile and transparent process for exploring ideas every employee can feel included in the innovation process – if you want to there is a clear and simple way. The idea process created in the company is defined by association to gardening where an idea is a seed that is planted, the investigation is a sprout that is growing and the flower is a finalized investigation – resulting in sufficient knowledge to know if it is interesting to proceed and what next step can be. See figure below for a schematic view of the company’s idea process.

![Figure 8. The idea process with seed, sprout and flower](image)

5. User oriented

An innovation is a new solution adding value for the customers or the users. This factor points out the importance of having customer and/or user focus and start from there with all innovation initiatives. To truly
understand the actual needs is crucial because needs lasts longer than solutions. A company’s competitiveness is more sustainable with need-based innovation, rather than product-based, and that approach help companies to adapt its solutions to new, identified needs. One way to strengthen this factor is to develop need-finding skills in the company and the author and her team made the first innovation model related tool a workbook for systematic customer need-finding. Innovative companies never forget the reason for their existence and respond to real needs with innovative solutions.

6. Clear leadership

In large, mature organizations any innovation initiative will end up having low priority while quality problems, production issues, cost reductions and NPD projects are always in focus, unless company leadership addresses the need to be innovative. With a strong executive leadership protecting and promoting the innovation initiative it can survive. Even with that clear leadership it is of high importance to point out that everyone is invited to contribute with insights, ideas and innovations.

7. Committed management

An organization striving for better innovative capability needs to have strong management commitment, supporting that aspiration, all the way through the hierarchy. The commitment is more than only accepting that innovation must be allowed; it also includes active contributing in creating the right conditions, encouraging employees to participate and sincerely desire innovation initiative from the employees. The explorative work that spurs radical innovation is much different from the linear, predictable incremental improvement work for which the stage-gate processes and the governance structure usually are optimized for. With managers hesitant or ignorant to innovation the company will not be good at innovation, even with pockets of successful isolated innovation activities, because the entire system impacts the company’s innovation performance. Managers must support and encourage the employees to contribute with ideas. Top management must request creativity and new ideas in parallel with deliveries and quality. Innovation is fragile and needs protection and to secure long-term commitment the line management should be the protectors.
8. **Inspiring working environment**

This factor is related to both the physical and the virtual room for interaction, experimentation and co-creation. These conditions are needed to secure innovative capability. For a globally distributed and culturally diverse workforce the virtual working environment can be the differentiating advantage or disadvantage. Insights and ideas shared across the global community can be combined and lead to unique innovations - therefore the virtual working environment need to allow for ideas to build on each other and fluid discussions around the clock, independent of time zones. The physical working environments need to similarly allow for interaction, experimentation and co-creation. The possibility to spontaneously go from words to action - from a spontaneous talk over lunch to building simple prototypes is crucial to innovative capability. Companies where leadership have a biased towards the exploitation are often optimized for the predictable, efficient and cost-optimized system even during meetings and prototype builds. This makes the non-linear process of innovation engineering difficult to embrace since it is far outside the comfort zone. A company that embrace both explorative and exploitative activities have room and acceptance for both even though the needs and approaches are much different.

9. **Time for ideas**

Companies with focus on exploitative activities, with cost optimization and efficiency as top priorities, might end up with insufficient innovative capability due to the fact that time for ideas has been driven down to a minimum. Innovation requires slack in the daily work to allow for observations, reflections, interactions, collaborations and associations, the five discovery skills defined by Dyer et al [59]. With workforce utilization as a key performance indicator the important slack can be perceived as waste by KPI chasing leadership and that will not strengthen the innovative capability of the company. When “free” time is considered as undesired, employees might feel that creativity, ideas and interaction with others must be eliminated. Such behavior damages the company in several ways; without new ideas innovations cannot be created and the employee engagement goes down when passionate engineers don’t have room for free thinking, creative problem solving and ideation through interaction with others.
5.2 The Innovation Coaches (iCoaches)

The previously described framework is essential to enable a company to be innovative, but the drivers of innovative capability are the iCoaches. The iCoaches are the backbone of the Innovation Model framework and a global network of innovation enthusiastic change agents. The innovation ambassadors are called “iCoaches” and work part-time to drive innovation on every site. The first generation of iCoaches (2010) were selected based on their passion for innovation and their willingness to drive and support the initiative, some iCoaches applied because of interest and some were appointed by their line manager. In a global organization with many different sites the number of iCoaches clearly set the status on the different sites and in the global organization. In 2017 there are approximately 50 iCoaches active in the global organization; in most cases more than one per site.

All iCoaches are trained in several methods and tools corresponding with the nine factors in the innovation model, and the trainings are carefully selected by the core team. The network meets and share experiences online regularly and gathers face to face once per year. With the expectation from executive leadership that everyone with a meaningful idea should be able to share it and explore it further, no matter where he or she works, the team decided to define a fully transparent and collaboration oriented process for the exploration activities. The research engineers work full time in the AE process and make the core team for exploration activities and as leaders of the global iCoach network.

5.3 Deciding to measure innovation

Another expectation from the leadership was that the effects of the new innovation efforts should be measurable, preferably with one single metric. It was a clear expectation that the improved ability to tap ideas from the organization would lead to increased profit. The number of filed patents and the number of company-internal invention disclosures (potential patent applications before assessment) were the existing performance indicators related to innovation when the innovation model work was initiated. In the core team discussions with academic collaboration partners and benchmarking of different existing solutions were performed.
The selected method that was implemented is a four-dimensional assessment tool called MINT (Measuring INnovation in Teams) defined by Nilsson et al [35], selected due to the fact that it combines four important dimensions in one system and provides a single total number that can be utilized as the company’s innovation performance metric. Also, the method is built from the idea that innovation teams let managers know how to measure and follow their work bottom-up rather than top down. The MINT approach provides a switch from patents as innovation measure, to activities with potential to lead to innovation in the future. The method was adapted to the specific company through workshops, tested in a successful pilot and then implemented with the company-internal name Innovation compass.

5.3.1 The implementation of the Innovation Compass

At the time for the introduction of the innovation compass the only existing key performance metrics corresponding with innovation performance was related to patent filing and profitability. Through literature studies, benchmarks and dialogues with academia the author concluded that the most useful innovation measurement solution was the MINT (Measuring INnovation in Teams) method, suggested by Nilsson et al [35]. The method assesses innovation in a four-dimensional system, which can be seen as a neural network. The combination of the four makes it possible to have one single innovation performance metric, which was a preference of the executive leadership in the company. The single metric in the MINT system is the average of the resulting data for all four dimensions. In the following figure the MINT framework is visualized.
The MINT method involves four areas: (1) Innovation Elicitation, (2) Project Selection, (3) Ways of working, (4) Impact. In order to be useful for the company the factors need to be defined in the specific company context. Typical metrics for the innovation elicitation area are related to how the company executes its idea process. In the project selection area the factors to assess correspond to how the company balances and manages its project portfolio, for example the balance between exploration and exploitation. The ways of working area include factors about the company’s innovation climate, the organization, competences and process improvements.

The way the MINT method was applied in the company was not directly matching the description of the model, since the entire R&D organization was considered as “the team” instead of a project team performing work together. The more optimal way of implementing the MINT method would be to let all project teams define metrics and then consolidate in the neural network, but in a matrix organization where employees work in several different projects and several types of projects (product
maintenance, NPD, AE) that solution was not feasible. To let every department define their team metrics was not a feasible solution either since the matrix organization with a strong project orientation led to that departments consisted of team members with many different focuses and goals – depending on what projects they were involved in. The author and her team started with involving R&D and had, supported by the executive leadership team, the intention to involve the entire company across all functions once the assessment system was up and running. Metrics were defined through a series of workshops where approximately 60 employees representing different departments and functions participated. With a first generation of metrics in place the team ran a pilot assessment in 2014. The pilot was successful – it resulted in insights about both the characteristics of company’s innovative capability and the value of the metrics. Adjustments in the set of metrics were made and the assessment was company-internal named Innovation Compass. In 2015 and 2016 the assessment was done twice per year, from 2017 it is performed once per year.

With results from the innovation compass at hand several semi-structured interviews were performed including dialogues about how to improve the company and what to change in the assessment. A series of student thesis works focusing on the Innovation Model, the Innovation Compass and the iCoach network and have also provided additional insights and data. All iCoaches utilize the Innovation Compass results to analyze and drive improvements on the different sites, the observations, insights and actions on the different sites have also contributed to the research.

Figure 10 shows an example of how the Innovation Compass result was presented in 2015 and 2016, using a tweaked version of an application called Andara [60]. Later this tool was abandoned since the iCoach network that worked most in the Innovation Compass metric system preferred to work in Microsoft Excel.
5.3.2 Innovation compass data

The data gathered in the innovation compass covers the four dimensions in the innovation system as defined by Nilsson et al [35], these four dimensions are: Innovation Elicitation, Project Selection, Ways of Working and Impact. The metrics need to be context-specific and have been defined and fine-tuned starting with the pilot assessment performed in 2014 and continuously. Below is the system of company specific metrics listed (from 2017):

**Innovation Elicitation Metrics**

- Number of visitors on Interact (the idea sharing tool)
- Number of ideas proposed for exploration as AE Investigations
- Number of ideas being explored as AE Investigations
- Number of finalized AE Investigations with available documentation for knowledge sharing
- Number of ideas being coached by iCoaches
- Number of local innovation events facilitated by iCoaches
- Percentage of local site management commitment to drive innovative capability

**Project Selection**

- Percentage of explore projects vs. exploit projects in Advanced Engineering project portfolio
- Percentage of explore projects vs. exploit projects in New Product Development project portfolio
- Number of on-going Advanced Engineering projects where customers are participating
- Percentage of the R&D budget allocated to the knowledge value stream / Advanced Engineering

**Impact**

- Number of products with innovative features offered to customers
- Percentage of revenue coming from products with innovative features
- Number of publications about the company’s innovations that are not published by the company itself
- Number of registered invention disclosures
- Perception on the company as an innovative brand by our customers
- Perception on the company as an innovative brand by non-customers
- Numbers of concepts tested together with customers

**Ways of Working**

The ways of working metrics are gathered through a survey sent out to employees across the globe, first involving the R&D organization, later expanding to cover more functions and intended to cover the entire company. Besides simple yes/no questions listed below survey respondents are able to type in explanations and suggestions for improvements. This provides both good quality of reliable statistical data, which can be compared over the years, as well as deeper insights triggering further interviews and discussions.
- Are you familiar with the innovation coaches on your site?
- Do you feel that your manager encourages innovative thinking in your daily work?
- If you come up with a new idea in your daily work – can you find time to explore it further?
- Do you feel that you and your colleagues openly discuss ideas to develop them further?
- Do you feel comfortable to post your ideas and/or comments in our idea sharing tool?
- Do you feel that you have a working environment that inspires and enables creativity?
- In your department, do you actively work to understand end-customer needs?
- Do you know the patent process?
- Do you know the company's innovation process?
- Do you know the company future goal?
- Do our leaders clearly stand up for the importance of being innovative?

The core team have learnt from each assessment and removed, added and adjusted questions, carefully keeping several unchanged in order to secure correlation with previous year’s assessments. During the discussions following innovation compass results several managers asked for data covering their own department only. This was not possible since the team have decided to tie the ways of working survey to the site level, but not deeper, as a conscious decision. On department level there is another annual survey available, measuring employee engagement, including leadership effectiveness, collaboration, creativity, communication, vision and clarity of expectations. The purpose with the innovation compass is not to assess particular departments or department managers, but about the innovative capability of the company – per site and globally.

The original driver behind the implementation of innovation performance measurement was that top management wanted to see that the ideas that lead to innovations generate profit. This is of course an important aspect of the measurement, but the most noticeable impact of implementing the measurement was that innovative capability becomes visible and talked about in management meetings. The innovation model framework was approved early in 2010 and even if the work with implementing a
measuring method started quite soon after that, the first assessment was not performed until 2014 and the difference between before and after the first assessment is tremendous. With assessment data available for analysis and discussions, management in the company suddenly show increased interest and care about innovation. The innovation compass metrics both educated the company on what it takes to be truly innovative at the same time as insights about weaknesses and strengths can lead to actionable improvement tasks.

There have been adjustments in the measuring system between the different assessments due to several reasons; one is learning from previous assessment, another is changes in the organization and changed opinions of people involved in selecting metrics and providing data, also removal of non-value adding metrics and a few changed wordings in the ways of working survey to be clearer. Still, the results have been instrumental in the work to improve innovative capability and the ways it have been instrumental are several; it drives the needed behavior, it diagnoses the health of the company in the four dimensions and identifies both strengths and weaknesses, it drives important dialogues and interactions across the organization, and finally the results tells whether the company have improved or gotten worse compared to the previous assessment.

During the implementation of the innovation compass and also long thereafter, many managers wanted to be able to see how they are doing in their specific team when it comes to the ways of working dimension, which is measured in the survey that is being sent out. The core team, which consisted of 2-3 people owning a very small budget for all the innovation model-related work considered what level of granularity should be provided in the ways of working assessment and concluded that only two levels should be provided - one for each site and one consolidated for all sites. The main reasons were the small budget with few resources and the fact that the company regularly do changes in the organizational structure, which could lead to challenges with the innovation compass data. The reasoning behind the decision to only provide site and total levels in the assessment was that innovative capability is tightly connected with culture and working climate and even if global collaboration is natural, the local interactions and relations sets the moods, the mindset and the general innovative capabilities more than

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any other structures. Recently, the organizational structure was changed from global teams to local teams, proving that the decision to consider site level and global level was a wise or maybe just a lucky decision.

The innovation compass assessment did already with the first pilot results provide information that spurred action. iCoaches could see that they were not enough well-known and too few people were aware about the tools and the processes related to driving innovation.

The innovation compass data have been gathered in an excel file where comments related to the different metrics can be made, the four dimensions results can be put together as a total innovation performance indicator. This is an area for further investigation, the MS Excel solution requires that very few people are editing in order to keep track of what is going on and in the app it was easy for the team to write over each other’s metrics and not user-friendly enough for a team to edit. The results could be clearly communicated and actions to improve were taken, but none of these tools provides the visualization that the research team envisioned. In order to engage the organization more a more dynamic visualization would help. For example, the number of users in the idea sharing tool could be visualized through a flow and the instances when the metric meets its target a celebration visual could drive more interest. The most challenging with the innovation compass assessment was all the manual work with discussing with different stakeholders around their metrics and the manual labour in editing the data into the excel sheets. The more data that can be gathered and represented automatically in the innovation compass tool the better, clearly room for development.

The MINT method makes it possible to quickly identify where improvements are needed and after a few assessments it is obvious where improvement have been made and where there is still a lot of work to be done. The domains where the core team and the iCoaches have been able to drive improvements are the ones where the improvements are most visible; Innovation Elicitation and Ways of Working. In the Portfolio Balance and in the Impact domain the gaps between the wanted level (100%, the data is normalized to be comparable across the dimensions) and the measured levels is large several years in a row. What the data shows is also what employees would tell when being interviewed. For example, the bias towards exploit activities rather than explore continues
to be strong and the number of innovative features reaching paying customers is still very small.

When implementing an assessment system of this format, in order to drive change and measure performance it is necessary to allow for adjustment of metrics, even if it disturbs the repeatability, driving change do not require absolutely correct and scientifically proven data, but something to refer to when initiating dialogues and knowledge building.

To continue to drive this work in the company it would be helpful to find a better visualization tool and to have both more intuitive and more automatically generated metrics.

5.4 Establishing online sharing of ideas involves real life too

One of the main reasons to establish the Innovation Model framework was to get hold of untapped promising ideas from the large, global organization. With that in focus the author and her team was tasked to make sharing of ideas online happen as one of the first deliveries. The team discussed with the executive leadership if the initiative should be internal or also inviting external contribution in order to enable open innovation. Chesbrough [61] suggests that open innovation is necessary to stay competitive and the author also believe that, but due to the low maturity of the organization and the executive leadership’s focus on internal untapped ideas the decision was made to first establish a well-functioning internal idea sharing process and tool, where all employees of the company should be invited to participate and later reconsider the possibility to also invite external ideators.

The first initiative to make online sharing of ideas on a global scale was a series of Innovation Jams, following the IBM concept, described by Bjelland and Wood [43]. The Innovation Jams had different strategic challenges, selected by the R&D leadership team and were performed in 2010 and 2011. The Innovation Jam concept developed by IBM with a first experiment in 2001 and further refined to an online innovation and collaboration platform called InnovationJam™ is a great solution to punctuated ambidexterity and directed innovation, but by design selective and many great ideas stay untapped when they do not fit with the selected challenges.
The conceptual idea with innovation jams were replicated from IBM’s experiment and all the needed processes, structures and tools were put in place by the author and the core team. After the R&D leadership team selected strategic challenge area the core team invited all employees to participate in the events online. For the first two jams the dedicated sharing pages were designed within the Windows SharePoint solution - familiar to all employees, but with several limitations. Using feedback and insights from the first two jams the core team concluded that a better tool was needed. The team explored online idea sharing solutions available on the market and when none of these met the identified requirements the team decided to develop a new platform for online insight and idea sharing together with a small web design bureau. The platform called “Interact” was created, providing possibilities to share insights, ideas, problems etcetera - and interact online with colleagues across the globe. The first version went live in 2011 and have is since then been updated continuously to improve and adjust to process and organization changes in the company. In the online idea sharing tool there are two domains; one where anyone in the company can initiate and participate in group discussions around any topic, and one where ideas are entered into a process, to be evaluated and potentially selected for further exploration and investment. Statistical data in the platform is generated automatically and followed up monthly on a dashboard, examples of metrics are:

- number of users
- numbers of posts
- number of ideas introduced to the innovation process
- number of ideas coached by iCoaches
- number of ideas evaluated in the innovation process
- number of ideas being investigated in the innovation process
- number of investigations performed in the innovation process
- time from initiated to finalized investigation

One important feature of the Interact platform is that it is dynamic, even though a lot of work has gone into designing it properly with many different user personas in mind, changes can be done fast and easily with small investments. Another important feature is that it is including everyone in the company, there are no license fees and no separate user identifications or passwords. If you are an employee you are welcome to
participate and that is an important detail when driving innovative culture.

A collaborative working climate need to be established both online and on the different sites where employees are working. A culture that encourages sharing include openness, trust and willingness to collaborate and contribute need to be nurtured in the physical office, in the daily interactions, as well as in the online tool. Discrepancy between the two gives the least safe, trustful and open culture the upper hand. With the expectation from leadership that the innovation capability should be strengthened stepwise without disturbing the on-going delivery work it was challenging to get the openness established on the online platform when the daily interactions did not encourage sharing and interaction. The aspiration to make employees willingly share insights, concerns, questions and build on others ideas through online dialogues was clearly too ambitious in the beginning of this work. At the same time the team could see that the company leadership was correct when they assumed there were many untapped ideas within the company. In the Innovation Jams many employees posted their ideas and expected quick feedback, few employees took the time to read others posts and build on them. One reason for this behavior was that during the limited time that the Innovation Jams took place employees were able to find time to quickly post their ideas, but then they felt that they had to do “real work”. Since leadership was not promoting innovation in the daily work employees felt that this activity was unimportant and came on top of everything else that need to be done urgently.

Insights from the innovation jams led to new ideas. The author and her team saw that the jam concept inhibits a lot of limitations. Instead ideas should be welcomed throughout the year, fostering a culture of contextual ambidexterity instead of the punctuated. An improved idea management process/innovation process and workshop facilitation training for iCoaches was launched, utilizing the MOVE model, developed by Carleton et al [62]. In order to accomplish effective idea sharing in a company, an open and transparent process that employees can understand, trust and feel included in is necessary. Participants need to rapidly receive feedback when they post their ideas is a hygiene factor, and the feedback must be appreciative, precise and meaningful. The MOVE workshop competence enabled iCoaches to foster innovation and creativity on the
sites. This was done to strengthen the innovative culture on all sites, to get hold of ideas that were not shared online, and get them online, and most of all to close the gap between the desired online culture and the actual local site cultures.

Following two conditions in the company made the first innovation jams less creative and collaborative than anticipated:

- With efficiency and delivery shaping the working climate many employees felt that spending time in the jams were not “real” work. Instead of participating in the collaborative dialogues and co-creation process many just quickly joined, posted their ideas with no awareness of similar ideas and no time for interaction. Then they went back to their daily urgent work tasks and delivery mode. A feeling of guilt for spending time in the jam was observed.
- The jams were addressing different predefined challenges with a small group of sponsors/receivers appointed and iCoaches as facilitators. Together the sponsors and the iCoaches provided inspiration material in the start of the jam and they also continuously provided feedback during the jams. The sponsors/receivers selected ideas to invest in and this together with the working climate made the jam more of an idea posting competition and a linear journey for the surviving ideas, instead of establishing co-creation and dynamic collaboration.

The author and the core team abandoned the innovation jam concept and instead defined an entirely transparent idea process, defined as the idea process, including the non-linear group discussions and the Explore phase in the AE process. In this process many people can participate in dialogues and selection of ideas to take further is based on collaborative understanding of the opportunity rather than a strict time-limited event for idea generation.

The importance having iCoaches with the right mindset and competences was recognized. They serve as cultural ambassadors, driving innovative culture, at the same time as they are facilitating in the idea process both locally and online. The iCoaches need to have the right competences and capabilities in order to strengthen the company’s innovative capability.
Rylatt [63] revealed in his research that these three capabilities differentiated high- and low-performing change agents:

- Taking responsibility for resolving difficult challenges
- Articulating compelling reasons for change
- Ensuring accountability over time

Most of the iCoaches involved initially were highly engaged employees with intrinsic motivation and passion for innovation, but with no specific training in driving change, fostering innovation or facilitating collaboration. By not having sufficient training in place from the beginning the author could observe what worked well and what did not and define the training needs for iCoaches based on identified gaps instead of assumptions. The author and her team decided to establish annual iCoach Days where the network could meet face to face, collaborate and receive training and tools.

All iCoaches were asked about both their contributions as hard and soft results and their motivation and two key criteria to have well-functioning iCoaches are that they feel support from local management and that they are being utilized by many, not only the department they belong to. The innovation work and the iCoaches have been challenged several times by the efficiency oriented company culture which in many ways caused problems and slowed down the work, but at the same time the global network was strengthened by the feeling of being underdogs and the willingness to share best practices and ask for help happened naturally. The innovation model and the iCoach network survived in harsh conditions, fostering a team spirit of patience, persistence and collaboration. Would they prosper in better circumstances or is the resistance necessary to make them motivated?

In order to create drive and confidence in the iCoach community the global collaboration was not sufficient - iCoaches often felt marginalized and innovation was seen as a “nice to have” instead of a necessity on the local sites. The problems were the biggest on sites where only one iCoach was located, and easiest to manage on small sites with 2 or more iCoaches.
The decision to go for the iCoach approach was selected after literature reviews and insights from colleagues’ experiences with a similar network called cultural ambassadors. The solution had its challenges, but successfully enabled the company to establish contextual organizational ambidexterity. Even though the company have gone through several organizational changes and substantial budget reductions the iCoach network continues to be committed and motivated in driving the change and supporting colleagues locally and globally. When iCoaches on one site struggles due to budget reductions or urgent deliveries other sites are asking for innovation and the global team can encourage each other and provide support to each other, keeping the initiative alive over time. The global network of iCoaches has sufficient innovation competence as a total and when there are competence gaps in individuals the global team can engage and contribute. The individual preferences determine individual skills related to innovation and every local site has specific needs that the local iCoaches need to satisfy. Instead of making every iCoach being good at the same methods and tool the network utilize the strength of being many.

Site specific conditions requires site specific approaches, so while on some sites the iCoaches facilitates creative workshop most of the time, on others sites innovation areas are established. Some sites request training and guidance in need-finding methodology while others are more focused on understanding patent and innovation processes.

The understanding that the idea process does not start with ideas, but with insights and sharing of insights makes a big difference in the innovation performance. Leaders of a company need to understand that exploration and exploitation activities have different characteristics, requiring different ways of working, different ways of assessing performance and in general different mindset are used in these two domains. With that understanding organizational ambidexterity can be secured.

Even if a lot of the insight and idea sharing can take place online it is important to combine the “online life” with a matching real life culture. With both these reflecting the same trustful, inclusive and open work climate the combination of those makes the idea process more dynamic, collaborative and successful. By integrating these two worlds - the virtual and the real one can accomplish efficient idea sharing, meaningful idea
coaching and strengthened innovative capability in the innovation elicitation area. Failing to combine those two worlds lead to a disconnection and the company will risk that other, site unique and isolated idea processes are initiated. This can be problematic for companies with R&D forces globally distributed because the same idea might occur, be discussed and developed by several teams in parallel not aware of each other’s work and competences. Lacking global collaboration and knowledge sharing can be a dangerous competitive disadvantage, causing both inefficiency in the organization and unnecessary slow time to market.

Coaching of ideas and collaboration around ideas is difficult to do well online, especially if the physical office environment does not reflect the same collaborative and transparent working climate. The disconnection between online idea sharing and daily office atmosphere can cause a discrepancy between the two - where the least collaborative and open work environment tends to dominate. The motivation to actively participate in the online idea sharing tool is influenced by the site specific working climate and the manager behavior. The online collaboration tool, transparently providing knowledge and inclusively inviting everyone to participate can be a great asset to the company if respected and included as part of the daily operation, but can also cause frustration and even be demotivating if it is seen as a separate side activity, not really part of the “real work”.

The team working with the idea sharing tool concluded that instead of collecting ideas through focused and time limited innovation jams the company’s idea process should always be open for employees to share insights and ideas, to discuss and ask for input, to know what is being discussed and to be able to get funding for exploration of ideas. The online idea sharing tool enables that and complete transparency within the global organization. To further support such dynamic the AE Process was split in two phases - the explore phase and the mature phase, where the explore phase is where ideas are further explored and the mature phase is where AE projects are executed in order to provide the right maturity level to the following NPD process.

When ideators wish to spend time and money on exploring their ideas, for example purchasing components for prototypes, iCoaches coach and
support them to describe their ideas clearly, to connect them with strategic directions and knowledge building needs and once the idea is on the right level promote it to suitable AE Programs where decisions for funding can be made. The selected ideas are taken further as AE Investigations and with the entire idea process openly and transparently shared in the online tool, the organization both achieve new knowledge on a broader scale and well-defined project descriptions for the following steps. Also in the cases where the conclusion is that the idea should not be further developed the achieved knowledge building is documented and available for all employees to learn from.

The AE programs are managed by program leaders who are employees in the AE focused department and up to 5 core team members from different departments, to secure diversity in ways of thinking and inclusion. The core team members are selected based on customer, industry and technical understanding and entrepreneurial mindset. The organizational ambidexterity is strengthened through the broader involvement in the AE Programs, where exploration is in focus and exploitation is supposed to happen in other phases of the development process.

The event-driven innovation generation, the punctuated ambidexterity, was not what the team believed would survive in the particular company context; instead the online tool would be a “thinking together tool” where sometimes ideas would be promoted for further investigation, while sometimes the online conversation itself would be enough. That is the reason why the team decided to develop a corporate specific, tailor-made online idea sharing platform.

5.5 Securing time for ideas

Observations performed during 2009 showed that many engineers felt that free time for ideas and innovation was reduced to a minimum. Their work tasks in projects were defined in detail and seemed to always be time critical. It was not uncommon that engineers were involved in more than 5 different projects and on top of that they were also expected to participate in continuous improvement activities and department meetings. Many of the interviewed engineers said that there was no room for reflections, observations or interaction with colleagues except for time constrained, regularly scheduled meetings. An engineer engaged in
several different projects participated in more scheduled meetings and also needed more time to shift focus, which leads to even less room for ideas. In 2009 the new global organizational structure led to that many engineering teams were globally distributed and some engineers had their line manager on other sites. This caused a disconnection between the engineer and his or her line manager, while project managers driving deliveries had more interaction with the engineer than his or her line manager. The interviews performed during 2009 showed how most engineers believed that ideas were not wanted, except if they are solving urgent product maintenance problems. Engineers expressed a frustration about being too tightly controlled and no time for creativity or interaction outside project work.

One department had a different situation, out of the approximately 2000 engineers, 20-25 research engineers had as main responsibility to come up with innovative solutions for the future generations of the company’s offerings. They were part of the Emerging Technologies team and worked only in the advanced engineering process. The intention with the team was that they would be the core of advanced engineering, always focusing on innovation and exploration and driving the long-term roadmap by identifying most promising technologies for the industry and conceptualize those. Other employees were invited to participate in the advanced engineering work, both on the ideation side and the project execution side. This was challenging because of the high workload in several projects and also the communicated priority order where product maintenance activities and industrialization project activities always had higher priority than advanced engineering activities. Even though the intention with the emerging technologies team and the advanced engineering process was to create a combination of structural and contextual ambidexterity the constant lack of free time for engineers and the low priority of advanced engineering led to a disconnect in both the organizational and in the process domain. Several years later many advanced engineering projects with promising results got stuck. The reasons why promising results did not get further were several; project planning, resource allocation, knowledge sharing etc. The lack of involvement from the broader organization of engineers, documented results in textual format and presentations are not easy to take further if you have not personally been involved in the knowledge building process. Also, when creating product plans based on incremental updates of
existing offerings rather than considering customer needs the innovation contents becomes minimal - instead the next generation should have a little bit better of everything that already exists.

The R&D spending in the company was continuously challenged and reduced during the time for this work, both during good and bad times. With a financial target of 3.5% of the turnover the R&D workforce was expected to deliver more with fewer resources. The company which have developed physical products for many years spend more and more time on the combination of physical products with embedded software, still leaning on product development processes and methods optimized for hardware. More efficient use of resources could be enabled by implementation of more simulation tools, model based development and integrated PLM system, but the financial targets made such initiatives difficult to push through. Great examples of improved process steps, methods and tools could be found in pockets of the organization while the total system still relied a lot on the waterfall process model.

In the strife to get control of the R&D spending the finance department have supported with tools and processes that had a good intention but led to a bad behavior, at least if your mission is to secure innovative capability. In an annual process budget owners define the projects to run, the resource need and demand resources from each department based on the well-defined project work packages that defined the deliveries in the projects. Every line manager sees these demands and can then also see if they are under- or over allocated. The number of employees per department is determined by the sum of project demand, plus a maximum of time for non-project activities. A line manager with too low project demand compared to the capacity in the team fearfully start to chase demand from project managers while a line manager with too high project demand start hiring additional staff. Based on a company culture with focus on following the process project managers and line managers are busy in the administration tools and have limited time to discuss the actual contents of the projects, the realistic time needed and the competences and motivation factors of the individuals. Process and budget focused leaders have no time to check with other departments if they can support the project and the project managers request hours from particular departments only, invisible to departments with low demand.
The line manager behavior is determined by the financial control system instead of the purpose of the organization and care for the people. Even the previously mentioned Innovation Jams needed to be paid by a budget owner and allow for engineers to report hours and even with this many engineers witnessed that they felt guilty for wanting to take part in the innovation activity since they had many different delivery projects that always had higher priority than innovation and advanced engineering.

The financial reporting system had room for reporting hours that were not project related, called non-billable hours, including time for department meetings, continuous improvement work, competence development and technology specialist time. Every department had a KPI called chargeability, which was the percentage of project reporting time, when the non-available (parental leave, sick leave, overhead) and the non-billable hours where excluded. For the bigger part of the organization the target number was 81% time on projects and anyone with less time than that for projects was challenged, and also their hourly rate went up which caused disturbance to the project’s budget spending.

Several times during this research the very detailed cost control within R&D at the company have been brought up since Innovation Compass results show this as the main concern and frustration of employees. With a company which performance is measured through quarterly financial results and a targeted level of R&D spending leading to cost reduction mode for several years it is difficult to abandon the detailed finance control. Knowing that the extreme level of control causes inefficiency and frustration line managers find creative workarounds in order to create room for interaction and innovation. During 2017 a shift in mindset of executive leadership could be observed and for the 2019 budget processes it is likely that a changed and improved approach will take place.

In order to secure that time for ideas is protected an idea process was included as the front end of the AE Process, in this process ideas can be shared, discussed and further matured to the stage where funding from the Explore phase enables ideators to further build insight and knowledge. The entirely transparent process with its online sharing tool Interact invites all employees to contribute. The selection of what ideas to take further is done by cross-functional core teams and the documented results are stored online, available for all. Some ideas do not match the criteria to
be funded by AE, some are about organizational development and should be funded by the departments themselves, some are just adjustments of existing products and should be funded by industrialization project budgets. Here the company still have improvements to do, and good progress in addressing several different funding mechanisms matching the different types of ideas.

All the initiatives from the author and her team, including funding and allocated time did not lead to the wanted situation. The clear communication from executive management supporting innovation and requesting ideas was not sufficient either. The voluntary opportunity to participate in innovation work seems to engage and motivate some individuals that passionately want to innovate, but not so many. The individuals utilizing the opportunity would most likely have found a way to proceed with their ideas anyway, officially or not. The difference was clear when the line management also asked for innovation, then engagement came on a broader scale and the ideas process started to gain traction. The author witnesses many cases when engineers complained that they had no time and no budget for innovation and when this was provided they still did not take the opportunity, unless their direct manager asked for it. With several different R&D sites to observe the team could clearly see, both in the innovation compass data and through the selected local actions whether local line management asked for innovation or not. The different sites and the different departments addressed the need for innovation in different ways - unique for every site, and iCoaches shared their failures and best practices with each other. Time for ideas will be reality when the system provides the prerequisites AND when the line managers ask his or her employees for it.

In the early days of the innovation model work it was a common criticism from the organization that innovation should not be in focus when quality problems must be fixed. To establish a broad understanding that quality and innovation need to co-exist to secure long-term success is not easy and particularly difficult in times when executive leadership and site management focus heavily on short-term and quality. The team, including the iCoaches, have learnt to have patience and adapt to the local circumstances and plan the innovation related activities carefully in time. The important connection between iCoaches and local site management is observed and where it works well the iCoaches and the local management
team drive innovation together in a way that is best for the local site. The iCoaches have developed skills to drive innovation in good and bad times, with and without support and most of them do so, respectfully and selflessly, knowing that this work is about the company future, not about individuals getting well-deserved recognition. With many challenging situations it is important that the global network make sure to provide support and recognition.

The major problem in creating time for ideas is the financial focus. If you control the engineering team on every project they work in and driving key performance indicators (KPI’s) that are efficiency metrics based on hours in projects at the same time as you limit hours available in projects you will eliminate time for ideas, except for the cases where the line managers finds ways to hide that work. When a R&D organization focus heavily on finances and detailed control the passion for the engineering discipline and the engagement in goes down. Engineers start to ask for reporting numbers even before they respond to a question and when project demands decide size of departments managers start to chase for demand figures instead of contents and employees see the fear and also get anxious. The finance focused R&D department is not an innovative organization. Zoom out from the R&D cost perspective and focus on business, future business opportunities and customer needs and a more innovation supporting behavior can be trained. In an ambidextrous organization both short-term exploitation and long-term exploration are equally important, side by side, with different approaches.

5.6 Line managers’ influence on innovation

The company’s executive management team made the decision that the proposed innovation model should be implemented. The leadership delegated the implementation to the author and her team and requested status updates regularly. Since the decision in February 2010 several major organizational changes have taken place and many executive managers are replaced, through all this the innovation model work continued. The only adjustment was that hours for the iCoaches work was funded by the Advanced Engineering budget until 2017, then the responsible executive manager decided that those hours should be part of the department expenses, similar to continuous improvement, department meetings and competence development. The reason was that innovation,
just like continuous improvement is something every line manager should support and encourage.

With strong support and consistent commitment from the head of R&D the innovation model work kept progressing also during very tough times. The small budget and the site adaptive / collaborative approach with the highly motivated iCoaches made it possible to show progress and promising results even when using small amount of resources. From 2015 the Advanced Engineering Program structure proved that the systematic idea process generated a lot of innovation knowledge and the executive management team protected the initiative even when the total AE budget was dramatically reduced.

iCoaches invited themselves to site management team meetings; information was spread in town hall meetings, intranet news and through emails. The core team presented the progress annually, until 2016 the regular updates were presented to the company executive team, but after some organizational changes the reporting was directed to the R&D leadership team. The initial intention to start with R&D organization and then expand was forgotten.

In some departments the line managers was supporting and actively participating in driving the innovation initiatives, in some departments the line manager allowed an employee to be an iCoach, but did not care, controlled that the time spent was not more than the agreed 10% and made it clear that innovation was not a priority.

The author has analyzed line managers’ relation to innovation from 2009 to 2017. From 2014 the Innovation Compass provided global data. The survey question: “Do you feel that your manager encourages innovative thinking in your daily work?” provides Yes (100%) or No (0%) data from all sites, consolidated as a site average. The question is followed by an optional free text box where respondents explain more. The Innovation Compass results are also utilized by iCoaches in follow-up activities. Here additional information about the line manager support, the department climate and the site culture can be discussed and analyzed. Below graph shows the answer to above mentioned survey question in 2015 and in 2017. The 7 sites are selected because on those sites iCoaches been present from the start, the number of respondents is sufficient to be
reliable and free text responses provide enough additional information to draw conclusions. The year 2015 and 2017 are selected because data from these years is considered to be most correct, with organizational stability and comparable metrics. In general one can see that all sites still need to work on reaching the 100% goal where every respondent feel that the manager encourages innovation. One concern mentioned by many is the way projects are managed and budgets are being followed up, another concern is the bias towards urgent activities. Innovation and creativity is low priority for almost every departments, except the few working full time within Advanced Engineering.

![Figure 11: “Do you feel that your manager encourages innovative thinking in your daily work?” average per site 2015 (blue) and 2017 (red) ](image)

The different sites have different characteristics and challenges. When analyzing the results it is important to understand these differences. The differences considered in this study are site priorities, site focus, site size, site leadership and connection between iCoaches and line management. There are other differences to consider - such as leadership styles, age distribution and gender, etc. The Innovation Compass setup do not allow for such detailed insights; in fact the hierarchical and traditional organization in this case have mainly rule-based, authoritarian leadership styles and nearly 100% middle age or senior men in the leading roles. In table 6 the different sites characteristics are described.
Table 6: Site characteristics 2015 and 2017, unchanged if not noted

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
<th>Site 5</th>
<th>Site 6</th>
<th>Site 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priorities</strong></td>
<td>Business</td>
<td>Delivery</td>
<td>Delivery</td>
<td>Business</td>
<td>Delivery</td>
<td>Business</td>
<td>Business</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>One Product</td>
<td>Across Products</td>
<td>Across Products</td>
<td>One Product</td>
<td>Across Products</td>
<td>One Product</td>
<td>One Product</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Medium</td>
<td>Small</td>
<td>Large</td>
<td>Large</td>
<td>Small</td>
<td>Small</td>
<td>Small</td>
</tr>
<tr>
<td><strong>Site leadership</strong></td>
<td>Strong, narrow</td>
<td>Strong, wide</td>
<td>Scattered, wide</td>
<td>Strong, narrow</td>
<td>Strong, wide</td>
<td>Strong, narrow</td>
<td>Strong, narrow</td>
</tr>
<tr>
<td><strong>Connection iCoaches / Leadership</strong></td>
<td>2015: Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>2015: Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
</tr>
<tr>
<td></td>
<td>2017: Strong</td>
<td></td>
<td></td>
<td>2017: Strong</td>
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</table>

The “time for ideas” survey result added to the picture provides further indication that line managers are most influential to individuals’ motivation to contribute in innovation work.

Figure 12: “Do you feel that you, in your daily work, have enough time to spend on innovative ideas?” average per site 2015 (blue) and 2017 (red)
Top management have consistently supported and protected the initiative, but local managers’ attitude determines the innovative capability’s strength or weakness. After all, the line managers form the work climate and prioritize among tasks.

Where iCoaches are utilized as support to the local site managers the respondents feel that innovation and ideas are more supported than in the cases where the connection between line managers and iCoaches is weak. Also, over time it is clear that the local site managers have bigger impact than the global initiative. The difference between allowing people to be innovative and asking for innovation is tremendous when it comes to employees’ relation to innovation. In a large organization there will always be individuals with a very strong intrinsic drive and a dedication to innovation no matter how the manager behaves. For most engineers in this study it is different; whatever is a priority for your line manager is what you will prioritize. Some employees are frustrated with their line manager and seek support elsewhere, for example the full time AE core team, that will give motivation for some time, but without the line manager support and commitment, without the line manager requesting innovation the engineer will feel stressed.

5.7 Innovating in small, self-organizing teams

The company had focused on fine-tuning and optimization of the new product development process during many years. The matrix organization with strong project management and clear project execution process and weak line management was clearly biased towards exploitation activities which was the reason that the author was given the task to insert innovation into the organization. Two of the first observations were that the engineers needed more customer focus, and that an alternative formation of project teams is needed. In order to drive the change towards more customer- and user- oriented innovation focus a need-finding workbook was developed together with the academic partner and a master student. The need-finding workbook was printed and handed out to all iCoaches and the iCoaches was also trained in how to use the workbook.

Observations of several on-going AE project teams provided valuable input; some project teams were small, dynamic and agile, with good team harmony while other teams were large, involving over 100 individuals a
few working full time in the project while most of the team members worked part time in the project and the speed, dynamic, budget spending was not satisfying. The larger project team did not have close connection between the team members and the general work satisfaction was lower than for the smaller team.

The author initiated collaboration with Mikael Johnsson, pursuing his PhD studies in the domain, and initiated an experiment with the alternative team setting, supposedly enabling successful innovation. The first two teams were called iGroups, the third AIT (accelerate innovation team) and these were self-organizing project teams applying a systematic tool called the RAFT model [53], led by an iCoach, funded by the innovation model, coached by Johnsson acting as a facilitator and sponsored by the author.

The innovation team and their sponsor made assessments regularly and even though they in dialogues often pointed out the importance of management support, time availability and secured budget these never made it to the top list when they sat down and did the ranking.

The author participated actively as sponsor and to learn how to build a strong innovation team and in dialogues with members in the three innovation teams it was clear that the opportunity to work in a different way was motivating and encouraging, not only the team members, but also other employees witnessing the less structured and more autonomous way of working appreciated the innovation team concept. Some employees saw the team setup as a more promising and inspiring way of working than the normal project team setup. A small team with less hierarchy, less rigid process, less control and more freedom accomplished a lot quickly with small budget and felt proud of its effectiveness and drive. Again, the team motivation was established through purpose, autonomy and mastery, as stated by Pink [47]. The three teams all expressed concerns about how colleagues might feel unfairly treated since only the small innovation teams were allowed to work like this, members in all the teams were certain that the approach was correct and never doubted that they would succeed, but had to defend the initiative when being criticized by local management. Also, with weak management support the budget for the experiments were extremely limited.
The insights from the research performed together with Johnsson [53] helped the author and her team to define the Explore phase managed by the AE Programs where anyone in the company can initiate an investigation on something that might lead to innovation, at the same time iCoaches and the core team was trained in the design thinking methodology, but the AE Project execution process was kept as a linear stage-gate process in order not to disturb on-going work. In end of 2015 one AE Project was initiated together with a Key Account Customer and here the work was performed less linearly and more matching with the characteristics for a high performing innovation team, utilizing design thinking methodology. The author and her team learnt that this way of working not only motivates the innovation team to work harder, but also strengthens the relation with the external customer and makes them jointly believe in the concept as a future successful innovation. The company is still heavily leaning on stage-gate development process and project prioritization is still made based on current product sales, hindering radical innovation to really take off, but at least the AE project is considered as a great example of how design thinking and innovation teams are adding value to the business.

During these studies the author has learnt that the ability to work passionately, focused and hard when given freedom is a skill that needs to be trained. Many engineers in the studied company have been controlled by project leaders are expect to be told what do to. Engineers working with research in the Emerging Technologies team are trained to work in a less constrained manner and have no problems to make progress without control. In order to build strong innovation teams the skill to make progress without control is crucial.

Another insight is that when the innovation teams operate only in the AE process and the following process is unchanged a tension is built up in the product development process. The innovation team develops deep understanding of what the user needs, the customer want to have and when handover to the normal stage-gate process much of that knowledge is not captured, leading to that promising innovations are reduced to listed features and the value for the user or customer is reduced. Innovation is lost in translation from agile and iterative design thinking approach to requirement specification based development in a linear, waterfall process structure.
The exploration process, including the idea sharing, the iCoach facilitation and the AE Programs shows great results, high performance with rapid and broad knowledge building and multiple promising proves of concepts. The company need to adjust the following process to embrace the innovation that is being prepared, broader than incremental improvement of existing product, leading to new ways of doing business and radically new solutions to the industry. The explore activities are taken care of, let the better way of working disturb the rest of the organization.

The industry and the world are experiencing rapid shifts in technology and in customer expectations. No company will be able to handle the transformation alone. The only way to successfully innovate in the future is to co-create in the ecosystem of companies, customers, universities. The company have succeeded in developing the innovation model, the idea process and the exploration activities protected – now it is time to open up for extensive collaboration.
6. Discussion

The approach with the innovation model was systematic, subtle and small enough to receive stable funding year after year which enabled the continuous change of mindset and culture. The transparent way of working, clear and simple process, and iCoaches acting as ambassadors on the sites made the initiative sustainable over time, even though there were cases where middle managers stated that innovation is the opposite of quality. Another important survival factor was that the initiative was led by a small team focusing entirely on exploration, innovation and future, not getting dragged into urgent product maintenance or industrialization projects.

The requirement from company leadership to not disturb the exploit work caused some setbacks; promising, proven concepts in the innovation work got stuck between the exploration and the exploitation processes. The connection between the iterative exploration work and the exploitation work is a challenge remained to be solved. The stage-gate processes efficiently securing project execution from determined scope to controlled market launch need to allow for innovations entering in the front-end, alternatively an entirely different process for exploration is needed.

The company have implemented a combination of the three types of organizational ambidexterity, a small team that work full time with explore activities and driving innovation which is described as structural ambidexterity, opportunity for all employees to participate in the innovation work and perform explore activities which is described as contextual ambidexterity and both physical and virtual innovation events for focused explore activities which is described as punctuated ambidexterity. The actions to strengthen the different factors of the innovation model have been triggered by assessment results and the different site characteristics are taken into account when actions are selected.

The company specific constrain that the initiative would not disturb the rest of the organization focusing on exploit activities have of course challenged and sometimes frustrated the participants in the work. This
limitation, the small team and the small budget has clearly slowed down the change towards better ambidexterity, compared to if it had been run as a high-profile, company-wide initiative. At the same time this has led to a highly motivated, passionate team overcoming obstacles and driving something they strongly believe in. Considering the rapidly changing world and the necessary need for speed in innovation it is clear that the explore capabilities are crucial for long-term survival, and with the conditions changing considering workforce it is necessary for companies to deal with explore and exploit activities in different, most suitable manners. With a future workforce being a combination of internal permanent employees, temporary employees and freelance engineers a clear and systematic way of performing exploration activities is needed. Company-specific strategy, suitable process, tools and methods will help companies to stay ambidextrous over business cycles. The result of this work provides elements that can help companies to systematically strengthen its innovative capability, provided that the company is a large, mature firm with bias towards exploitation.

The company have had a managerial orientation towards exploitation for many years and leadership behavior is strongly affected by that. With priority and attention towards exploit activities individual managers and formal decision bodies are biased towards well-defined and predictable initiatives with low, but certain profit and low risk. Those are more likely to receive priority, funding and resources than the uncertain exploration activities if decision bodies rely on individual’s opinions, or gut feelings. With increased awareness of the need to strengthen the innovative capability in the company this bias can be pointed out, education and conversation can help to drive change of behaviour.

6.1 The value of measuring innovation

Company leadership looks for metrics for comparison with peers and that is of course important to do - in any competition it is important to know one’s ranking and competitors status. This is crucial data in any type of sports where your ranking vs. competitors is the main driver and very important input in your tactics for the coming race or game. It is not so meaningful to compare yourself with competition in such a complex domain as innovation.
Comparison can certainly be useful in other domains, such as market share, profitability and growth – corresponding with the innovation domain and can complement the innovation metrics that are focusing more on the inner life of the company. The innovation metrics should instead be designed and utilized in companies to drive innovative capability. The expression “what cannot be measured cannot be managed” points out (1) the importance of understanding what one wish to accomplish, (2) how it can be influenced and managed, and (3) how progress can be measured.

In complex domains like innovative capability it is important to understand the context in a holistic manner. There are stringent measurements that can be measured numerically and easy to compare between the assessments and there are soft measurements that are more cultural, emotional and feely. The process of selecting the system of metrics serves both as a knowledge- and awareness-building activity as well as putting the system of metrics in place.

When selecting innovation metrics it is important to decide what the purpose of the assessment is. In many cases companies want to compare themselves with peers and that is probably where innovation metrics are contributing to waste of resources. The metrics that can be compared between companies are high-level and never show details, so conclusions drawn from such comparison can be right or wrong and nobody can tell which it is. For example, the percentage of sales that goes to R&D can tell you something about the investment in developing new solutions, but not much about the innovation performance. The R&D includes research, development and related expenditures which can be product maintenance costs, process and system improvements and investments related to the development work, such as test equipment, cost for patents and data servers. Companies have different ways of defining what is included in the R&D cost, therefore a straight comparison, while costing time and money, borders on pure speculation. In a similar way, the comparison with peers when it comes to number of filed patents can tell something about the difference in number of filed patent, which might correspond with IP strategy, financial situations, skills in writing the patent applications and quality or quantity of the company’s inventors; but it says nothing about the innovation performance. The number of recently launched products can also be an insidious innovation metric because the
way companies are launching new products and services can vary a lot and innovation comes in many different formats - products, services, customer experiences, processes and business models.

To measure innovation clearly has merits even if the metrics are not perfect. Any mature company that decides to strengthen its innovative capability should start with implementing an assessment system and let the following actions be based on the results from the assessment. To involve management early, and have them engaged in defining the metrics can be helpful. An effective measurement system needs to be tailor-made for the specific organization in a network manner, to include as many different responsibilities as possible in the company. The four-dimensional method utilized in this work helped the team to drive behavior and reflective conversations considering both soft and hard aspects. The neural network of metrics helped to avoid driving behavior that push to meet KPI targets rather than driving the wanted change.

To have a dashboard presenting the data in a nice, pedagogic visualization is preferred, but such a solution need to be easy to work with. The best scenario would be to have a tool where data is pulled automatically and visualization is done more often than annually, without relying on manual labour.

To use the results from the assessment to select what types of actions are needed is a good way to drive innovation, and most effective when the management commitment is strong.

A company-wide engagement is more preferable, even if some progress is made when focusing on the R&D function only, the real impact on strengthening the innovative capability should involve every function in the company.

6.2 Online sharing of ideas as one piece of the puzzle

To invest in an online tool for sharing of ideas is a good way of driving innovative capability, but the usefulness of such a tool is only as good as the real-life working climate. When a company is too much in efficiency mode, forcing urgent deliveries from the workforce and not allowing for
time-slack to reflect, observe, question, interact and associate, a sharing tool can cause more frustration than innovation.

When the online tool provides the possibility for ideators to obtain funding to explore their ideas, the usage tend to become less of an open sharing platform with high level of exchange into a more linear idea posting tool. To combine the online sharing with local creative workshops is a good way of driving both the physical and the online culture. A pressured organization easily forgets about information that has been shared and therefore the responsible team need to constantly communicate the possibilities, and support the right development of culture on all sites. The iCoaches can support a combination of global, online innovation drive and local innovation-related initiatives such as challenges, competitions and hacks. An online tool without the site-specific activities is not helping the organization to change, even if one or two ideators have their ideas funded.

Any company that want to establish online idea sharing need to know its specific culture and it is not certain that the commercially available tools will provide the wanted features.

6.3 Securing time for ideas requires freedom and trust

A company intending to stay competitive long-term through innovation needs to provide sufficient slack for the employees in order to pursue innovation related activities. To adopt non-linear, iterative approaches such as design thinking give not only time for innovation, but also deeper insights in customer needs and good team collaborations. The R&D function must provide freedom to the employees, creativity and innovation need freedom and direction, but not detailed control. A hierarchical project team structure effectively eliminates interaction and creativity. An alternative project team setup can create much more room for valuable innovations.

If the leadership is able to provide the organization with clear and challenging strategic direction, opportunities to understand customers, a feeling of being trusted to solve the big challenges, and the employees are competent, loyal to the company and passionate it is likely that only providing more freedom will generate more innovation.
6.4 The line manager’s role

The line manager is the first one that boosts or kills innovation because this is the individual that have the biggest influence on job security, performance reviews and personal development. This dynamic is not always recognized in a matrix organization and in this work the correlation could be observed. A company that wants to secure innovative capability need to invest in educating and engaging its line managers, or the risk is that innovation initiatives will fail because the line management is not seeing the complete picture. The need to engage line managers is even bigger when the culture is conservative and risk adverse. To hire the right line managers is of course a necessity and if the company has been rule-based and want to shift towards becoming value-based there is a clear risk that the administrative managers are dominant and the visionary leaders are a minority. The engineers’ direct line manager is the most important leader for him or her, the company need to secure that leaders have ambidextrous understanding, zoomed out, business-oriented perspective and not only focus on the administrative.

6.5 Innovating in teams

To build good innovation teams requires understanding of need for diversity and it also required a functioning support system to the team. One of the key features of the support system is to remove roadblocks and help with specific resources. The team needs to interact with each other frequently and there is no need for a hierarchy. A networked leadership is preferred rather than an authoritarian leadership behavior. Innovation teams should also report progress and share their insights; not be fitted into a stage-gate process. Tight deadline is not a problem, but a linear follow up process with pre-defined levels of maturity will not support innovation. A focus on built knowledge, rapid iterations and sharing of failure and success generates better innovation in team than a perfectly optimized project plan to follow.
7. Conclusion

In this chapter the research questions are revisited, conclusions are made based on those research questions and future work is suggested.

**RQ:** How can a large, traditional and globally distributed company improve its innovative capability without disturbing the organization and the on-going new product development process?

**Answer to RQ:** The iCoaches, or any innovation ambassadors, are important enablers in driving improvement of innovative capability, the iCoaches need to feel that they have the right level of competence and the right level of support to contribute effectively. The innovation measurement made the organization able to actively drive improvements based on real-life data and this work was most effective on the sites where iCoaches and line managers collaborated well. The innovation model seem to be a sufficient framework to cover all essential factors of driving innovation, the online idea sharing tool is helpful – but is clearly not sufficient – the virtual and the physical working climate need to be connected and aligned. The way of inviting every employee to the explore work as part of the AE process seem to be a very good approach, but to really take off the leadership need to ask for innovation, not only allow it and the connection between explore and exploit need to be defined. Potentially, the “do not disturb” approach caused a lot of the problems, but maybe also enabled stronger motivation and drive in the core team.

Additional to the main RQ, the following sub-questions are posed:

**RQ1:** How can measuring of innovation performance help to reinstall exploration abilities?

**RQ2:** How do employees in a large, globally distributed organization respond to the implementation of a process and a tool for online sharing of ideas?

**RQ3:** What factors ultimately influence employees’ interest and ability in participating in voluntary innovation work in a large, mature firm?
Answer to RQ1 is that the measuring actually helps to point out the detailed actions needed to improve and takes the initiative down from corporate buzzwords to tangible actions.

Answer to RQ2 is that the online sharing of ideas is meaningful, but only works satisfactory when the real day to day life also encourages sharing of ideas. The culture need to be consistent both in the daily work in the physical work environment as well as in the online life of the employees.

Answer to RQ3 is that as long as the participation is voluntary there will always be individuals that always find ways to innovate, with or without support, but in order to drive participation in a more generic manner, the line manager need to be innovation oriented. This means more than accepting and allowing for innovation – it means asking for and sincerely desire innovation to come from the team. This should not be done in a “one size fits all manner”, but every employee need to feel that if he or she want to explore something promising it should not only be supported by the organization on higher level, the first line manager need to encourage, engage in and actively support the employee to explore further. Other factors that influence the employees’ willingness to participate in the innovation work are already defined as parts of the defined innovation model.

7.1 Future work

The research reported in this licentiate indicates that the practiced approach of inserting innovation into an exploit oriented organization in a subtle, small scale manner can be effective in other large, mature companies. Insights from the performed research would lead to slight adjustments enabling further research cases. Below is some of the suggested research focuses listed:

- Inserting innovation in a similar manner in a similar organization, but introducing the work by first educating line management on all levels about the importance of organizational ambidexterity and the unique conditions needed for conducting explore activities. Also initially establishing a way of measuring innovation as starting point. This would be a good following case...
study building research insights additional to what was
accomplished in this work.

- Establishing an entirely new organization utilizing the methods
  and insights from this work in order to secure organizational
  ambidexterity from the start and long-term. To have the new
  organization apply design thinking from the start and all the way
to market introduction would also be a great case to study.
- The iCoach network could be better supported financially and
  education wise. It would be interesting to implement such a
  network with more available time for the iCoaches and a better
  grounded iCoach toolbox.
- Utilizing automated data analytics to provide an organization with
  a more dynamic and continuous assessment of the organization
  innovative capability would be interesting to study. Especially if
  an attractive and easy to grasp visualization of the data could be
  implemented. If the tool could utilize data in a neural network
  without manual inserting of data the network could be a lot
  bigger, more tailor-made for every team and more relevant to
every employee. This would be a very interesting case to observe
and conduct research on.

The author believes in the continuous development of shared insights in
an innovation team and it would be very interesting to create a small, self-
organizing innovation team from the start and let the team perform
innovation work continuously, not necessarily full time, but staying as
one team over a longer time. The top-down approach to appoint project
team members is commonly used in large, mature firms and this would be
the opposite of it. The hypothesis is that such a team, correctly formed in
terms of skills and personalities, utilizing design thinking approach would
just need a clear purpose with the work, freedom to conduct the work as
needed, active engagement and support from leadership including
continuous progress reporting. Maybe the research would show that the
team need more firm control and well-defined targets, but that is not what
the author believes.
References


[33] G. Pinchot, “Introducing the ‘intrapreneur’: Successful innovators in large companies sometimes function as in-house entrepreneurs, running


Appended
Papers