A Study of Creativity and Innovation Support Within an Agile Context
Applied on a Scrum Team

JOSEFIN SNÖBOHM

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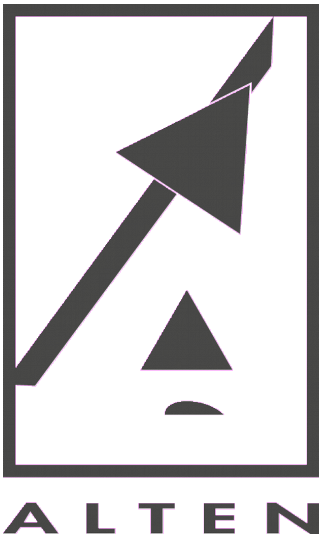
Alten
Supervisor at Alten: Detlef Scholle



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En Studie om Kreativitet- och Innovationsstöd i ett Agilt Sammanhang
Tillämpat på ett Scrum Team

JOSEFIN SNÖBOHM
Master of Science Thesis MMK 2015:43 MCE 319
Supervisor at KTH: Jens Hemphälä
Examiner: Lars Hagman
KTH Industrial Engineering and Management
Machine Design
SE-100 44 STOCKHOLM

KTH Industrial Engineering
and Management

KTH Industrial Engineering and Management

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Josefin Snöbohm

Approved	Examiner	Supervisor
2015-06-15	Lars Hagman	Jens Hemphälä
	Commissioner	Contact person
	Alten	Detlef Scholle

Abstract

The objective of the master thesis was to extend and evaluate a management system to support creativity for an agile team, with the aim to secure innovation at Alten.

The thesis was divided into a literature study and a case study. The literature study focused on determining internal innovation determinants and analysing the interplay between creativity, innovation and agility. The case study included multiply methods and had a quasi-experimental approach. The work was limited to software development and a time period of twenty weeks.

Several shared success factors between creativity, innovation and agile principles emerged from the literature study. There were also discovered contradictions between the three concepts. Guidelines were extracted from the literature and supported the design of the new dimension in the management system. The main part of the implementation of the management system was to evaluate the requirements in relation to the Scrum team. Two workshops were held, primarily to establish an action plan. The result showed that nine requirements were fulfilled by agile practices. The empirical findings strengthened ten success factors that were derived from research. Also, three new success factors emerged; diverse insight, communication channels and reflection. External pressure was the only strengthened contradiction in relation to the literature. Two new contradictions emerged; 'documentation', 'processes and tools'.

KTH Industrial Engineering and Management	**Examensarbete MMK 2015:43 MCE 319** **En Studie om Kreativitet- och Innovationsstöd i ett Agilt Sammanhang** ***Tillämpat på ett Scrum Team*** Josefin Snöbohm	
Godkänt 2015-06-15	Examinator Lars Hagman	Handledare Jens Hemphälä
	Uppdragsgivare Alten	Kontaktperson Detlef Scholle

Sammanfattning

Målet med examensarbetet var att utveckla och utvärdera ett ledningssystem för att främja kreativitet i ett agilt team, med syftet att säkerställa innovation hos Alten.

Arbetet var uppdelat i en litteraturstudie och fallstudie. Litteraturstudien fokuserade på att fastställa interna innovationsdeterminanter och analysera relationen mellan kreativitet, innovation och agila metoder. Fallstudien inkluderade flera metoder och hade en experimentell infallsvinkel. Arbetet var begränsat till mjukvaruutveckling och pågick under loppet av tjugo veckor.

Flera delade framgångsfaktorer mellan kreativitet, innovation och agila metoder framkom under litteraturstudien. Även motsättningar mellan koncepten identifierades. Riktlinjer för att stödja kreativitet extraherades för att stödja utformningen av kreativitet- och innovationsdimensionen i ledningssystemet. Huvuddelen av implementeringen var att utvärdera kraven i ledningssystemet i förhållande till Scrum teamet. Två workshops hölls, främst för att upprätta en handlingsplan. Det visade sig att nio krav uppfylldes av agila metoder. De empiriska resultaten stärkte tio framgångsfaktorer för innovation och agila metoder från litteraturstudien. Dessutom uppstod tre nya framgångsfaktorer; bred insikt, kommunikationskanaler och reflektion. Externt påförd press var det enda stärkta hindret i förhållande till litteraturen. Två nya motsättningar uppstod; 'dokumentation', 'processer och verktyg'.

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External Contributors

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Anders Törnqvist	System Developer and innovator, ReadSoft
Ingrid Kihlander	Director Product Innovation Engineering Program, KTH
Martin Törngren	Professor Mechatronics, KTH
Simon Elvnäs	Industrial Doctoral Student Ergonomics Department, KTH

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Josefin Snöbohm, Stockholm, June 2015

Abbreviations

Abbreviation	Definition
BM	Business Manager
CCQ	Creative Climate Questionnaire
CD	Continuous Deployment
CI	Continuous Integration
DI	Dependencies and Impact
FFE	Fuzzy Front End
ICE	Innovative and Creative Environment
ISD	Information Systems Development
KPI	Key Performance Indicator
PO	Product Owner
QR	Quality Ranking
QR1 - QR5	Quality Rank 1 to Quality Rank 5
RA	Runtime Analysis
RE	Review and Collaboration
Req	Requirement
ROI	Return On Investment
RQ	Research Question
SA	Statical Analysis
ScM	Scrum master
SD	Software Development
SH	Stakeholder
SP	Structural Planning
TF	Testing and Functionality
1G - 5G	First- to Fifth-Generation of Innovation Processes

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Chapter 1

Introduction

The world is rapidly changing primarily due to the ongoing globalization and its effects. It is therefore not only sufficient for organizations to focus on today's productivity and fast revenues. Continuous change and disruptive innovations are especially essential factors for an organization's survival [67].

Many people believe that the majority of the accumulating problems the society is facing only can be addressed with creativity. Researches seem to agree that creativity is the creation of new and useful ideas, which embodies both divergent and convergent thinking. When you implement a creative idea successfully; you get innovation [32].

The unpredictable market has resulted in that agile methods are becoming increasingly popular among a range of organizations [40]. Agile methods are used to cope with the unpredictable environment through various features, such as responsiveness and flexibility [63]. Continuous change is not only an innovation trigger, but also the main element in agile practices [17].

The practical contribution of the master thesis is to extend and evaluate a management system to support creativity within an agile team, with the objective to secure innovation at Alten. The project is carried out at the Embedded Systems Department at Alten AB with additional support from KTH Royal Institute of Technology.

1.1 Problem Statement

According to the Agile Manifesto [9] should individuals and interactions be prioritized over processes and tools. However, in many cases are models or frameworks needed in order to perform and deliver as expected. The main reason why these are necessary is that the majority of software projects that fail do it because of the absence of a shared vision [56]. Creating frameworks means that tacit knowledge is illustrated and structured in a way that creates a common understanding of its practitioners.

There is an expressed need at Alten to evolve the existing quality rank (QR) system to include a creativity and innovation dimension. The Agile teams at the office use the QR system to ensure quality in code. The existing system supports software development in several areas, such as dependencies and relationships, testing, verification etc. The system is a tool to support the software developer to know in what order tasks should be executed in order to elevate quality. The next step in the evolution of the system is to add creativity and innovation as a focus area. The purpose of adding this to the framework is to stimulate the agile teams to be more creative. The framework was originally developed by Sigrid Eldh [25] (PhD Software Test; Senior Specialist in Software Test Technology at Ericsson) for ensuring software quality and has been the inspiration of the current QR system at Alten.

The QR system at Alten consists of five levels where each level is an advancement of the previous one. The levels represent the maturity dimension of the system. The system is focused on code development, but the new dimension may mainly contain management principles. The system is further explained in section 5.1.

Development of the QR system and an action plan for the agile team were the two main deliverables to Alten. The result aimed to increase the competitiveness of Alten's agile in-house teams. The academical contribution is to identify creativity and innovation determinants and to analyse the interplay between innovation and agility. The context and expected deliverables require the thesis to be holistic. A holistic approach is more valuable to Alten but may be an academical weakness since it is not exhaustive. This is considered and dealt with through focusing on the shared success factors and contradictions between innovation and agility.

Three research questions have been formulated, one with the objective to understand the underlying context and the other two with focus on the implementation of the management system.

Research Questions:

- *(RQ1) In what way are agile methods impediments or facilitators when it comes to innovation?*
- *(RQ2) To which extent is it possible to implement research guidelines for innovation onto an agile team within the context of Alten?*
- *(RQ3) Do the implemented guidelines give an effect?*

Researches who have done extensive reviews on existing literature within innovation and agility and condensed them into guidelines and management systems find it important to test their work [17] [48]. Turk et al. [72] raises the issue of need for empirical studies in projects using agile processes, to better understand how they differ from non-agile.

1.2 Research Methodology

The thesis work is divided into a theoretical and a practical phase. The theoretical phase aims for exploring earlier research within the area and mapping a framework for the continued thesis work. The literature review consists of state-of-the-art research that consider creativity, innovation and agility. The literature study is complemented with external interviews and seminar attendance to generate knowledge and ideas. The external interviews were held with professionals at other companies and researchers at the Royal Institute of Technology. The creativity and innovation dimension in the QR system is developed through combining guidelines from the literature and placing them into the current QR system at Alten. The practical phase rely on multiple methods, with focus on a single case study conducted at the Alten office in Stockholm. The case study involves a Scrum team located at the office. The work process is shown in figure 1.1 below.

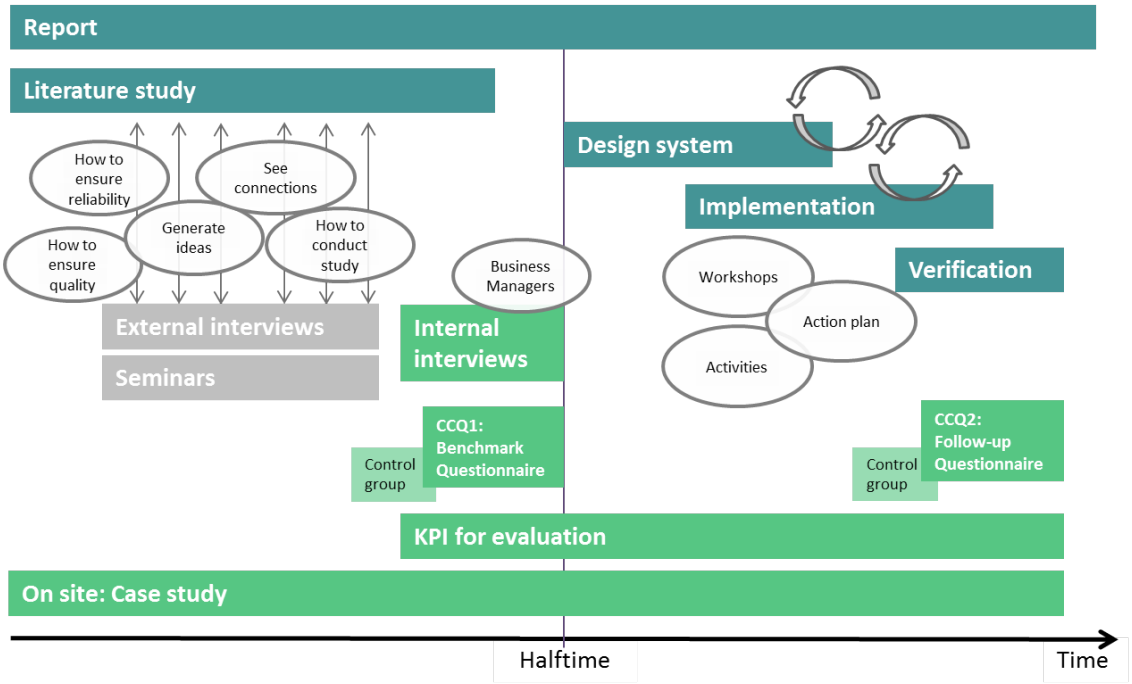

Figure 1.1: *Master thesis work process*

Case studies are preferred when analysing ongoing procedures since it brings a holistic view of the ongoing events, processes, relationships and changes [78]. A software development environment is a complex situation between social issues and human-technology interactions. Therefore are case studies preferred in these situations by

studying the contemporary phenomenon in its actual context [59]. A single case study provides a rich understanding of one setting through observing the situation and do in-depth analysis of the case. By being present in the study context you are able to recognize changes in the participants behaviour, perceptions and positions that may occur. You are also able to explain how processes are connected to outcomes [43]. To study "in action" is crucial for this study since suggestions for improvement are given; You need to know the current state and analyse the effect of the implemented changes.

The case study consists of observations, questionnaires and focused interviews with management with the aim to get familiar with the context and content of the situation. The observations are done through being present in the setting and attending team planning meetings, retrospectives and review meetings once a week and attend daily scrum meetings. Scrum tools, such as scrum board and planning tool (JIRA), are used to generate even greater insight in their way of working. The questionnaire was analysed through comparing mean scores and also applying a T-test. The focused interviews were transcribed and coded.

Multiple-case studies have the advantage of relying on multiple evidences, but they need to complement and enhance each other to ensure triangulation. Participant observation gives great opportunities for collecting data, such as access to groups and events that are inaccessible to scientific investigations, receiving insights from people inside the case study and have the ability to manipulate minor events. However, there are problems with participating in your own study despite these advantages. You may produce your own biases and and it can be hard to keep your role as an observant, which may be contrary to good scientific practices [78].

The study is quasi-experimental because the logic of experimental design is applied but behaviours cannot be controlled [78]. An alternative study approach could be to act more as an observant and rely solely on surveys and secondary data. Maybe it would have been a less biased study, but on the other hand, it would probably make less difference for Alten. By applying quasi-experimental logic you actively contribute to make improvements. The effect of the thesis work will be measured by comparing two identical surveys (before and after). However, there might be influences that are not controllable. A control group that is not affected by the changes will be used to analyse the result.

Rosenberg et al. [57] argue for that creating a schematic representation of chosen case study design gives a structure and brings clarity to the reader, especially when there are multiple case study methods used. See figure 1.2 for a schematic map of this study.

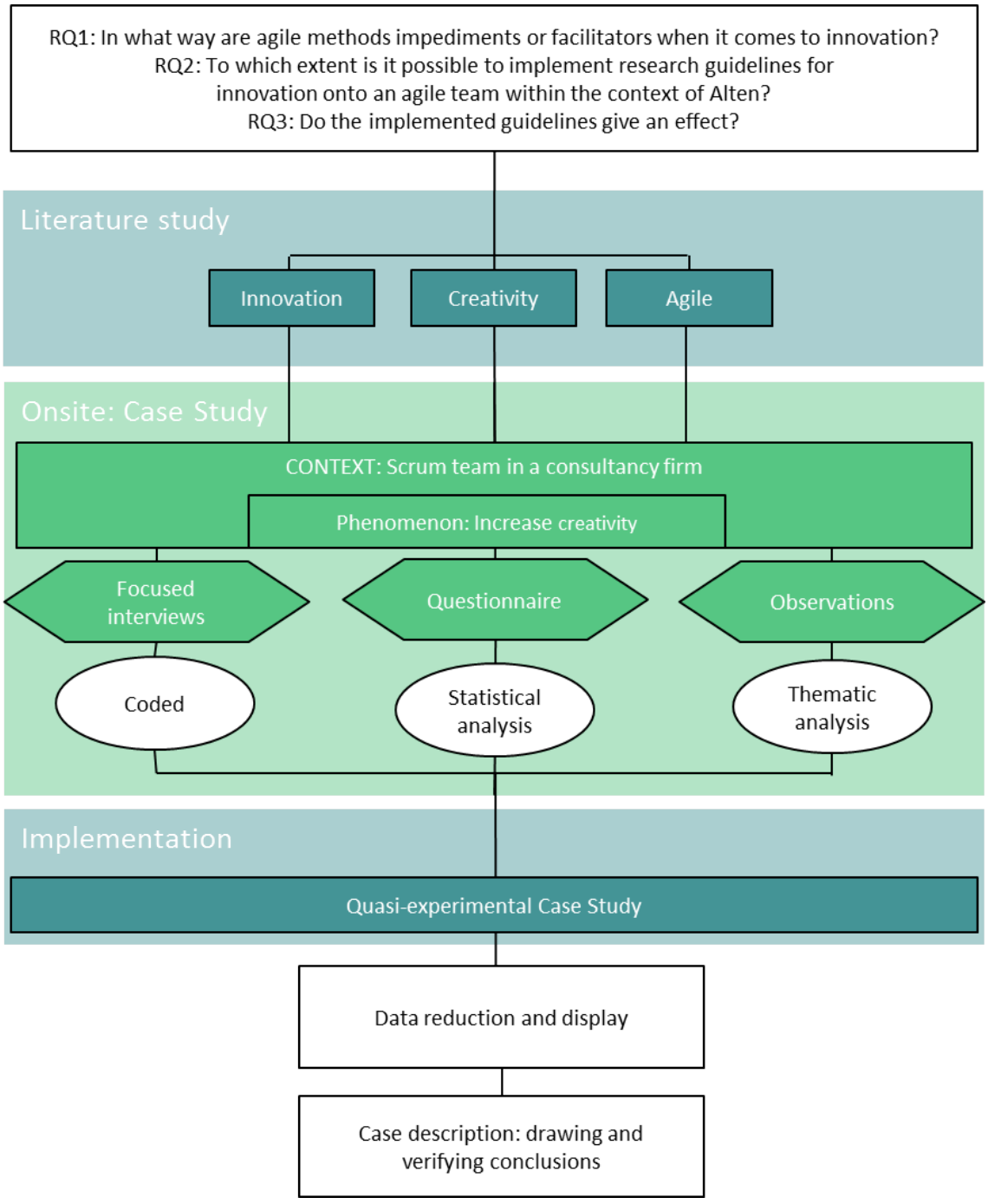

Figure 1.2: *Schematic map of case study*

1.2.1 Study Context of Alten

Alten is a consultancy firm that have customers within energy, telecom, automotive, industry, defence and aerospace. They can provide service and expertise throughout the whole product development cycle. The company is a part of Alten Group which has a workforce of over 16,000 employees and is represented in 16 countries. This means that Alten is one of Europe's largest technology and IT consultancy companies. Their pronounced positioning is *"The most committed engineering and IT consultants"*. Alten emphasizes that genuine commitment arises from freedom and self-defined professional development [2].

1.2.2 Study Context of Scrum Team

The case study focuses on a specific Scrum team at the Alten office in Stockholm, called MakeMake (named after a dwarf planet in the Milky Way), see figure 1.3. The three roles in Scrum are; Product owner (PO), Scrum Master (ScM) and team members. The team size varied from 5 to 9 team members during the study, but the ScM role was assigned to the same person for the whole period. The ScM had close contact with the PO, assured that the team worked according to Scrum and was in charge of the work progress. Their closest supervisor was the PO who also acted as project manager. The PO in collaboration with clients and other stakeholders (SH) were in charge of the backlog (containing tasks for team). The team had three business managers (BM) who were involved in their work. One of the BM was responsible for the team members on an individual level.

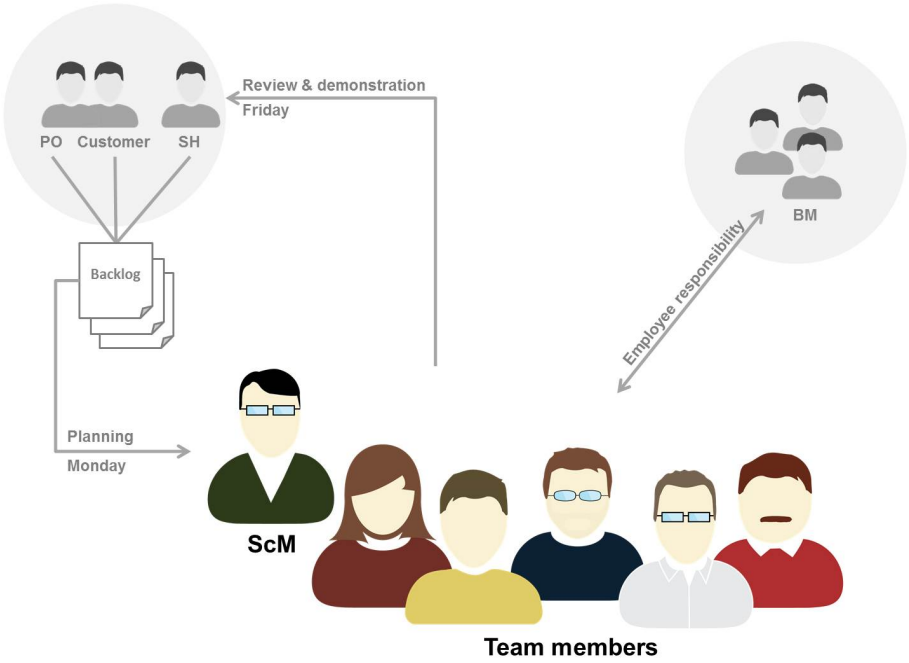

Figure 1.3: *Team MakeMake and relations to extended team*

1.2.3 Validation

A validation plan was formulated with the purpose to state the desires of each stakeholder in the project (Alten, KTH, and Student) and how they are going to be achieved, see Appendix A. Three methods are used to validate the work, they are: member checking, saturation and triangulation of methods, sources and subjects [59].

Member checking validates conclusions from interviews through allowing participants revise and clarify earlier statements. Conclusions are validated when interviewees' statements overlap. It also increase depth in interviews and increase self-understanding [21]. This is of high importance when designing the framework for Alten to achieve competitive agile teams.

To make a trustworthy academic study is it crucial that the referenced literature is peer reviewed and published in academic journals. Saturation is the point when nothing new emerges in the studied literature and it validates that all interesting areas and findings are covered. Triangulation is when several methods, subjects or sources are taken into account. It allows problems to be processed from different perspectives.

1.3 Thesis Structure

The thesis is structured equally to the way the work was carried out. First, a deep literature study within creativity, innovation and agility is presented (chapter 2). Thereafter is the theory analysis described. Creativity and innovation guidelines are clustered into subtopics and conclusions drawn upon given evidence from the authors. Analysis regarding shared innovation and agile success factors and contradictions is also included in the theory analysis (chapter 3). After the theory chapters are the empirical prerequisites described. The prerequisites were uncovered trough observations, KPIs, business management interviews and a benchmark questionnaire (chapter 4). The thesis continues with describing the development of the new dimension in the QR system (chapter 5), which is formulated with regard to the extracted guidelines. It is thereafter described how the system was implemented in the context (chapter 6) and the results that emerged from the implementation (chapter 7). The evaluation is then presented (chapter 8) and the thesis comes together in a summary, conclusions and further work (9).

1.4 Delimitations

The master thesis reaches over twenty weeks in total and is adapted to the set time boundaries. The framework covers a big range of aspects and due to the limited time only a selected amount of guidelines are going to be implemented. The system is implemented and tested on a software engineering team and thus the thesis is focused on management within Software Development (SD). Creativity is a broad research area and therefore the focus of this paper is put on creativity within organizations.

Chapter 2

Theory

This chapter is divided into four main sections; creativity, innovation, agility and the relationship between creativity, innovation and agile principles. These four sections represent the foundation of the study.

2.1 Creativity

"Creativity is one of the key factors that drive civilization forward." - Hennessey and Amabile [32][p.570]

Amabile is a recognized researcher within Creativity. Her definition of creativity is: the production of novel and useful ideas by an individual or small group of individuals working together. It can either be reflected as a personality, process or product [3]. Creative people are by nature motivated and autonomous and creative work depends on interest, curiosity, and intrinsic motivation [47]. Singer and Adkins [65] declare that creative talents are the most valuable resource for a company. Therefore should the workplace climate motivate and support employees to recognize, develop and utilize their ideas. The authors mention enhanced quality to customer, productivity and profits as corporate benefits generated by creativity. However, employee benefits are highlighted as the most valuable, which are improved work life and high satisfaction with work. Their definition of creativity is 'imagining, combining, visualizing and arranging existing elements to generate new ideas'. Kaufman and Sternberg [38] explain a creative idea as something new, good and relevant. They also believe that creativity is an attitude towards life, it is not something one does but develops over a lifetime. A creative person continuous to move forward, challenging themselves to do better and see things from a new perspective. Madjar, Oldham and Pratt [41] state that creative work can be generated by anyone in any job in the organization, which should be encouraged. Torrance [71] puts creative thinking in an everyday perspective. He describes the creative thinking process as recognizing problems and gaps in information, making guesses and formulating hypotheses about these shortages, evaluating and testing these guesses, possibly revising them and finally communicating the result. Similar

to other researchers, Oldham and Cummings [49] state that creative performance is products, ideas or procedures that must be novel and also be potentially relevant to the organization. Woodman, Sawyer and Griffin [76] imply that creativity and human behaviour overall is best described as a combination of both a person and situation. Therefore companies have great opportunities to affect their employees' creativity.

2.1.1 Creativity Enablers and Impediments

Creativity and benefits of it are described in previous chapter, but what can be done in organizations to enhance creativity? And which impediments should companies be aware of?

Personal creativity traits are often highlighted in the literature, and if people have knowledge about these they are able to improve on them [70]. Amabile [3] states a range of personal traits of problem solvers that promote creativity; persistence, curiosity, energy, intellectual honesty, self motivation (most important), cognitive abilities (creativity skills), risk orientation, qualities of the group (synergy), diverse experience, expertise in the area (domain skills), social skill, brilliance and naivete. Similar qualities are highlighted by Singer and Adkins [65]; high motivation, openness to feelings, curiosity, questioning, persistence and concentration, tolerance of ambiguity, fundamental knowledge, sensitivity to problems, creative memory, ability to analyse, think in visual images, originality, fluency and flexibility. Mumford [47] states that creative people are motivated, autonomous, curios, do changes in approach and have genuine interest. Anderson et al. [5] highlights expertise, creative-thinking skills and intrinsic motivation. There are some traits more than one of these authors mention, they are; motivation, curiosity, persistence, flexibility, expertise and creative skills.

In comparison to these creative qualities, there are traits of people that inhibit creativity; unmotivated, unskilled, inflexible, socially unskilled and externally motivated. External motivators can be money, recognition, respond to restrictions and goal by others, competitive and jealous [3]. Amabile raises the awareness of that external motivators are not always inhibiting creativity, even sometimes they are necessary or desired (deadlines, evaluation, surveillance, reward, feedback, recognition guidelines). Other inhibitors for creativity are emotional blocks (fear of mistakes), cultural blocks (taught that specific behaviours are wrong) and facilities blocks (poor facilities). Different approaches can be used to overcome these blocks depending on what is inhibiting your creativity. Some approaches are; challenge your own opinions, list the elements and look for new relationships, rearrange the parts, take time to develop a new idea and develop a thick skin through pitching your ideas even if they seem ridiculous, set a period for no interruption, signal desire for privacy and campaign for better facilities [65]. Organizational inhibitors are; inappropriate award system, lack of collaboration across levels and divisions, little regard for innovation, constraints, organizational disinterest, poor project management, inappropriate evaluation, insufficient resources, time pressure, overemphasis

on status quo and competition [3].

Oldham [49] links personal and organizational characteristics through stating that employees are the most creative when they have appropriate creativity characteristics, work on challenging assignments and are supervised in a supportive non-controlling manner. Amabile [3] [4] state that organizational characteristics for a creative climate are freedom (autonomy, most prominent promoter for creativity), challenging work, good project management, sufficient resources, encouragement, mechanism for considering new ideas, climate market by collaboration across levels and divisions, atmosphere where innovation is prized and failure not fatal, recognition (award creativity), sufficient time (balance), challenge and pressure. Singer and Adkins [65] also describe the creative organization with the following characteristics; idea champions, open channels of communication, suggestion systems, brainstorming sessions, encourages contact with outside sources, heterogeneous personnel policy, assigns non-specialists to problems, allows eccentricity, objective fact-founded approaches, ideas evaluated on merit (not on person), sometimes uses blind votes, sometimes holds back on broad policies, invests in basic research, flexible long-range planning, experiments with new ideas, giving everything a chance, is more decentralized and diversified, employees have fun, allows freedom to choose and pursue problems, freedom to discuss ideas, organizationally autonomous, tries to be different from competitors, provides an environment which allows innovation and separates creative from productive functions.

Mumford [47] provides some organizational practices that encourage creative climate. Flexible work schedules, diversity in work tasks and self-defined work plans enhance autonomy and motivation and allow creative people to reach their full potential. Reviews and feedback are essential and should focus on problems encountered, key outcomes, and plans for subsequent work focusing on progress and opportunities rather than production expectations. Ongoing skill development can be seen as a reward to encourage creativity. Examples of organizational learning are; self-study programs, conference attendance, visits to other sites, external courses, and sponsored technical mentor as well as traditional classroom training. Leaders should be provided with training in managing creative enterprises and employees provided with time to think and appropriate resources.

Isaksen and Ekvall [35] build one of their researches on positive and negative tensions in organizations. Tensions can affect the creative climate, where people share and build upon each other's ideas and suggestions. Their findings demonstrate that tension can be viewed positively as debate and negatively as conflict. They highlight that managers must know the difference. The three types of conflicts that are described in their research are task- (positive), emotional- and process conflicts (negative). The outcome from a debate is considered positive or productive when different points of view can be exchanged, understood and appreciated. But if too much debate is taking place some people stop listening, close down ideas too fast and do not see the potential. If there is too little debate people may not engage others in the conversation. If the conflicts are personal, managers should help the involved to understand and appreciate each other's differences to reduce the negative tension.

Other essential aspects for creativity within organizations are mutual trust between employees and managers (willingness to share ideas and possibility to implement) [14], attention to other's ideas and time to reflect (incubation) [51], supervisory support and positive mood [41], encouragement and reward [38], identification with the leader [75], high team learning behaviour [33] and organizational encouragement of innovation and support for innovation [53].

2.1.2 Creative Teams

According to Oldham and Cummings [49] is creative performance produced on individual level. This perspective is developed by Woodman, Sawyer and Griffin [76] who put the individual creativity into the context of group creativity. Group creativity is not simply the sum of all individual's creative abilities. Work group creativity is influenced by diversity, cohesiveness, size, processes (problem solving) and contextual influences from the organization. Group creativity is a complex social setting and if managed right it can contribute with creative synergy. Mumford [47] state that most creative work happen in a team setting. Paulus and Yang [51] show that idea generation in group is more beneficial for creative thinking since the participants get exposed to more ideas and are therefore cognitively stimulated. The authors suggest brainstorming or brain writing, which are more productive in group than individually.

Through an empirical study Taggar [70] discovered that creativity is not completely determined by individual creativity. Rather, synergistic group creativity may appear when members interact in certain ways. Creativity-relevant processes involve goal setting, preparation, participation in group problem solving and synthesis of ideas. Other creativity elevating factors are team commitment, focus on task, readiness for creative activities, effective communication, providing feedback and conflict management. These interactions and behaviours may be a major contributor to quality of group creativity. If members feel that their efforts are neglected or poor integrated, it might reduce motivation and decrease individual creativity. Too large groups or inadequate creativity activities can affect group creativity negatively. Teams can overcome this through open information sharing. Most leaders believe they provide regular feedback, but that is rarely the case. Exceptionally little time is dedicated to it [26]. Managers of creative teams should be aware of creativity positive behaviours and act on them.

Pirola-Merlo and Mann [53] conducted a study of 56 teams within four large R&D organizations, with the attempt to clarify if team creativity is simply aggregated team member creativity. They found that this was only true for a short period of time because random influences on creativity may appear at any time. The authors concludes that team creativity is more than the sum of the members' creativity since group performance is determined by the type of task and the way it is structured among group members. They demonstrated that team climate affect team creativity, but emphasized that it does not necessarily mean that teams with good climates or processes can make up for individual creativity. When it comes to creativity is it not

necessarily true that a champion team will outperform a team of champions.

Jiang and Zhang [37] found four aspects that distinguish team creativity from individual creativity; the subject, goal, scale and process. These aspects reflect that all team members contribute and affect each other which make it hard to judge ownership (subject), creative teams always have a uniform goal (goal), it is hard for an individual to compose large-scale creative ideas (scale) and on a team level ideas can be implemented collaboratively (process). These aspects emerge when integrating team creative thinking, -action and -outcome.

A creative team can achieve innovative outcomes if managed right. Anderson and West [6] condensed literature about innovation in work groups, and created the Team Climate Inventory. They found that innovation is enhanced if the team share an understandable vision, team members feel safe and feel like they can propose new ideas, the work is task oriented and contains stimulating debates and discussions and team members perceive sufficient support for innovation. In a recent work of Anderson et al. [5] is team creativity described as a consequence of individual creative behaviour, group composition, characteristics, team processes and contextual influences such as culture and reward.

2.1.3 Creativity and Innovation

Creativity and innovation are closely related and in some cases are they even treated as synonyms. Creative performance refers to idea generation, whereas innovation refers to successful implementation of a creative idea on an organizational level [5] [3]. Innovation is also about making changes in an established idea, thought, method or concept [65]. Employee creativity makes an important contribution to the organizations' innovativeness since companies need ideas before they can develop and implement them. This in turn affect effectiveness and survival in the long run [4]. Organizations need creativity and innovation to prosper [5].

Anderson et al. [5] state that creativity and innovation often take the same form at work; as processes, outcomes and products of attempts to develop and introduce new and improved ways of doing things. Job complexity (skill, variety, task significance, task identity, autonomy and feedback) is identified as a key aspect for creativity at work. The authors discovered that companies that provide training, employee involvement practices, use performance based pay systems, flexible working hours, job variety and appreciate autonomy have a greater chance to achieve higher innovation. They raise the issue that idea generation and implementation often are two separate activities, which need to be merged.

2.1.4 Measuring Creativity

All innovation begins with creativity; it is the implementation of people's ideas [4]. It can therefore be relevant to assess creativity in combination with innovation activities. Amabile et al. [4] explain the assessment tool KEYS and summarises its main components.

Table 2.1: *Amabile et al: KEYS Assessing the Climate for Creativity [4]*

1. Organizational Encouragement: *Risk taking, idea generation, prioritized innovation across all management levels, supportive evaluation of ideas, reward and recognition of creativity and collaborative idea flow across the organization*
2. Supervisory Encouragement: *Goal clarity, open interactions between supervisor and team members, supervisory support for ideas*
3. Work Group Support: *Team member diversity, openness to ideas, constructive challenging ideas and shared commitment to the project*
4. Autonomy or Freedom: *Sense of ownership over own ideas and work, perceive to have a choice of how to solve tasks*
5. Resources: *Practically sufficient resources, beliefs of project value*
6. Challenging Work: *Time pressure is perceived challenging for an important project*
7. Workload Pressure (negative): *If time pressure is perceived as external controlling, no time for exploration*
8. Organizational impediments (negative): *Internal strife, conservatism, rigid and formal management structures*

The majority of these elements relate to intrinsic and extrinsic motivational factors. If people are intrinsically motivated to execute work, the possibility that creativity is present is high. Extrinsic motivation can make people feel controlled and may decrease creativity. The tool helps management understand contextual influences on creative behaviour in the organization, and estimate to which degree the different assessment elements are present. The most influencing parameters on creative work environment are found to be; supervisory encouragement, challenge, organizational encouragement, work group supports and organizational impediments. The authors

highlight that it can be used together with other assessment tools, interviews or questionnaires. One great benefit of using the tool is that attention is put on creativity and the awareness of it is increased. The tool can be applied at any level in the organization as long as the participants are working within the same environment [4]. Measuring people's creativity is perceived to be complex (if even possible) since it is a biographical phenomenon, therefore are most instruments focused on assessing and define novelty, appropriateness and impact of climate and products. Since creativity is the sum of several accomplishments it should be measured both objectively and subjectively [52]. Anderson et al. [5] clarify that creativity and innovation at individual and team level are often measured with survey-based questionnaires, while organizational creativity and innovation are assessed on secondary objective data.

2.1.5 Summary of Creativity

Creativity is the production of new and useful ideas and can either refer to a person, process or product [3]. Several corporate benefits can arise from creativity, such as quality, productivity and profits. Employees can also benefit from creativity through improved work life and satisfaction [65].

A range of personal creative traits are mentioned, some of them are motivation, curiosity, persistence, flexibility, expertise and creative skills [3] [6] [47] [65]. Oldham and Cummings [49] state that employees are the most creative if they have these characteristics and are stimulated by the environment.

There are several corporate approaches presented that stimulate creativity, for example challenging work, resources, failure tolerance, flexibility, experiments, freedom, diversity, trust, idea time and learning [3] [4] [14] [47] [51] [65].

Creativity and innovation are closely related. Creative performance refers to idea generation, whereas innovation refers to successful implementation on an organizational level [5] [3].

Amabile et al. [4] contribute with a creativity assessment tool called KEYS, which can be combined with interviews, questionnaires and other tools. Creative teams are not the aggregated creativity of each team member, there are also other influences that affect the creative outcomes in teams [76] [53] [70].

2.2 Innovation

The word *innovation* is nowadays widely used, it has been defined as: the successful implementation of creative ideas [32]; implementation of new or improved product, process, marketing method, business practices or external relations [69]; application of knowledge, ideas, methods and skills that generate unique capabilities and competitiveness [39].

Steiber and Alänge [68] point out that innovativeness do not necessarily mean that every launch of a new product, service or model needs to be successful since no failures indicate that it is a less innovative firm. A company that is innovative takes risks and learn from mistakes when an implementation is not successful.

2.2.1 Innovation History

Innovation processes are not stagnant, they are dependent and evolve with the market. The first-generation (1G) of innovation processes appeared after World War II, when the rapid industrial expansion amplified the economic growth. By this time the process was driven by technology push, i.e. a scientific discovery was developed and then launched on the market. In the mid 1960s the second generation (2G) was established, which was based on market-pull. As the market became unstable (due to oil crises) in the early 1970s and marked by inflation and demand saturation, companies had to investigate the basis of successful innovations. It was shown that technology-push and market-pull were two extremes of general processes. The third-generation (3G) of innovation process, or *The coupling model*, embrace both 1G and 2G through linking the technology community to the marketplace with feedback loops. When the market recovered in the early 1980s, innovative Japanese companies showed remarkable performance and efficiency through integration and parallel development instead of sequential development. This was the basis of the fourth-generation (4G) innovation process. The latest innovation process (5G) is basically a development of 4G, with focus on systems integration and networking [58].

2.2.2 Why Continuous Innovation is Needed

The attention of continuous innovation is mainly driven by the price-quality competition, which means companies must provide improved quality for less money [42]. The ability to continuously innovate is crucial for a company's survival, at the same time it is perceived to be extremely difficult to do so. Continuous innovation is about renewing and developing products and business models constantly [68]. Steiber and Alänge elaborate this problem in the context of studying one of our time's most successful IT-giants; Google. Google is percieved to be world leading when it comes to innovation. In its portfolio you find Google Search, AdWords, Gmail, Youtube, Android, Google+ and Google Glass, just to mention a few. The organization is a dynamic and open corporate system where innovations takes place in the regular

work. The reason why it is crucial to continuously innovate can partly be described by Joseph Schumpeter's famous expression *Creative destruction*; clearing out the old routines and imposing new ways in their place [64].

2.2.3 How Continuous Innovation can be Handled

O'Connor [48] raises the issue of companies' ability to cope with the unstable market. The author suggests major innovation as a dynamic capability and creates a framework for how to manage and build major innovations. A major innovation is both radical and really new. The framework is based on literature within systems theory, management of innovation and dynamic capabilities theory. In short the framework includes seven elements which are (1) innovation responsible group; (2) major innovation system interfaces tightly coupled to strategy and loosely coupled to the mainstream organization; (3) exploratory processes that are learning oriented; (4) skills and talent development; (5) governance and decision-making mechanisms; (6) appropriate performance metrics; and (7) appropriate culture and leadership. The author argues for that every pillar in the framework need to be fully adapted in order to achieve the desired effect. However, empirical evidence of the argument is lacking.

In contrast to O'Connor's suggestion of how to handle the changing environment is Bessant and Caffyn's [10] work on how to establish continuous improvement through high involvement in the incremental innovation process. The purpose of Bessant' and Caffyn's work is to increase the participation in innovation. The authors believe that the more people are involved into change, the more they are willing to adapt to changes. Even if changes often are perceived as good can they be discouraged by companies. Companies can have fear of uncontrolled change, not believing everyone in the organization can contribute (or be creative), believe someone will come up with a superb and disruptive solution, lack support for innovation, expect short-term returns or no skills in innovation among employees. This means that an organization that wants to change need to understand, support and have willingness to change. They present six behavioural routines which are supposed to support a learning process of continuous improvement. It is highlighted that changes in an organization's mindset and culture can take several years. The routines for learning continuous improvement are (1) getting the continuous improvement habit; (2) focusing on continuous improvement; (3) spreading the word; (4) walking the talk; (5) the learning organization; (6) continuous improvement on the continuous improvement system. All these routines are coupled with constituent behaviours, blockage and enablers [10]. 'Walking the talk' concerns mostly top managers, who need to prove that what they say is consistent with what they do. Damanpour and Schneider's [19] research touches the same area. It shows that top managers facilitate innovation through favourable attitude towards competition, change and entrepreneurship. More complex structures also have a positive influence on innovation and creativity because of a diverse knowledge base and communication opportunities. However, companies are affected by the wider environment even if they have the best conditions internally. The authors highlight urbanization, popula-

tion growth, community wealth and unemployment rate as innovation determinants. Matzler et al. [42] argue that top management and leadership skills are prominent sources of success, which include attitude, values and norms which are supported by strategic methods and processes. These skills and methods should foster change, promote new ways of doing things, be inspiring and build collaborative teams. In a study by Bessant and Rush [11] it is mentioned that a common assumption is that innovation information is freely available, which is not true. To have a wide range of communication channels is therefore crucial for innovation activities. The authors also highlight that the current competencies in the team should be reviewed and new ones defined and acquired to remain competitive.

Many firms use continuous change to strengthen their competitiveness. Brown and Eisenhardt [12] argue that companies need to understand the past, the present and the future in order to survive and compete, especially if the organization is continuously undertaking changes. To understand all time aspects, a firm should start with understanding the current state. To achieve a deeper understanding they suggest low-cost probes for experiments. The most successful companies in the study combined structure (clear responsibilities, priorities, meetings) with extensive communication and managed the company in a semi-structured manner, which enhanced intrinsic motivation. When it comes to communication, firms need to be alert because real communication happens at other places than pre-defined [7].

Process management is highlighted in the study Kim et al. [39] conducted. The result from 223 manufacturing firms showed that process management direct and indirectly affect innovation positively. In this study it was shown that process management facilitates innovative and creative activities through routines. Stable and detailed routines may add value to products and services in an existing market. If an emerging market is targeted, the organization should apply simple and flexible routines. The routines help to establish a learning base, support innovation initiatives and to encourage creative ideas and experimentation. Also, measuring performance and coordinating conflicts are considered to generate incremental and radical innovations.

2.2.4 Innovativeness and Productivity

How a firm can be both productive and innovative is an issue many firms are struggling with, it is called *The Productivity Dilemma*. Adler et al. [1] describe how Toyota has succeeded to manage this dilemma through ambidexterity (doing two things simultaneously). The constraint is perceived to be solved if companies focus on exploitation (efficiency) and exploration (innovativeness) through continuous learning. Toyota has five main areas it focuses on to achieve continuous learning, they are; ubiquitous (across the organization, all the time), automatic (without management intervention), iterative (phases of standardization and experimentation), gap-driven (space between current and ideal state) and problems as opportunities (learn by failures). Yet again is process management highlighted, with focus on people, motivation, knowledge and skills in the organisation and relationships

built on trust. It is a wrong assumption that bureaucracy inhibits innovation, but it should be used as a tool rather than a weapon. Favourable structures and systems can enable both innovation and creativity [1]. O'Reilley and Tushman [50] also conclude that ambidexterity is the solution to solve the dilemma. They mention several companies that have survived over 100 years by changing their core business, such as Nokia (Lumber to Mobile phones), 3M (Mining to Office Supplies), American Express (Express delivery to Financial Services), Xerox (Photography paper to Business Equipment) etc. Gupta et al. [29] raise the awareness of that ambidexterity is just one way of confronting the problem, whether you interpret exploration and exploitation as opposites or co-existing. It is also easier to have high levels of exploration together with exploitation across loosely coupled domains (individuals and subsystems) than within a single domain. The authors suggest that within a high level system each subsystem can focus on either exploration or exploitation without threatening future performance.

2.2.5 Technical Specification: Innovation Management System

Recently was the standard SIS-CEN/TS 16555 released [69]. It is an European standard for how to manage innovation. It is claimed that several benefits can be drawn from using the standard, such as enhance growth, fresh thinking, better understanding of future market, identify risks, collective creativity, collaboration with partners and employee motivation. Only a selected amount of the elements are included in this summary because the standard is too extensive to be relevant for this purpose. If there is an interest in reading the standard it should be read in its original form.

The standard implies that companies should scan and analyse the external environment, such as the market-, technical-, political-, social- and economical aspects. The top management should establish an innovation vision and strategy, which can set the direction and inspire employees. Top management also has the responsibility to ensure an appropriate culture, integration of the standard recommendations, enough resources (human, budget and facilities) and support. A culture that fosters innovation should be understood as a mindset within each individual and that everyone is responsible to contribute to its growth. But it needs to be promoted by top management through idea support (allow time), recognition system, communication, means for openness and collaboration (internally and externally), conflict consciousness and failure tolerance (focus on learning).

The standard points out innovation enablers and driving factors. One of them is that the organisation should define responsibility for specific innovation projects and also general innovation management (either single person, team or unit). The responsibility includes following up on the innovation work and ensuring effective and efficient innovation management. To enable innovation the organization needs sufficient resources and competence, which needs to be continuously improved.

The person who is undertaking innovative work must be aware and motivated by

the innovation vision and strategy which includes the benefits from it. Effective communication channels must be established to ensure proper communication both internally and externally. Ideas can arise from almost anywhere, from a supplier, customer, trade association or university. Collaboration is mentioned several times in the standard and is described as stimuli for ideas and problem solving when people with different perspectives share knowledge. Collaboration can be undertaken at different levels; team, community, network and open innovation. In this context the team collaboration is the most relevant. Organizations can foster colleague collaboration and sense of common purpose through team building, encouraging cross-team support and providing clear expectations.

The standard describes idea management and emphasizes the importance of having a systematic idea management process that ensures steady flow of ideas. The scope (targeted or general) and the frequency of idea collection, evaluation and selection should be defined. The source of ideas can either arise internally or externally, where the internal source of ideas is through creativity. A generic innovation process is to select an idea, overcome obstacles and then disseminate or exploit it.

To come up with new and useful ideas, companies should stimulate creativity and have clear principles about generating ideas, selection, development and implementation as innovations. This is called 'creativity management' in the standard. Creative and creativity-fostering leadership is perceived important, which includes activities such as supporting employees in the creative process, recognising creativity and managing risks. Idea generation should include identification of creativity drivers (market, user, technology, social and economic trends), usage of creativity tools for seeking ideas and collecting the ideas that appear. The ideas should also be documented so that the organization is supported in the selection of ideas for immediate or future projects.

Several assessing indicators are pointed out and divided into financial and non-financial. The financial indicators for innovation are profit growth rate, revenue growth rate, cost savings (organization and client), growth in operational margin and return on innovation investment. The non-financial indicators are number of implemented ideas, market share, efficiency of processes, brand awareness, reputation, number of employees impacted, intangible assets and sustainability. From assessing these fields, a company can learn from success and failure and improve upcoming innovation management. Additionally, the company should determine their own indicators for monitoring the innovation strategy, the deployment on enablers and driving factors and the result.

2.2.6 Measuring Innovation

A range of innovation measurements have been developed lately with the purpose to classify organizations and identify innovative capabilities. Saulina and Juhani [61] divide innovation performance into innovation potential, -process and -results. They also describe how these are linked to business objectives. The innovation potential factor refers to the factors that enable creation of innovations, those are (1) lead-

ership and decision making processes; (2) organizational structures and communication; (3) collaboration and external links; (4) organizational climate and culture; (5) individual creativity and know-how. The business performance factors that are considered in the framework are personnel, processes, customer and financial. Innovation capabilities are measured through evaluating objectives within these areas, such as employee skills, reliability of deliveries, customer satisfaction and profitability.

Another measuring tool was developed by Wang and Ahmed [74]. They constructed a questionnaire (29 questions) based on earlier literature, which is suited for measuring an organization's overall innovativeness. In this study is organizational innovativeness divided into behaviour-, product-, process-, market- and strategic innovation. Product innovation is defined as novelty and meaningfulness of new products, launched in a timely fashion. Process innovation is highly connected to product innovation, but contains the organization's ability to exploit and recombine resources and capabilities.

Dobni [20] identifies four dimensions that encourage an innovative culture. The authors argue for that an innovation culture provides a competitive advantage. The dimensions are innovation intention, -infrastructure, -influence and -implementation. In other words are the dimensions representing the intention of being innovative, the infrastructure to support innovation, influence and knowledge of employees to support thoughts and actions necessary for innovation and an environment to support innovation implementation. These dimensions are divided into seven innovation factors that represent 70 culture statements. The innovation factors are (1) innovation propensity; (2) organizational constituency; (3) organizational learning; (4) creativity and empowerment; (5) market orientation; (6) value orientation; (7) implementation context. The innovation culture statements can be used descriptively or diagnostically to uncover specific areas for improvement.

Some measurement tools only regards one type of indicator, especially input indicators. This is perceived to be a problem according to Carayannis and Provance [13]. Input indicators are described as intellectual, human and technological capital. The authors want to include process-, performance- and output indicators to evaluate a company's innovativeness. Process indicators reflect organizational and innovation management systems. Performance indicators regard the results of the organizational innovation. Last but not least are output indicators that identify the success of innovation activities in form of rates, patent quotes, number of new products and percentage of sales.

Ekvall [23] has developed an instrument to measure organizational structure and climate for creativity and innovation, Creative Climate Questionnaire (CCQ). Ekvall claims that climate is influenced by various conditions and qualities in the organization, such as goals, beliefs, values, norms, people, technology, resources etc. [24]. The climate is perceived to be powerful since it influence problem solving, decision making, communications, coordination and controlling as well as individual aspects, such as learning, creating, motivation and commitment. The ten climate factors Ekvall include in the tool are shown in table 2.2.

Table 2.2: *Ekvall: Creative Climate Questionnaire [23]*

1. Challenge: *Is when employees find joy and meaningfulness in their work tasks and have an emotional involvement in the organization. This means they invest much energy into their work.*
2. Freedom: *To the extent employees have independent behaviour. They make contacts in the organization by giving and receiving information. They are also able to discuss problems, take initiatives and make decisions.*
3. Idea support: *Is the way new ideas are treated. How well co-workers and managers receive and support ideas and suggestions. Employees listen to each other and initiatives are encouraged. There should also be possibilities to try new ideas.*
4. Trust/Openness: *Where people feel safe in relationships at work and employees dare to put forward new ideas without fear. The communication is clear and straight forward.*
5. Dynamism/Liveliness: *Is the eventfulness in the organization, where new things happen all the time. Alternations between handling issues and ways of thinking often occur. People in the organization have a feeling of "go" and "full speed".*
6. Playfulness/Humour: *Where spontaneity, laughs, ease and jokes characterize the organization and contributes to a relaxed environment.*
7. Debates: *Different points of view, ideas and experiences are expressed and considered. Many voices in the organization are heard and employees put forward new ideas.*
8. Conflicts (negative): *Emotional and personal conflicts within the organization. Where the amount of conflicts is high and people dislike each other.*
9. Risk taking: *To the degree uncertainties are tolerated. Decisions are prompt and rapid and new opportunities are taken. Experimentation is preferred over detailed investigation.*
10. Idea time: *Time that employees can and do use for elaborating new ideas. There are possibilities to discuss and test impulses that are not planned or included in assignment.*

Each dimension includes three to seven measurement values in its original form. It is stated that these dimensions might not cover all creative aspects of an organization, and it is not always the case that innovative firms score high. For example is negative time pressure not included which is perceived to have a big impact on creativity and innovation. However, the tool has been assessed and is considered to be reliable [36]. Ekvall highlights idea time, risk taking, debates and idea support as the most distinctive dimensions that differentiate innovative from stagnated firms [23]. Isaksen and Ekvall [35] summarize articles that highlight the usage of the CCQ. It is shown that the climate dimensions have a positive influence on several output indicators, such as higher sales volume, market share and revenues, productivity, profitability, greater impact from implementing new social and technical systems (self-managed teams) and improved ability to implement more complex work designs.

2.2.7 Summary of Innovation

Innovation is a continuous process and many companies utilize innovation to continuous change and improve. In this paper is innovation defined as an implementation of a creative idea that generate competitive advantage [32] [39].

The 5G of innovation processes is reached today and innovation is managed as a parallel process with focus on systems integration and networking [58].

Researchers suggest that organizations can cope with the unpredictable market through major innovations [48], high involvement in the incremental innovation process [10], top manager's attitude [19], communication [11] [7] [69], time perception [12], process management [39] and experimentation [12] [39].

The productivity dilemma seem to be solved with ambidexterity [1] [50] or if a company separate exploration and exploitation activities [29].

The technical specification SIS-CEN/TS 16555 [69] provides a range of guidelines and recommendations for managing innovation, like establish an innovation vision, scan the environment, idea support, communication, collaboration and failure of tolerance.

Innovation can be assessed and measured in many different ways. The specification [69] proposes financial and non financial indicators. Saulina and Juhani [61] measure innovation potential, -process and -results. Wang and Ahmed [74] measure innovativeness through a questionnaire divided into behaviour-, product-, process-, market- and strategic innovation. Dobni [20] measures innovation culture and divide the term into innovation intention, -infrastructure, -influence and -implementation. Carayannis and Provance [13] believe several different types of indicators are necessary for judging innovativeness, they are input-, process-, performance- and output indicators. Ekvall [23] has developed CCQ which contains ten climate dimensions.

2.3 Agility

Agile methodologies have mainly been driven and developed by practitioners and consultants, with surprisingly little attention from researchers during its early evolution. Conboy [17] argues that the literature lacks clarity, theoretical glue, parsimony, has limited applicability and naivety regarding the evolution in other fields than systems development. Therefore the author collected material and made a definition of the concept, which can be applied regardless of which agile method that is used. The definition of agility was further translated into a taxonomy, see table 2.3.

Definition of agility: The continual readiness of an information systems development (ISD) method to rapidly or inherently create change, pro-actively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment. [17]

Table 2.3: *Conboy: Taxonomy of Agility [17]*

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1. To be agile, an ISD method component must contribute to one or more of the following:
Creation of change
Proaction in advance of change
Reaction to change
Learning from change

2. To be agile, an ISD method component must contribute to one or more of the following, and must not detract from any:
Perceived economy
Perceived quality
Perceived simplicity

3. To be agile, an ISD method component must be continually ready i.e. minimal time and cost to prepare the component for use.

Misra et al. [44] have identified several success factors a company can gain from when applying agile through a survey-based investigation. The success factors they claim a company can benefit from when using agile methodologies are customer satisfaction, customer collaboration, customer commitment, decision time, corporate culture, control, personal characteristics, societal culture, training and learning. An extensive survey-based research conducted by Laanti et al. [40] involving over 1000 employees at Nokia showed that 60 % are optimistic about the methodology and want to keep working according to agile. Only 9 % wanted to go back to the old way of working. The authors concluded that agile methods are here to stay. Vijayasarathy and Turk [73] found that earlier software development experience and organizational size are negatively related to adoption of agile practices. Perceived hindrances and benefits are separately unrelated to adoption of agile, but the two in

combination drive the use of agile practices, i.e. if there are no perceived hindrances the benefits are not a driving force. Managers should be patient and take time to listen to problems and promote the benefits of agile use. The organization should also identify and provide useful training on agile methods to encourage Agility.

Iivari and Iivari [34] summarize the agile approach from the Agile Manifesto [9]. They state that the main goal of agility is to satisfy the customer through early and continuous delivery. Individual and interactions are more significant than processes and tools. It is also more important to respond to changing requirements than following a plan. The fundamental concept is that software should be considered to be an emergent system, where the best requirements, architectures and design emerge. There should be frequent delivery of working software, focus on software rather than other documentation and close collaboration between developers and customers. The authors classify enterprise agility within the developmental culture. A developmental culture is future-oriented, effective in growth and resource acquisition, creative and adapt to the external environment. Even if they are sceptical towards manipulating and designing an organizational culture in the short run, they believe a culture change can be made through lengthy processes of adoption, diffusion and enculturation of agile methods.

2.3.1 Briefly About Agile Methods

There are a number of software development methods that are collectively named agile. Some of the most popular methods are eXtreme Programming XP [8], Crystal [16], Dynamic Software Development Method DSDM [66], Feature Driven Design FDD [15], Lean Software Development LSD [54] and Scrum [62].

Qumer and Henderson-Sellers [55] compare agile methods to judge level of agility. The methods are scored on four dimensions (method scope, agility characterization, agile value characterization and software process characterization) based on five values (flexibility, speed, leanness, learning and responsiveness). The dimensions are divided into phases and practices, see figure 2.1.

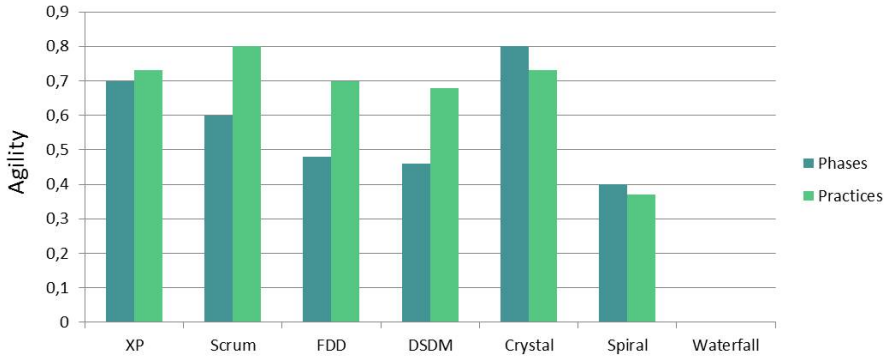

Figure 2.1: *Level of Agility [55]*

As figure 2.1 illustrates is Scrum on first place regarding practices and third place regarding phases. The only value the method does not support is leanness, i.e.

keeping the process cost effective. The authors found that Scrum does support Project Management and Development, but does not mention Configuration- and Process management. In the graph is 'Spiral model' and 'Waterfall' included as a reference. Spiral model is a software development process also known as risk development.

2.3.2 Description of Scrum

The central method in this study is Scrum. The Scrum process is iterative and incremental. A visual representation of the flow can be seen in figure 2.2.

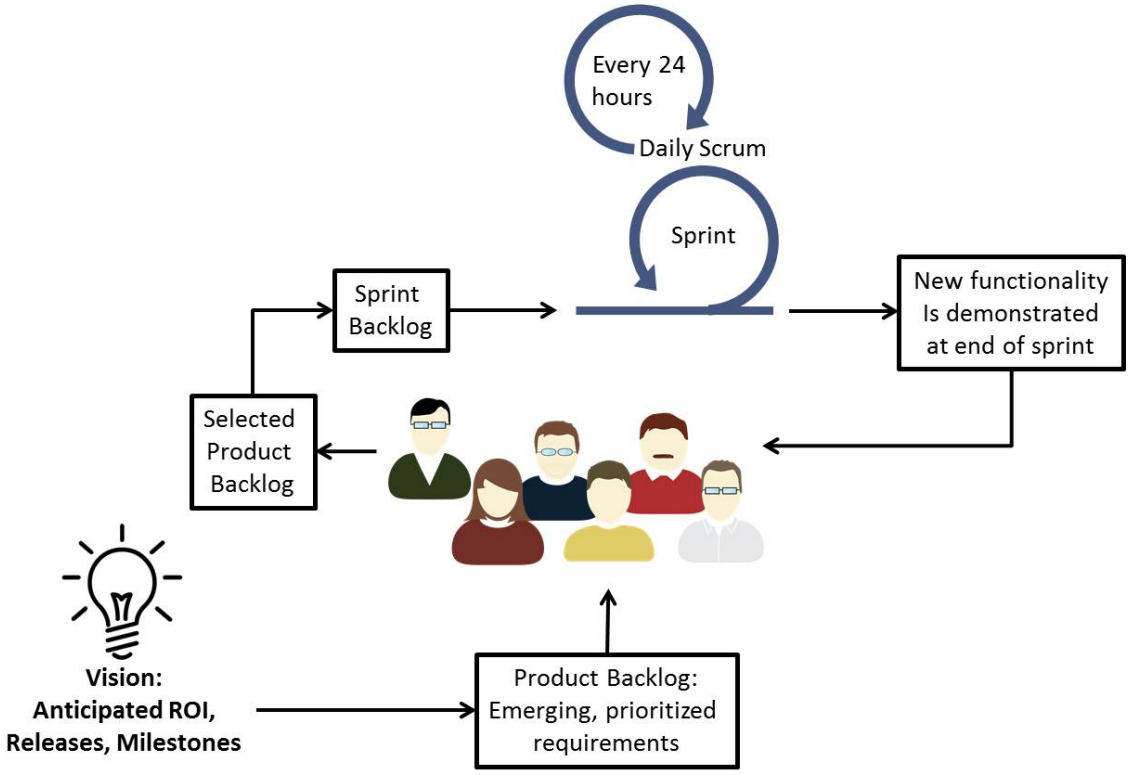

Figure 2.2: *Scrum Process Overview [62]*

Product Owner (PO), Scrum master (ScM) and team members are the three roles included in Scrum. All responsibility is shared between these roles. The PO represents the interest of stakeholders, create initial requirements, return on investment (ROI) objectives and release plans. The list of requirements is called Product Backlog and it is the PO's responsibility to prioritize these. The ScM is responsible for the process, making everyone aware of Scrum practices and ensure that everyone follows the rules and practices. Also, he or she is responsible for adapting the Scrum process to fit within the culture of the organization. The team members are responsible for making every iteration and the whole project successful. The work is done in sprints and every sprint starts with a sprint planning meeting where all roles collaboratively decide on what to include in the upcoming sprint. It is important that all parts agree on content, purpose, meaning and intention. Each day the team gets

together and have a short meeting called daily scrum by the scrum board. During the meeting each team member explains what was done last day, what is going to be done today and if there are any risks or hindrances. At the end of the sprint a sprint review meeting is held and new features presented. The ScM holds a retrospective after the review to encourage the team members to revise the process and discuss how it can be more effective and enjoyable. In addition to these essential Scrum elements is the burndown chart, which shows the amount of remaining work across time [62].

2.3.3 Empirical Agile Research

A recent study on Ericsson shows the challenges and benefits of introducing Scrum in the organization. The challenges were overcommitment caused by external pressure, managing maintenance work and balancing between efficiency and generalist teams. The benefits were increased flexibility, decreased development lead time, waste eliminated in the planning process and higher developer motivation [31]. Moe et al. [46] conducted a more team focused study, and evaluated the implementation of Scrum. It was found that the team was struggling with being self managed because scrum gives no advice for how to share leadership and the team members were used to be individually autonomous. Highly specialized skills was in this case a barrier for the team to be self managed. Also, there was a lack of trust among the team members and the Scrum master, which led to team members spending time on protecting, checking, and inspecting each other's work. It was obvious that trust was needed for shared leadership, feedback and communication. The authors give four practical implications for future scrum implementation; organize cross-training and encourage generalists to develop a shared mental model, be aware of that high individual autonomy may be a barrier for self managing teams, changes take time and resources (in this study previous practices were sustained) and make room for reflection and learning to enable efficient work.

Dybå and Dingsøyr [22] identified and analysed 36 empirical studies of agile software development, most of them concerning XP. They found a broad picture of experience. Agile methods seem to be difficult to implement in large and complex organizations, whereas it is easy to do in other types. The same reasoning is also applicable on team size, i.e. Agile methods are appropriate in small teams. Other common arguments they found against agile methods were; lack on focus on architecture, little scientific support and XP practices are rarely applied by the book. Reported benefit areas were customer collaboration, handling defects, learning in pair programming, thinking ahead for management, time estimation and focusing on current work. Conversation, standardization and progress monitoring are mechanisms for creating awareness in organizations and teams. They also highlight that successful agile teams balance individual and team autonomy with corporate responsibility. Good interpersonal skills and trust were found to be essential for a successful agile team. Further, customers are overall satisfied with agile methods because they are given opportunities for feedback and response to change. However, if the customer is on-site it can be stressful for developers and decrease their performance. Some studies

found that projects that use agile methods incorporate change more easily and business value is demonstrated more effectively. It is also possible to combine agile principles with traditional project management. Most studies reported increased code quality when agile methods are used. A discovered limitation was that team members are less interchangeable in agile teams. The authors concluded on that scrum is under-researched compared to its popularity.

2.3.4 Summary of Agility

Conboy [17] defines agile as a method that rapidly create change, embrace change or learn from change while contributing to perceived customer value in terms of economy, quality and simplicity.

Success factors related to agile methods are customer satisfaction, -collaboration, -commitment, decision time, culture, training and learning [44].

The Agile Manifesto [9] emphasize the importance of customer satisfaction, continuous delivery, interactions, respond to changes and close collaboration.

Agile is a term that covers many popular methods, such as XP [8], Crystal [16], DSDM [66], FDD [15], LSD [54] and Scrum [62], where Scrum is the most agile method when it comes to practices [56]

Empirical studies show barriers and complications of introducing agile methods, such as external pressure, maintenance work, struggling with autonomy, difficult to implement in large organizations, lack of trust and feedback [31] [45] [22]. Positive effect from applying agile are increased flexibility, decreased development lead time, motivation, customer collaboration, learning, time estimation, focus on task, response to change and code quality [31] [22].

2.4 Interplay Between Creativity, Innovation and Agility

Innovation in software product development is different from other industries. Start-up costs are low and lead-times short. It is possible to create, compile and test code in one day and present to the customer. The only resource utilized is the software developer's time. Physical products on the other hand often need physical resources to test and produce [45], which make the process less flexible.

Hannola et al. [30] compare agile and innovation processes and conclude on several agile guidelines that enhance innovation. The guidelines aim to solve the challenges traditional processes are struggling with, such as fixed implementation plans, transfer of know-how, understanding of customer's needs, shared vision, handling fuzzy front end (FFE), changing requirements etc. The way agility confront these problems are through customer involvement (for interpreting customer needs), interdependence between customer and development team (instead of extensive pre-planning and fixed plan), common space (improve transfer of knowledge) and iterative process that integrates FFE (changing customer needs). Gassman et al. [27] also concludes on that FFE is solved through high customer involvement using XP practices. Another issue XP seems to solve is the tension between creativity and and resource efficiency. Agile methods are explorative through probe-and-learn which is perceived to enhance the innovation process. The authors highlight that too much discipline and customer demands may affect creativity in a negative manner.

Moe et al. [45] identified seven internal determinants of innovation related to Atlassian, a fast growing agile company. The innovation determinants they found were (1) Organization culture; (2) Empowerment; (3) Customer-related; (4) Inter collaboration; (5) Trust; (6) Knowledge management; (7) Champions. However, their study showed that the agile method practised (combination of Scrum and XP) only supported two of these; empowerment and knowledge management. The authors concluded that agile practices alone are not sufficient to foster innovation. They highlighted that the developers had little freedom and tasks were assigned on skills not preference. There was also little flexibility within the teams, mainly due to specialization. To overcome these challenges, the company applied *FedEx Days* and *20% Time*, two activities that allow time and space to explore new ideas. They also used *dogfooding*, which is when the developers are the users of the product and evaluate them from a user perspective. These three additional activities in combination with agile were perceived to cover all seven internal innovation determinants.

Hannola et al. [30] integrate the five generations of innovation processes (1G-5G) [58] (mentioned in section 2.2) into the evolution of the SD processes models [60]. They highlight that the models have been developed simultaneously and they share similar trajectories, see figure 2.3.

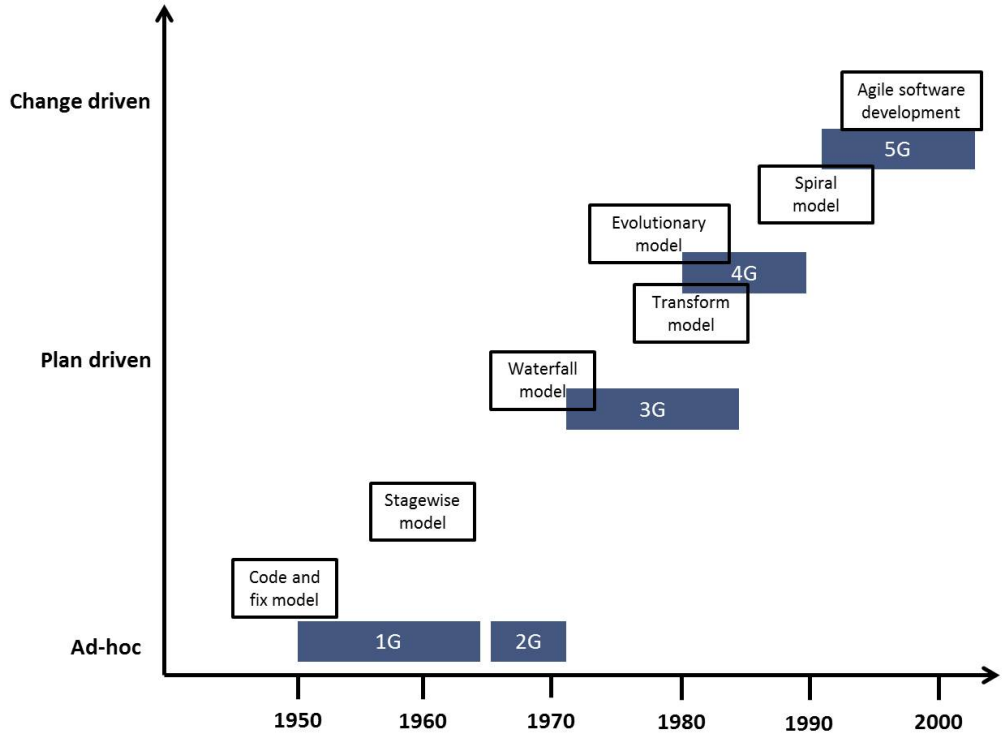

Figure 2.3: *Evolution of the innovation process (1G-5G) and SD processes models [30]*

Wu et al. [77] provided guidelines for how to handle innovation in large IT projects. They recommend flexible project planning and in some cases even leave the project plan incomplete to easier adjust to response of solutions found for radical innovation. Also, iterative cycle planning was recommended. They stated that the execution of work should be done in parallel with exploration and re-plan until all innovation points are dealt with. The work is more effectively directed towards developing successful solutions if the teams are smaller and more focused with diverse knowledge. Further, radical innovations require a flexible mindset. There is a clear connection to agile methods and these recommendations.

Conforto and Amaral [18] evaluated how agile project management principles affected innovative projects. Agile project management principles focus on people development, self-management, self-discipline, shared decision making, customer focus and less bureaucracy. The authors found that agile principles enhanced project outcomes and the performance was easily checked through a set of simple KPIs. The teams were struggling with being self-managed and have self-discipline because they had to contribute, evaluate and discuss the role of project management in an agile approach. The projects involved uncertainties and dynamic work which required creativity, innovation and flexibility. The agile guidelines provided the teams with simple and flexible techniques to control innovative projects, but it was highlighted that that best project management practices not should be neglected.

2.4.1 Summary of Interplay Between Creativity, Innovation and Agility

There are several similarities between innovation and agile principles, in some cases agile methods even seem to enhance innovation.

Hannola et al. [30] describe how agile methods reduce innovation obstacles that occur with traditional processes. The authors also show how the innovation processes and SD processes have evolved and that agile software development is closely related to 5G innovation processes.

Moe et al. [46] conclude that agile practices support innovation, but are not fully sufficient alone.

Wu et al.'s [77] guidelines for managing innovation are very similar to agile processes. Conforto and Amaral [18] found that agile project management principles enhanced outcomes in innovation projects.

Chapter 3

Analysis of Theory

The included research findings are condensed and connected in this chapter, with focus on determining innovation drivers and also analysing the relationship between innovation and agility.

3.1 Creativity and Innovation Determinants

The gathered data (from Creativity and Innovation, Section 2.1 and 2.2) was apportioned on Post-its and only one statement was included on each Post-it. Over 200 research statements were divided into 37 subtopics of internal creativity and innovation determinants and placed on the levels that represent the management system (figure 3.1). The subtopics were connected with lateral links across levels in the management system. Appropriate indicators were also spread across the levels.

Figure 3.1: *Clustering Post-its regarding research findings*

The extracted findings show that each subtopic is an important area to consider for a company that wants to sustain or increase creativity. In figure 3.2 below are the areas included in a mind map. Each node has a number that shows which level in the QR system it matches into and has several findings connected to it. The mind map was made to facilitate the design of the system. In Appendix B are the findings summarized.

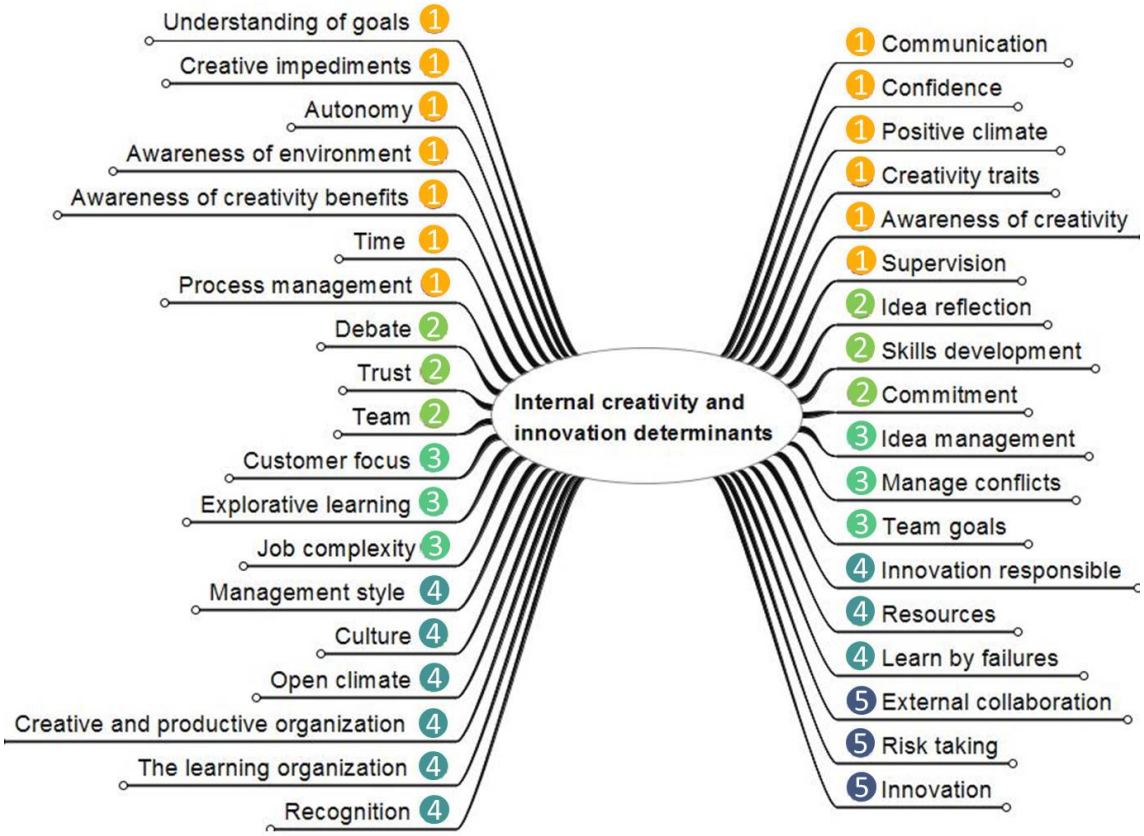

Figure 3.2: *Mindmap of internal creativity and innovation determinants*

3.2 Creativity and Innovation Guidelines

Guidelines for each subtopic were derived from research and named from Guideline 1.1 (G1.1) to Guideline 5.4 (G5.4). They can be seen in Appendix C. The guidelines are clustered into the same levels as in figure 3.2. Level one considers individual creativity and infrastructure that influence individuals. Level two, three and four are advancements of individual creativity and ranges from team to internal organization. Level five is when the company accomplish to launch innovations. In figure 3.2 are also appropriate indicators included and linked to corresponding level.

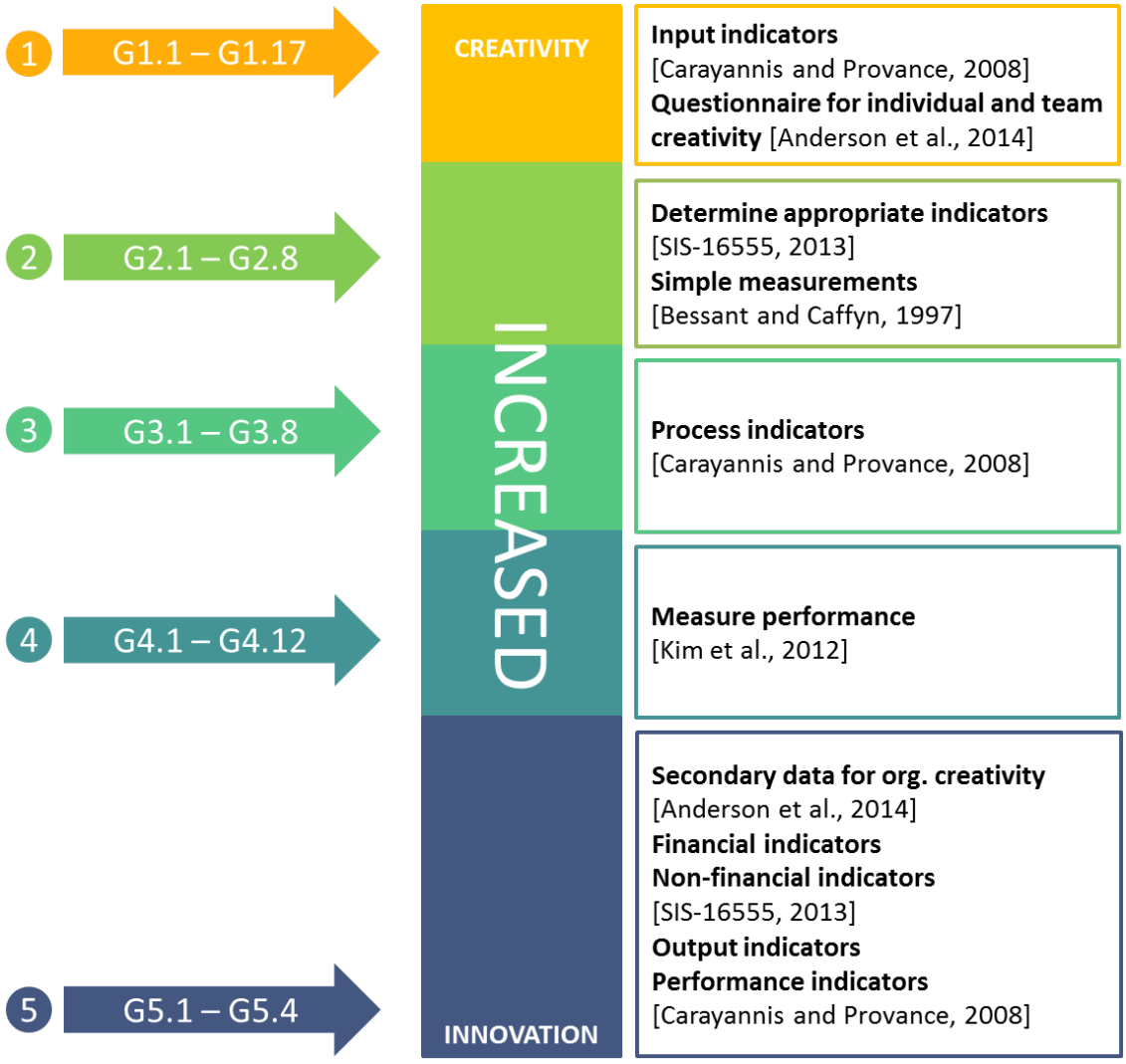

Figure 3.3: *Visualization of guidelines and indicators, reaching from individual creativity to innovation*

3.3 Comparison of Creativity, Innovation and Agility

In this section are conclusions drawn regarding the connection between innovation and agility. It is interesting to find out if above findings interfere with agile principles. Earlier research on the area is presented in section 2.4.

In 1994 predicted Rothwell [58] the main characteristics of 5G, two of them were; greater overall organization and systems integration (including external networking) and flatter more flexible organizational structures for rapid and effective decision making. The characteristics were condensed into four key aspects; integration, flexibility, networking and parallel information processing. These statements are distinctively similar to the Agile features Sherehiy [63] emphasizes; 'flexibility, responsiveness, speed, culture of change, integration and low complexity, high quality and customized products, and mobilization of core competencies'. It is obvious that agility and 5G of innovation processes are theoretically similar and both of them target the unpredictable environment. Agile methods are often implemented in business contexts that value productivity and goal achievement. Iivari and Iivari [34] argue that it is naïve to believe that there are no contradictions between agility and productivity, which they demonstrate through mapping and characterizing cultures. As mentioned in section 2.3 is enterprise agility embedded in a developmental culture, whereas productivity is a part of a rational culture that focuses on stability, efficiency and goal achievements. This dilemma is similar to innovation ambidexterity (section 2.2.2) where the constraint between exploration and exploitation is discussed. This strengthens the relationship between agility and innovation, since both terms require an explorative approach which can be hard to combine with productivity.

Shared success factors and contradictions between agile, creativity and innovation are identified and included in figure 3.4. Some of them are explicitly mentioned in earlier text, such as flexibility, integration, customer collaboration, empowerment and explorative. The factor 'motivation' cannot be foreseen in creativity and innovation research, many authors argue that motivation increase both creativity and innovation [1] [3] [4] [5] [12] [23] [47] [65]. As mentioned in section 2.3.3 were developers' motivation increased when applying agile methods [31]. Motivation is therefore interpreted as an agile driver of creativity. Trust is not necessarily an outcome from implementing agile, but trust is essential for both agile methods and creativity to flourish [1] [3] [5] [14] [22] [23] [45] [46] [47]. Trust is perceived to be an agile success factor [22] and lack of trust in an agile team can lead to poor feedback, lack of communication and difficulty to share leadership [46]. Trust is also an innovation determinant [45] and important when you want employees to put forward their ideas [14] [23].

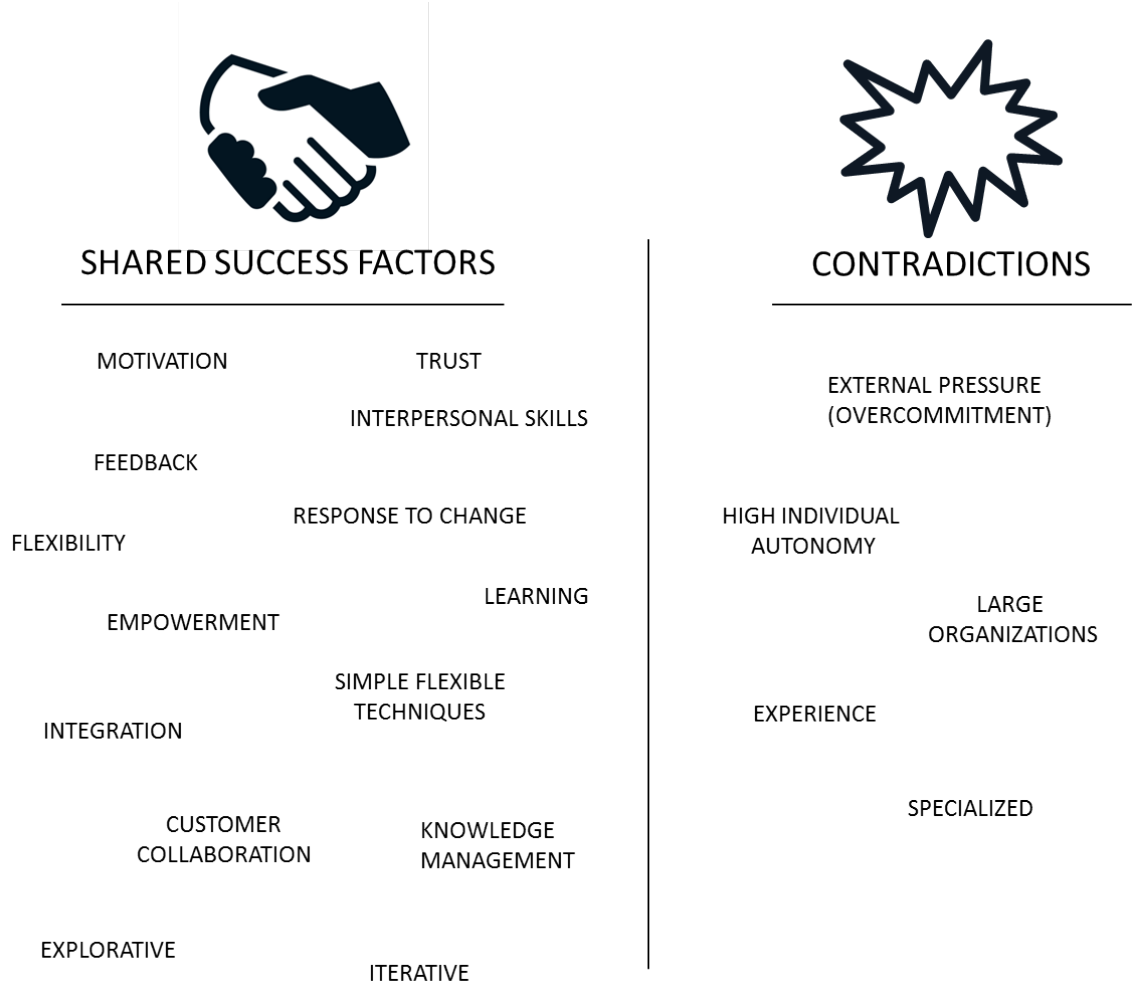

Figure 3.4: *Shared success factors and contradictions between creativity, innovation and agility*

Agile methods handle the unpredictable market through 'response to change' and 'iterative' [22] [40] [63]. To establish innovations companies must handle the changing environment [10] [48]. Amabile [3] states that a creative processes may involve loops to solve complex problems.

The hindrances found were; external pressure, high individual autonomy, large organizations, experience and specialized. External pressure was found as a challenge when introducing agile methods [31] and has a negative influence on creativity [3]. Gassman et al. [27] state that involving the customer into the innovation process solves FFE, but the authors also conclude that too much customer demands may decrease creativity. Being autonomous is an individual creative trait [47], but high individual autonomy was found to be a barrier for shared leadership which is required when working according to Scrum [46]. Dybå and Dingsøyr [22] analysed 36 empirical agile research papers and found that agile principles are hard to implement in large organizations, the same result as Vijayasarathy and Turk [73] concluded on. Creativity and innovation however are desired in all kinds of organizations, from small start-ups to world leader companies, like Google. Steiber [68] describes the

way Google work but does not mention Agile once. Skills and expertise are seen to increase creativity [3] [5] [47], but specialization can be a barrier for self managed agile teams [46]. At Atlassian were developers assigned on skills not preference [45], which is against agile principles but sometimes necessary. A common problem with agile methods is the balance between efficiency and generalist team members [31]. The same holds for experience, where diverse experience was found to increase creativity [3], but experience of software development can be a hindrance for adopting agile methods [73].

3.4 Summary of Analysis of Theory

The research findings of creativity and innovation were condensed into 37 subtopics. These topics stretch from communication, confidence and awareness to team, risk taking and innovation. All topics can be seen in figure 3.2 and further developed in Appendix B. For each subtopic were guidelines extracted, to support the development of the QR system.

Similarities between innovation and agility were analysed, such as Rothwell's [58] and Sherehiy's [63] definitions of 5G innovation process and agility, which include flexibility and integration. Also, both innovativeness and agility seem to have contradictions with productivity [34].

Identified shared success factors for agile, creativity and innovation are motivation, trust, interpersonal skills, feedback, response to change, flexibility, learning, empowerment, simple flexible techniques, integration, customer collaboration, knowledge management, explorative and iterative. Contradictions that were found are external pressure, high individual autonomy, large organizations, customer demand and specialized.

Chapter 4

Initial Empirical Findings

This chapter describes the prerequisites and data gathered before the implementation of the new dimension in the QR system. The empirical underlying findings include observations of the Scrum team, KPI, interviews with business management and the benchmark questionnaire.

4.1 Observations of Scrum Team

Through being present on a daily basis during 22 weeks a nuanced comprehension of the team's behaviours, perceptions and positions was generated. More than 25 planning- and retrospective meetings were attended and notes taken. A mind-mapping session was held with the Scrum team to systematically collect information where the team members could express their perceptions, opinions and additional information. This enabled analysis of their perception of a creative climate.

The team described that they are overall happy with their surroundings, work and co-workers. They feel motivated to go to work and are stimulated by the diverse work tasks and challenges. The team members stated that Scrum is a suitable process for them. They said they prefer to work agile because it requires autonomy and continuous delivery, which in turn increase their motivation. To be a software developer seems to overall be a challenging and stimulating job, translated quotation:

"Programming is creative, you always need to find new ways to solve problems"
- Team member 1

Their time is divided into A-, B- and C-task. A-tasks are pushed from the backlog (by PO and SH). B-tasks are based on what the team finds important, and C-tasks are individually chosen. B- and C-tasks still need to be useful and facilitate A-tasks. By percentage, their time was divided into; A-tasks 60%, B-tasks 20%, C-tasks 10%, meetings (planning, review, retrospective) 10%. This time scheduling is similar to Atlassians 20% program [45] or Google's 20% program, which provide employees with opportunities to take initiatives and develop ideas. Google emphasizes the importance to have creative people within the organization and letting them work on things they believe are important and be able to make their own mistakes [68].

The team explained that they have many ongoing projects which require the project specifications to be clear. Sometimes it can be overwhelming when too much is going on and even if the team is autonomous they need good project management to stay focused. A re-occurring topic on the planning meetings was that they should create subtasks and do a systematisation of their projects in advance. This was particularly clear during an intense period (TS1510 - TS1516) when a new project kicked off, see table 4.1. The team was conscious about task-briefing, which sometimes increased the length of the meetings but was crucial for their further work. B-tasks and C-tasks were often quickly planned, probably due to that the team members knew in advance what they wanted to work on. Translated quotation:

"We care about our B-tasks, they give us power and space to decide for ourselves"
- Team member 2

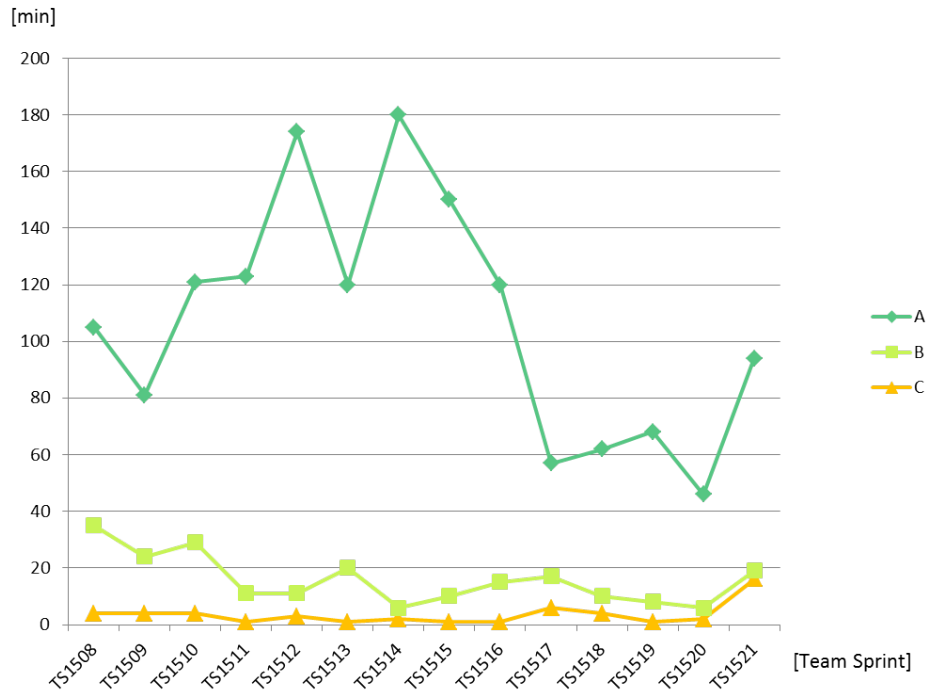

Figure 4.1: *Time spent on planning each prio level (accumulated) across team sprints (TS15W)*

Team members with fixed salary have a tendency to stay at the office, in contrast to employees with variable salary who tend to come and go. This phenomenon has a clear reason; the employees with variable salary earn more when working as consultants. It should be pinpointed that most employees at the office (besides management and human resources) are in between consultancy assignments. This was perceived to affect the team because there was no long-term vision. They said that most goals are individual and corporate, which implies that they do not have shared team goals. The team has confidence regarding their competence but they explained that they would like to have an experienced team member who is able to question status quo, increase cross functionality and act as a mentor with overall responsibility.

The team likes the open office landscape, it is a good balance between talking and focusing on work tasks. They would appreciate if all team members had their workstations closely located because it would enable them to have direct and close contact. There were contrarious opinions about the physical scrum board, some team members thought it was redundant while others believed it was a useful aid; bringing clarity to externals and work as a common space. Each morning at 9, the team gathered around the physical scrum board and each member shared what they did yesterday, are going to do that day and may alert the team about hindrances (figure 4.2).

Figure 4.2: *Physical scrumboard*

The scrum team itself developed a virtual scrum board (figure 4.3) where they can plan and follow up on projects. It also included KPIs to follow up on their work. Other tools they use are Jenkins (continuous integration framework), JIRA (task management), GIT (source control management), Gerrit (code review), IRC (group chat) and tools for static program analysis.

They have clear routines for meetings and reviews. This enable the team members to give each other individual feedback. Feedback given from managers outside the team is often targeted towards the team and can sometimes be unspecific. The team members wish externals could take more time to get involved into their work.

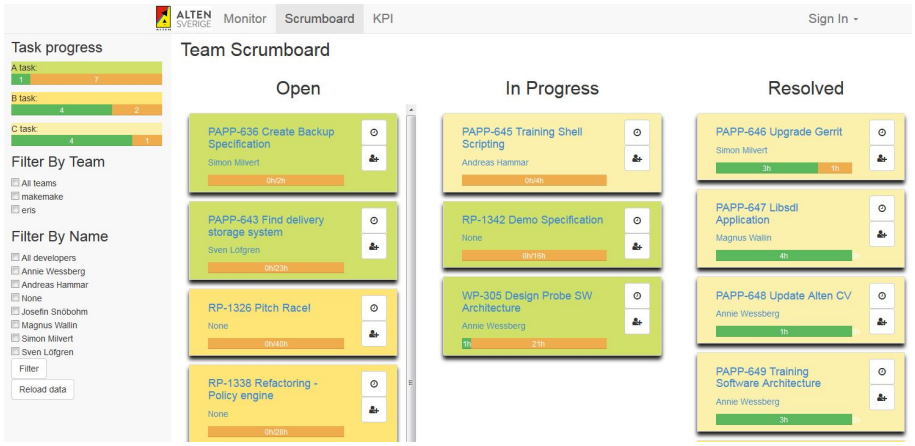

Figure 4.3: *Virtual scrumboard*

4.2 Key Performance Indicators

The team had several KPIs to evaluate work and to motivate efficiency. As in accordance to Scrum, the team had a burn down chart (KPI1) that illustrated resolved hours in comparison to reference value, i.e. each employee should resolve tasks that correspond to 8 hours each day. The team also measured number of code merges per day and developer (KPI2), with the aim to encourage continuous code integration. They also followed up on task progress for each sprint, i.e. resolved tasks and unresolved tasks (KPI3).

It was asked to implement a KPI that illustrates planned tasks hours (A, B, C) in comparison to resolved tasks hours (A, B, C) with the aim to analyse which kind of tasks they prioritize and how well they estimate time (KPI4). Analysis of time spent on each prio-level showed that the team spent their time approximately as intended. This is a proof that the team used the time that was dedicated to tasks selected by the team (B-tasks) and individuals (C-tasks). This KPI which reflect employee empowerment has shown to be crucial for innovative climate in research [45] [68] and is classified as an input indicator since time is a resource [13]. This KPI going to be analysed later on in the thesis, see section 7.2.

Carayannis and Provance highlight the importance of combining KPIs from different stages in innovation processes. In table 4.1 are KPI1-KPI4 mapped into type of indicators. It shows that there is potential to develop performance and output indicators.

Table 4.1: *Implemented and potential indicators [13]*

Type	Indicator	Status
Input	Resource capital	KPI4
Process	Process management systems	KPI1, KPI2, KPI3
Performance	Result of organisational innovation	Potential future KPI
Output	Patents, rates, percentage of sales, number of new products	Potential future KPI

4.3 Business Management Interviews

Interviews with the three closest business managers (BM1-BM3) to the scrum team were held. The interviews were focused due to the limited time available. However, the interviews covered a range of themes. They were transcribed and condensed to a code. When analysing qualitative data it is important to consider trustworthiness. It is done through choosing credible participants, focus, selection of context and data gathering. The credibility can also increase if quotations are presented. Dependability should also be considered, which is about data might change over time. The third way to ensure trustworthiness is through transferability, when the reader can apply the result onto another context [28].

One of the interviewees was the responsible manager for the team members and the other two were promoting the team to external clients. Their primarily work was focused on managing consultants, finding assignment for them, finding new markets and also new customers. The business managers and the scrum team were located at the same place, just a few steps away from each other. The objective was to get an overview of how innovation and creativity were perceived by the managers and understand the strategy behind having agile teams at the office. In addition, questions concerning the team were asked with the aim to analyse the relationship between the team and their closest managers. The interviewees were selected with consideration to the purpose. It would be irrelevant to interview unrelated managers to the team since they can not answer to team-specific questions. The interviews were held within a week and therefore was changing data not a perceived problem. Transferability was not determining in this case, since the purpose was not to inductively prove something but to interpret and analyse the environment. The questions and coded answers can be seen in Appendix D. The following topics were included in the interviews:

- Innovation perception
- Goals
- Agile teams at Alten
- Improvement management
- Feedback
- Resources
- Customer focus
- Failure management
- Conflict management

All interviewees perceived innovation and creativity to be essential for Alten's survival. They need innovation to stay competitive. However, it was rather a discussion about organizational improvements and innovations than product innovations produced by the agile team. Translated quotation:

"A lot I would say, it is how we survive; through taking it to the next step. You cannot do what everyone else is doing or the way the customer always have, it is about staying interesting towards our clients" - BM1

The most prominent tool they used to encourage creativity was communication channels, which was mentioned by two of the interviewees. Translated quotation:

"We have a palette, if you take part of department news and use our Intranet. There are everything from new service areas, new possible consultancy assignments, new types of courses to develop yourself as an individual, develop Alten by delivering more services to the customer, seminars and training" - BM2

Goals are formulated on individual and corporate level. Some goals can be derived to innovation but no goals are explicit focusing on managing innovation or creativity.

Having agile teams at the office had several strategic reasons. Firstly it is a way to stimulate and motivate consultants that are in between assignments. It is also an increasing trend among their customers to work agile and it has become a demand which Alten needs to respond to. The perceived benefits are quality assurance, efficiency, decentralized decision-making, joy, involvement, dynamisms and increased competency. The interviewees also identified some disadvantages; it requires social skills, might be unrelated work tasks, widespread work, undefined target, organize team instead of individuals and agile methods require appropriate assignments.

It seemed like the managers were open to receive improvement suggestions but did not use any specific method for considering and implementing them. If the managers wanted to have something done they had a portal at their Intranet which is synchronized with the task management tool JIRA. The given feedback is mostly about performance and happens often in spontaneous meetings. Every year they have individual career meetings, which is a structured feedback session. They used indexes both for satisfied employee and satisfied customer for evaluating and providing feedback. Every week the team members provided each other feedback when conducting the retrospective meeting. Continuous feedback from the customer was mentioned in all interviews and was one of the main assurances that the developers keep the customer-focus.

They had a clear structure for managing not successful projects. They call it Delivery Centre, which assures a structured way of managing projects and follow up on them. Two of the interviewees brought up "lesson learned" as a part of handling failures. All of them were clear about not blaming individuals but rather looking for reasons and improve on them. Translated quotation:

"In one project that we did not execute well was the customer-contact the issue. You need to get the attention of the customer and bring them to every meeting" - BM3

Conflicts were handled constructively and prompt. Conflicts seemed to be rare to them, and quite few are brought up to management. One of the interviewees said that the team is autonomous and should therefore try to solve it themselves before

taking it to the next level in the organization. However, if conflicts need to be solved by management they handle it honestly and openly.

The managers seemed to be engaged in the interview questions because they provided improvement areas during the interviews. One of the managers thought they could be better at encouraging creativity and innovation. He suggested innovation seminars, forums for improvement and more conferences in a creative environment. It was also a desire to formulate and clarify goals, strategies and plans. Openness was also interpreted as an improvement area, where the managers emphasized the importance of closer and more relaxed communication with the consultants. If the agile methods prove to be a beneficial way of working, it would probably spread bottom-up to management and the organization. One of the managers believed he could provide his consultants with feedback more often.

4.4 Creative Climate Assessment: Benchmark Questionnaire (CCQ1)

The innovation measurement tools presented in section 2.2.6 raise valuable insights and aspects that should be considered in organizations. Carayannis and Provance [13] state that a range of innovation indicators give a better overview of an organization's innovativeness. However, many of the indicators mentioned in their study take long time to give an effect. Those indicators would probably not contribute to evaluate the implementation in this thesis work, but they might be useful for long-term investigation of the innovative work at Alten.

Since perceived change can be noticed within a short period of time, a questionnaire with regard to Ekvall's ten creative climate dimensions [23] was developed. It was found that there were areas missing [36] in Ekvall's questionnaire [23], the ten dimensions were therefore supplemented with three areas from Amabile's et al. tool KEYS [4]. The additional area "workload pressure" is categorized as obstacle [24] and has negative influence on creativity, which Isakesen et al. identified as an important area to consider. The other two additional areas; sufficient resources and supervisory encouragement, are two stimulators [24] that are found to supplement Ekvall's dimensions. The statements were formulated with consideration to the authors' descriptions and narrowed down to four per area to decrease the extent. The participants graded the statements on a Likert grading scale; Not at all applicable (0); Applicable to some extent (1); Fairly applicable (2); Applicable to high extent (3). The questionnaire can be seen in Appendix E. The benchmark questionnaire (CCQ1) was filled in by four team members in MakeMake.

Another team at the office was asked to fill in CCQ1 as well to act as control group. The control group was separated from the rest of the office because they worked with confidential in-house projects. Their design process consisted of different development phases and they worked according to a schedule for five weeks. All team members were mechanical engineering designers, of which one was the project manager. It was a stabilized team and open communication was considered important.

Since the control group was isolated they would not be affected by the implementation of the creative guidelines. But, if organizational changes would happen during the study it might affect the control groups answers and that would be important to consider and for validating the effect of the implementation. See figure 4.4 and 4.5 for the result. The result is a representation of the mean value of the responses. To make the tables more comprehensive the negative parameters 'Conflicts' and 'Workload pressure' have been reversed, i.e. the higher scores the more innovative climate.

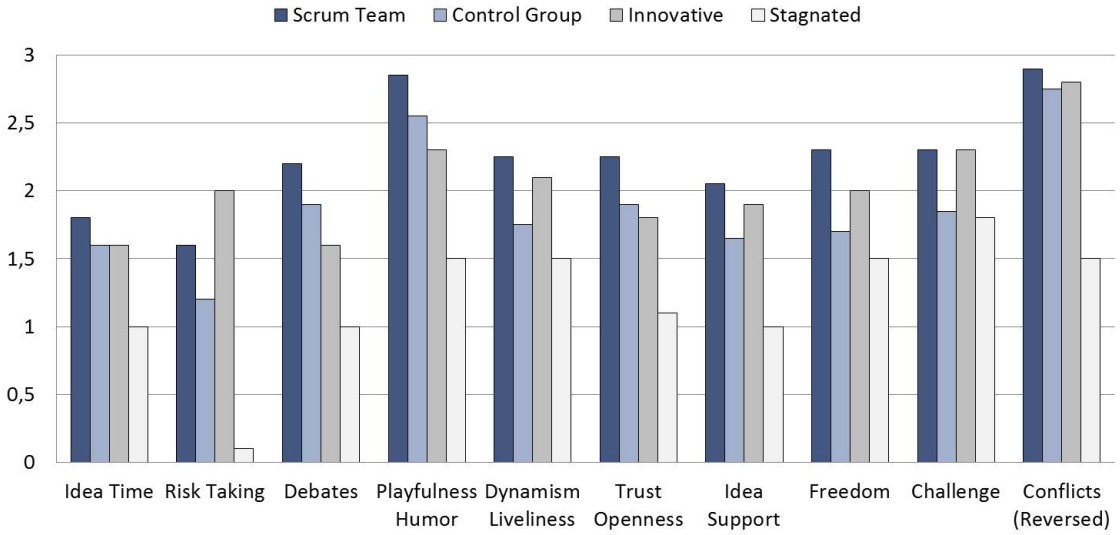

Figure 4.4: *Result from questionnaire. Ekvall's Creative Climate Dimensions [23]*

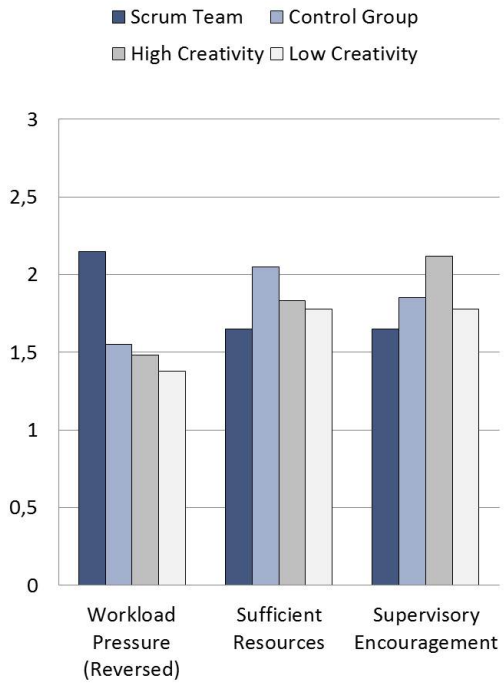

Figure 4.5: *Result from questionnaire. Amabile's et al. KEYS [4]*

Ekvall [23] has compared innovative and stagnated organizations. The scores for these two kinds of organizations are included in figure 4.4. Amabile et al. [4] asked their participants to fill in the questionnaire with their most creative project in mind and their lowest, which is why the reference values in KEYS represent high respectively low creativity. You can clearly see that MakeMake has scored higher than the innovative/high creativity reference in most cases. It should be emphasized that the comparison is an indication. The authors conducted their studies about twenty years ago. They also had more than four statements, with slightly different formulations, which can have influence on the result. Other potential sources of errors are; awareness of company reputation, low anonymity due to few participants, time pressure, earlier knowledge and formulation of statements.

Both Ekvall [23] and Amabile [4] conclude that some of the dimensions are stronger connected to innovative and creative work because they are more distinguished. The dimensions that are the most outstanding for creative work are idea support, debates, idea time, risk taking and supervisory encouragement. This reasoning is illustrated in figures 4.4, 4.5 where the gaps between the reference values are bigger. The dimension 'conflicts' has a big gap between the reference values, but might not be a controlling dimension but rather an effect, which may be the reason why Ekvall does not mention it as an distinguishing climate dimension of innovative firms.

At this stage some interesting results have appeared. The agile team had better scores than the control group and comparative innovative firms in most dimensions except 'risk taking', 'sufficient resources' and 'supervisory encouragement'. This partial result shows clearly that the agile team perceived their environment to support creativity and innovation. The relative relationship between reference scores shows which dimensions that are the most differentiated. A normalized graph was therefore made, see figure 4.6. The graphs are normalized against the stagnated/low creativity mean score, which means that the scores are relative stagnated firms and low creativity projects. 'Risk taking' is separately shown because the relative difference is extensively larger than for the other dimensions. Ingrid Kihlander (Director of Product Innovation Engineering Program, KTH) has considerable experience with using Ekvall's questionnaire. She explained that few companies reach the reference value of 'risk taking'[13th March 2015]. The team has already reached far but it would be remarkable if they would be equivalent to the innovative reference. Figure 4.6 shows that the scrum team members perceive their environment to be significantly more supportive than stagnated firms in terms of debates, playfulness and humour, trust and openness, idea support, conflicts and risk taking. Idea time, dynamism and liveliness, freedom, challenge and workload pressure are less diversified but still better than for innovative firms. It should be noticed that one of the dimensions the team scores lower than the innovative reference is risk taking. The team scores lower than the low creativity reference on sufficient resources and supervisory encouragement.

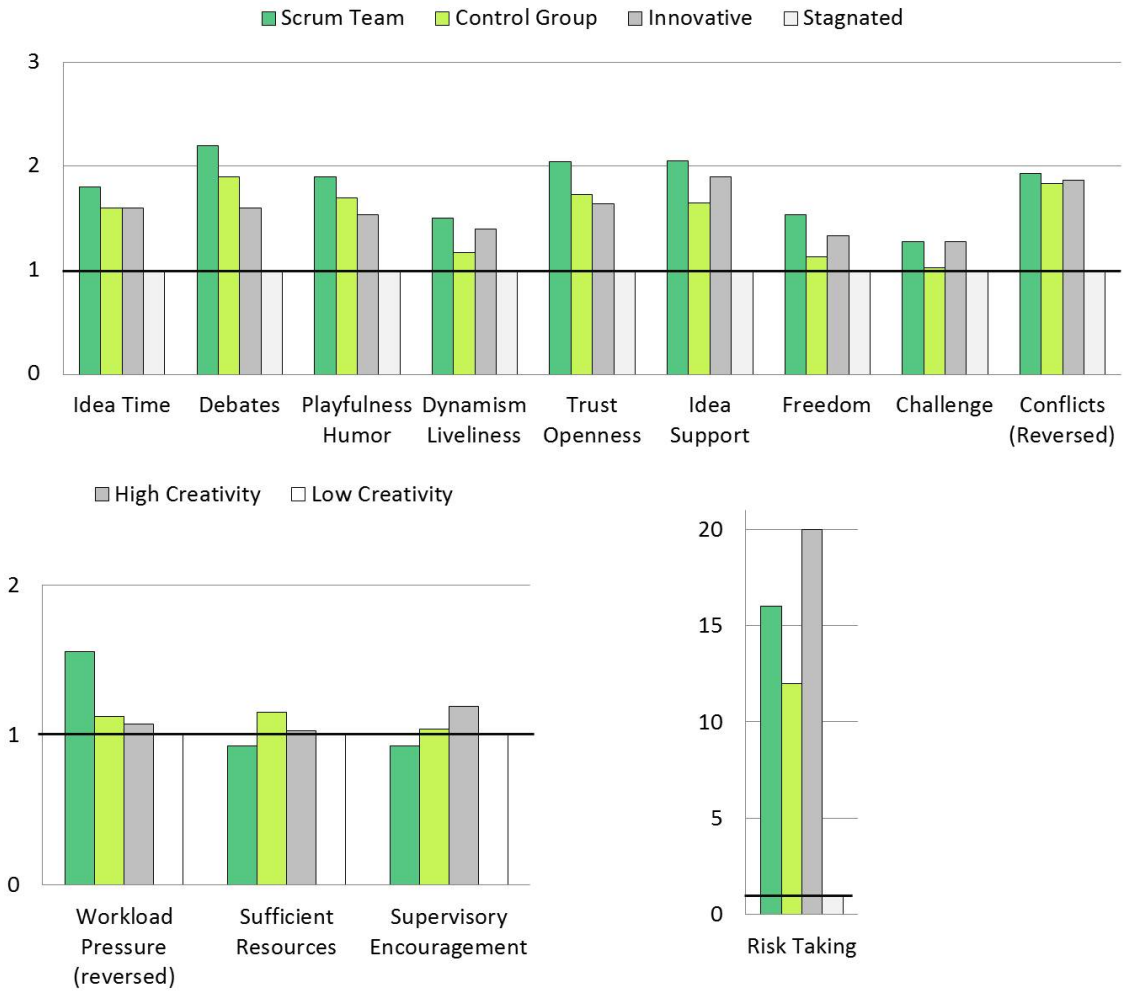

Figure 4.6: *Normalized result of Ekvall's Creative Climate Dimensions [23] and Amabile's et al. KEYS [4]*

A T-test was performed through using IBM SSPS Statistics Program. A T-test compare the mean value with regard to the standard deviation, which can tell if the result is statistically reliable or just a coincidence. The comparison was possible to make between the Scrum team and the control group since the groups answered the same questionnaire. However, since the participants were few are the majority of the answers not statistically reliable. In total is there a significant difference for 12 of 52 statements with $0{,}007 < p < 0{,}101$, see table 4.2. The remaining statements have $0{,}178 < p < 1{,}000$ which means the scores cannot be statistically assured. Table 4.2 shows that it is a significant difference for 'Sufficient Resources' and 'Supervisory encouragement' with low scores for the Scrum team (mean score difference >1). Statements for 'Workload Pressure', 'Debate', 'Dynamism and Liveliness', 'Trust and openness', 'Freedom' and 'Challenge' have a significant difference with a positive outcome (mean score difference >1).

The parameters chosen to be targeted for the implementation were;

- Risk taking
- Idea support
- Idea time
- Supervisory encouragement

These dimensions were perceived to have potential to be improved and are also determining for a creative climate [23] [4].

Table 4.2: *Statements in questionnaire with significant difference*

Statement	Scrum Team (mean score)	Control Group (mean score)	p
Sufficient Resources 2: We have the required competence in our team	1.5	2.6	0.025
Supervisory Encouragement 2: Our supervisor values individual contributions	1	2	0.101
Workload Pressure 1: Time pressure here is perceived as externally introduced and controlled	0.75	2.2	0.054
Risk Taking 4: The people I work with are prepared to take risks in implementing new ideas	2	1.2	0.016
Debates 1: Unusual ideas often occur in the discussions here	2.25	1.2	0.016
Dynamism and Liveliness 2: News are quickly embraced in the business	2.5	1.4	0.062
Dynamism and Liveliness 4: Alterations between ways of thinking about and handling issues often occur	2.5	1.6	0.052
Trust and Openness 3: There is support for the initiative so you feel encouraged to take new ones	2.75	1.6	0.048
Idea Support 4: The people I work with are actively encouraged to put forward new ideas and suggest improvements	2.5	1.6	0.052
Freedom 3: People here make choices about their own work	2.75	1.4	0.007
Challenge 2: People here experience joy at work	3	2	0.034
Challenge 3: The work atmosphere here is filled with energy	2.75	1.8	0.075

Chapter 5

Development of System

In this chapter is the existing QR system at Alten presented and the additional dimension that concerns creativity and innovation formulated. The development is based on the academical analysis and derived guidelines. The system is also adapted to fit Alten's QR system, which consists of several requirements. Therefore are the extracted guidelines rewritten and divided into requirements. The requirements state what needs to be done for each rank in the QR system.

The system was originally developed by Eldh [25] and is being refined at Alten, as mentioned in Section 1.1. However, there is a difference between Eldh's "Software Quality Ranking" and the QR system at Alten. First of all, Eldh calls it an improvement program and states that the first thing to do is to select targeted components of the code for quality improvements. The design of the improvement program is based on the assumption that the code has been tested before and that the company has delivered commercial software for years. The agile teams at Alten aim to include quality ranking into the every day work and do not target to produce commercial software. This is perceived to be the greatest differences.

Eldh [25] states that design and testing are often separated functions in software development organizations. By introducing Software Quality Ranking the designer gets a better apprehension of testing and quality aspects by early tests on a low level. Up to two to three weeks of work (code integration and system testing) can be saved if the developer has knowledge and a mindset towards testability and quality when designing the code. The improvement program is addressed to detect and solve faults as early as possible. This reasoning is the motivation of adapting Software Quality Ranking at Alten. The agile teams are supported in this matter by being cross functional, where they are expected to contribute with diverse competencies and learn from each other to understand other domains than their own.

Table 5.1: *Structure of Quality Rank System at Alten*

Rank	No. of requirements	Included dimensions
QR1 Awareness	42 requirements	SP, DI, TF, RE, SA, RA, CI, CP
QR2 Base Action	44 requirements	SP, DI, TF, RE, SA, RA, CI, CP
QR3 Transfer Quality	44 requirements	SP, DI, TF, RE, SA, RA, CI, CP
QR4 Structural improvement	20 requirements	SP, DI, TF, RE, SA, CI, CP
QR5 Performance improvement	15 requirements	SP, DI, TF, CI, CP

5.1 Quality Rank System at Alten

The QR system that was targeted to be developed at Alten was used by developers as a self-control tool for ensuring quality in code. It consists of five ranks, reaching from QR1 to QR5 (table 5.1). The ranks define the software maturity, i.e. how mature is the code? The system supports the software developer to know in which order actions and activities should be executed. Each rank is an advancement of the previous one, which means the ranks should be fulfilled chronologically. The ranks include several different dimensions to consider, which are: Structural Planning (SP), Dependencies and Impact (DI), Testing and Functionality (TF), Review and Collaboration (RE), Static Analysis (SA), Runtime Analysis (RA), Continuous Integration (CI) and Continuous Deployment (CD). The software developer can ensure the code has high quality by fulfilling the requirements in each dimension.

The first rank (QR1) represents awareness of fundamental functions that straight out "what we have and what we want". This rank should be fulfilled as early as possible. The second rank (QR2) is about taking action and do quality improvements. This rank is managed before the code is delivered to the main branch. Other developers should be able to revise the code. The requirements in the third rank (QR3) control that the improvements in QR2 are in congruence with the QR1. At this rank the code is ready for delivery outside the development team. A first risk analysis is done and issues prioritized. The fourth rank (QR4) deals with the issues related to risk and general research and analysis activities are performed. The aim with this rank is to define how the team will act to ensure that all software reach QR5. The last rank (QR5) is required before final release. Requirements in this rank are based on findings of the general research and analysis in QR4. All done parts are documented to ensure that the team is ready for changes in the future. The code is ready for customer release when all ranks are fulfilled.

5.2 Development of Creativity and Innovation Dimension

A system design specification and verification plan was established to support the design of the system, see table 5.2. These requirements are referred to when handled.

Table 5.2: *System requirements and verification plan*

Label	Slogan	System Requirement	Verification
Req1	Trustworthy suggestions	The requirements shall be derived from research	Requirements are based on research guidelines
Req2	Applicable in work	Translate creativity and innovation items into QR-system	Same appearance as the existing system
Req3	Applicable in context	System shall be formulated with regard to agile practices	Shared success factors are included, contradictions and Conboy's taxonomy considered
Req4	Internal change initiative	The requirements shall not specify how	Involve team into creation of action plan

The new dimension of Alten's QR system is named "Innovative & Creative Environment" (ICE). Alten wanted to keep the main part of the system confidential but the requirements in QR1 are evaluated later on in section 7.3. ICE has different attributes in comparison to the existing dimensions since it goes beyond the agile team and includes its surrounding and organization. This means that the Agile team has less influence on the higher QR ranks since it requires interest and attention from the upper levels of management. Although, the team can promote changes in the organization. The ranks are illustrated in figure 5.1, starting with individual creativity and reaches to the extended organization. How the QR ranks should be interpreted for ICE was elaborated with the supervisor of the Agile team who has introduced the system to the organization. The guidelines derived from research in Appendix C supported the development and formulation of requirements (Req1 - *Trustworthy suggestions*). The system resulted in 11 topics (32 subtopics), spread over the five ranks (QR1 - QR5).

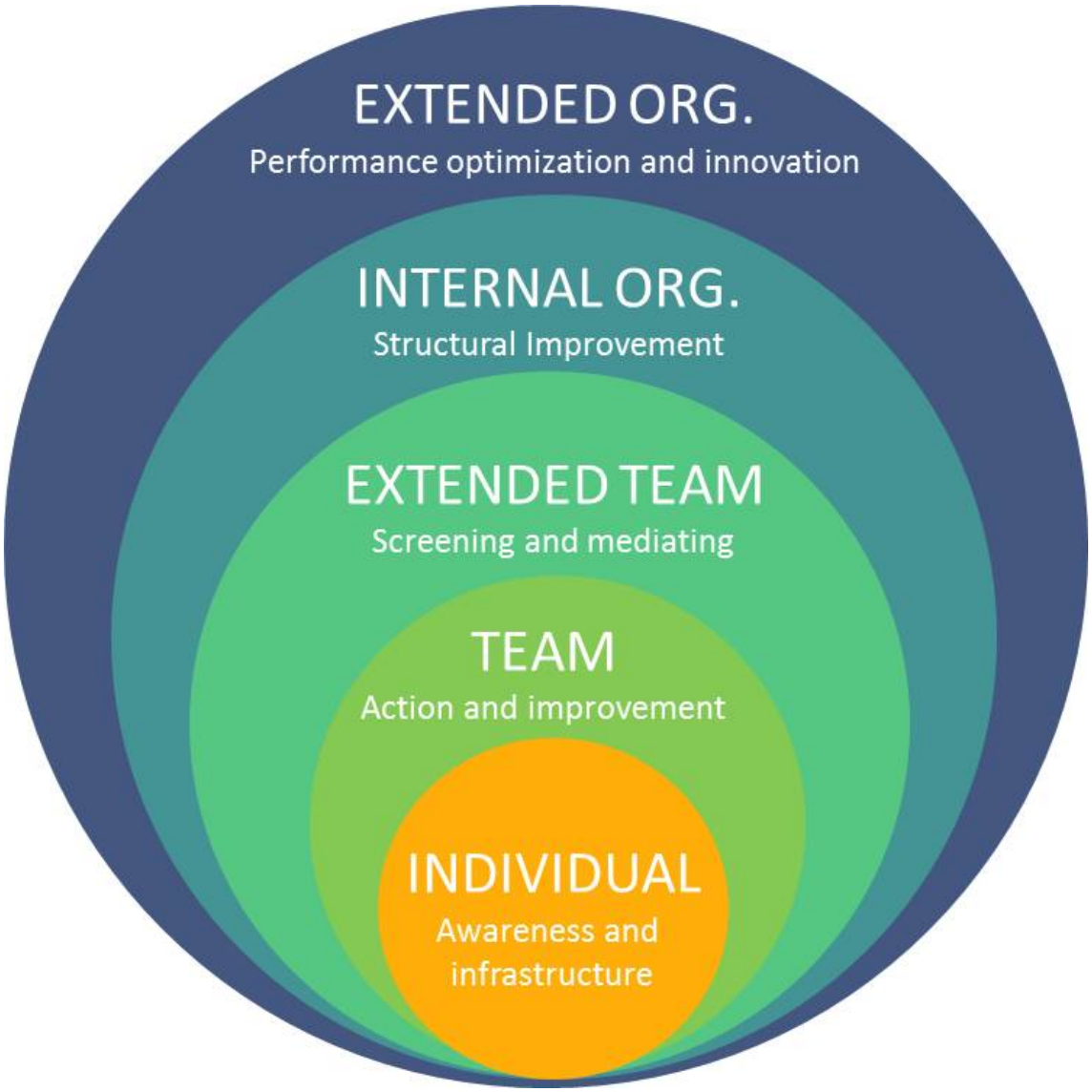

Figure 5.1: *Illustration of levels in QR system*

The structure of the system can be seen in table 5.3. The structure is based on the existing QR-system (Req2 - *Applicable in work*).

Table 5.3: *Structure of developed QR system, ICE dimension*

Rank	No. of requirements
(QR1) Individual: Awareness and infrastructure	28 requirements
(QR2) Team (Peer): Actions and intermediate improvement	15 requirements
(QR3) Team (Extended): Screening and mediating	12 requirements
(QR4) Organization (Internal): Structural improvement	16 requirements
(QR5) Organization (Extended): Performance optimization and innovation	10 requirements

Related subtopics are included in topics that reach over several ranks, which creates lateral links across the system. The clustering was made to improve the comprehension, clarity and structure of the system. This is illustrated in figure 5.2. The requirements are numbered according to corresponding rank and topic. For example, requirement ICE 2.11.1 belongs to QR2 (2), Idea Management (11) and is the first requirement (1).

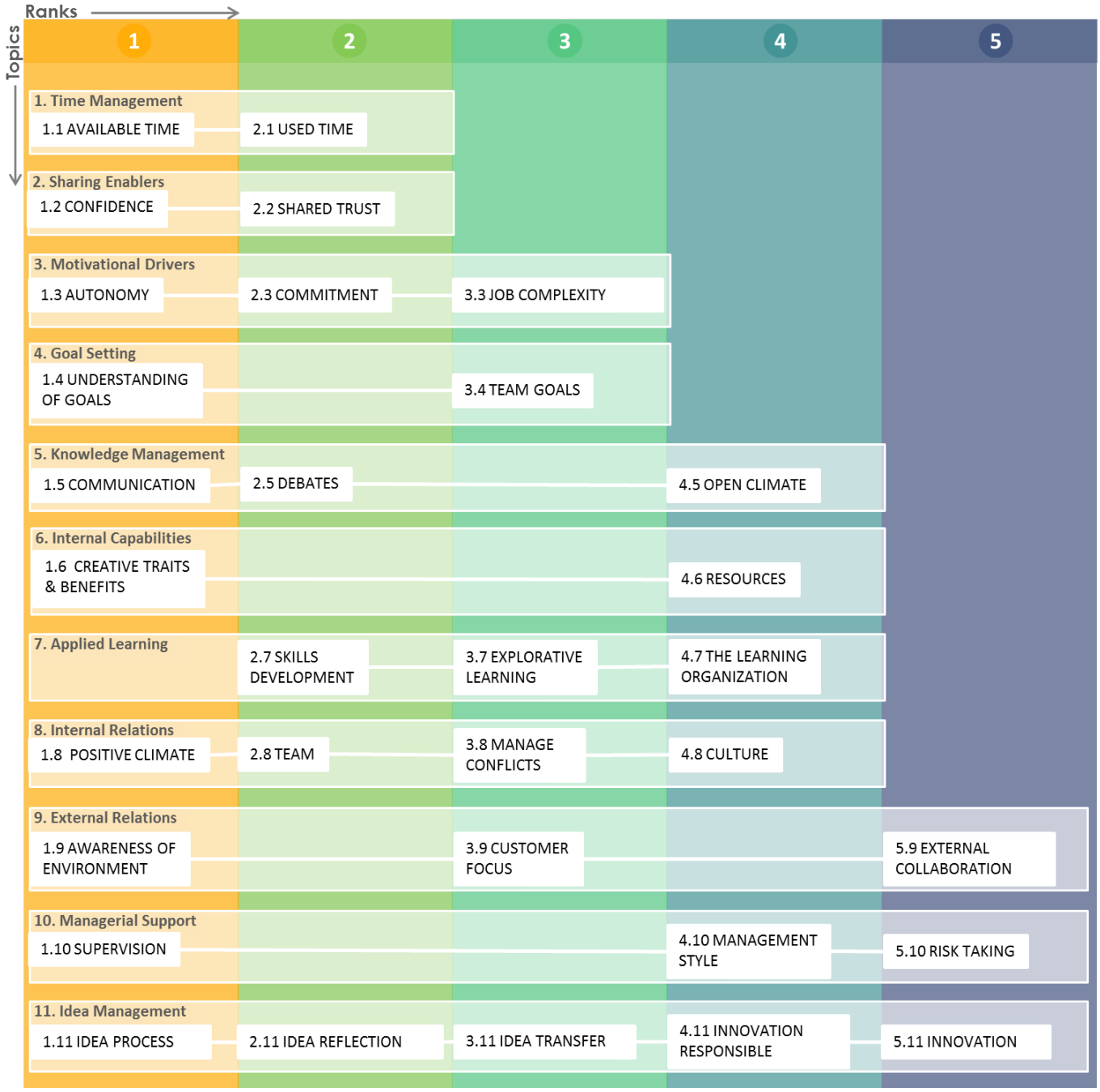

Figure 5.2: *Illustration of ICE*

The shared success factors between creativity and agility were essential to include, since the system was meant to be applied onto an agile team (Req3 - *Applicable in context*). The explicitly included success factors are; 'trust' (ICE 2.2), 'feedback' (ICE 1.10.1, ICE 3.9.2), 'empowerment' (ICE 1.3), 'learning/explorative' (ICE 2.7, ICE 3.7, ICE 4.7) and 'customer collaboration' (ICE 3.9, ICE 5.9). 'Knowledge management' is supported by communication channels and forums for discussion (ICE 1.5, ICE 2.5, ICE 4.5). Other success factors can arise from applying the requirements in ICE but cannot be directly controlled. For example is 'motivation' strengthen by autonomy (ICE 1.3), commitment (ICE 2.3) and job complexity (ICE 3.3) [3]. 'Interpersonal skills' is meant to be strengthen by team building and team work (ICE 1.4, ICE 2.8, ICE 3.4). 'Integration', 'response to change' and 'iterative' are handled by involving the customer into the process [27] and external environment monitoring (ICE 1.9, ICE 3.9, ICE 5.9). 'Simple flexible techniques' can preferably be applied for probe and learn (ICE 3.7) and the team itself can decide if they want to apply simple techniques for other practices, such as idea process (ICE 1.11), idea reflection (ICE 2.11) and idea transfer (ICE 3.11). These connections are shown in table 5.4.

To overcome the contradictions between creativity,innovation and agile methods was focus put on learning. The team should preferably develop skills that are in congruence with cross-functionality, i.e. improve core competencies but have general knowledge of other relevant fields. It helps the team to understand each other and work integrated. Continuous learning is also one way to handle the contraction between creativity and productivity [1]. The two impediments 'specialized' and 'experienced' regard mostly adoption of agile principles and managing agile teams. One solution to this problem is to work with both hindrances and benefits that emerge from agile methods [73]. This is crucial to consider when new team members are introduced.

The agile taxonomy created by Conboy [17] was also an important element to consider. To include ICE as a component in their work, it must contribute to one or more of the following; creation of change, pro action in advance of change, reaction to change or learning from change (in accordance to the Agile Taxonomy [17]). ICE clearly supports "learning from change", and has potential to be supportive when it comes to "creation of change". The potential lies in having an innovation responsible person (ICE 4.11) who develops an innovation strategy. The system must also contribute and must not detract from perceived economy, quality or simplicity. One risk is that the team perceives the system to be overwhelming and therefore inhibit simplicity. To aviod this, the implementation must be thoughtfully performed.

Table 5.4: *Requirements that regard shared successfactors*

Success factor	Topics and Requirements
Trust	ICE 2.2 *Shared trust*
Feedback	ICE 1.10.1 *Supervisors provide individual feedback regularly*, ICE 3.9.2 *The team receives constant flow of customer feedback*
Empowerment	ICE 1.3 *Autonomy*
Learning, Explorative	ICE 2.7 *Skills development*, ICE 3.7 *Explorative learning*, ICE 4.7 *The learning organisation*
Customer collaboration	ICE 3.9 *Customer focus*, ICE 5.9 *External collaboration*
Knowledge management	ICE 1.5 *Communication*, ICE 2.5 *Debates*, ICE 4.5 *Open Climate*
Motivation	ICE 1.3 *Autonomy*, ICE 2.3 *Commitment*, ICE 3.3 *Job complexity*
Interpersonal skills	ICE 1.4 *Understanding of goals*, ICE 2.8 *Team*, ICE 3.4 *Team goals*
Integration, Response to change, Iterative	ICE 1.9 *Awareness of environment*, ICE 3.9 *Customer focus*, ICE 5.9 *External collaboration*
Simple flexible techniques	ICE 3.7 *Explorative learning*, ICE 1.11 *Idea process*, ICE 2.11 *Idea reflection*, ICE 3.11 *Idea transfer*

Chapter 6

Implementation of System

When the design of the system was set, the next step was to uncover which requirements in the ICE system that needed attention. The main part of the implementation phase was to evaluate the ICE system in relation to the Scrum team. Some requirements in ICE were easy to evaluate. It was for example stated by the BMs and the team that the team did not have shared goals. However, many requirements in ICE depend on how the team members perceive their environment. Their perceptions were partly reflected in the questionnaire they filled in.

It was chosen to conduct two workshops, in order to involve the team members into the change towards an even more creative environment and uncover areas they want to improve on. Employees are the driving force of change [42] and are more likely to do changes if they are involved [10]. The first workshop (WS1) and the benchmark questionnaire CCQ1 identified improvement areas for the team, but an additional meeting was held to evaluate which requirements the team fulfilled in QR1. After these sessions was an action plan developed with regard to the requirements in ICE. A second workshop (WS2) was held to perform member checking of the action plan and explain how the actions should be interpreted. A creative event 'Pitch Race' was held with the objective to stimulate interest of creativity and address the targeted dimensions in the questionnaire. The event was inspired by Atlassian's FedEx Day, which is proven to support time and space to explore [45]. The implementation process is shown in figure 6.1.

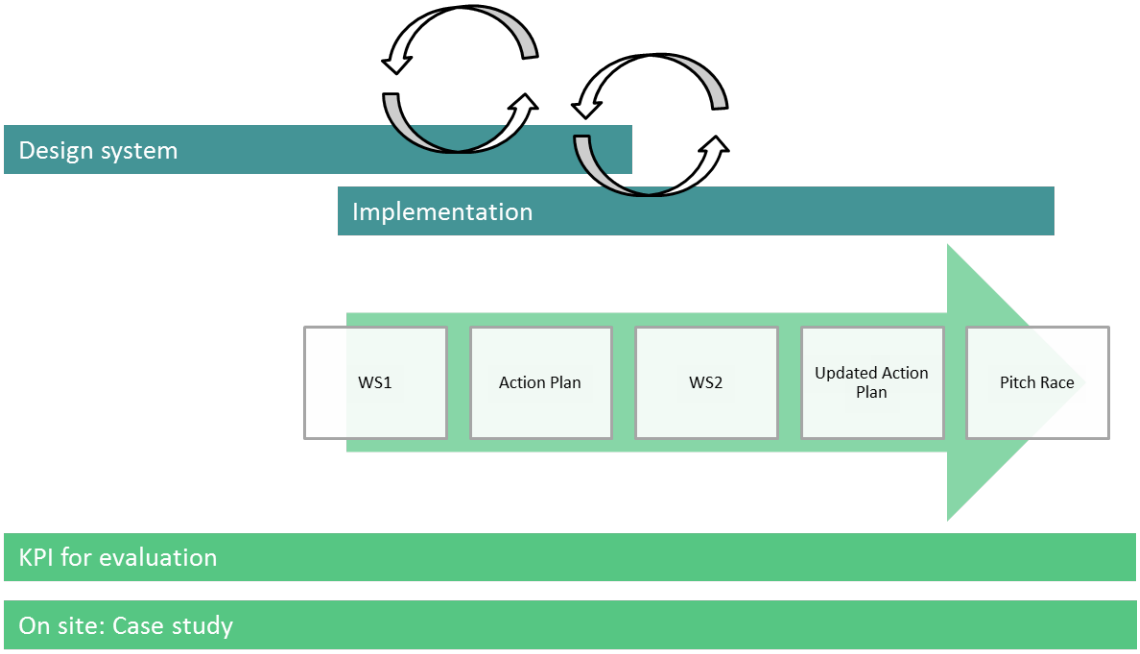

Figure 6.1: *Implementation structure*

6.1 Workshops

Two workshops were held, as mentioned earlier. Workshops are thought to be an efficient way to agree on improvement areas and solutions. The first workshop (WS1) was scheduled to cover a whole day, whereas the second (WS2) lasted for two hours.

6.1.1 Interactive Workshop (WS1)

When the first workshop (WS1) was held the team had grown to include nine (from five) team members. The workshop consisted of two main parts:
- Identification of improvement areas and suggestions of how to continue working.
- Discussion about Alten's vision and goal setting.

How to design a workshop was elaborated with Andreas Larsson, former *Associate Professor* at Luleå University of Technology and Lund University and is currently *Innovation Practice Advisor and Case Manager* at Doctors Without Borders, Sweden Innovation Unit. He prefers workshops to be interactive, i.e. the participants contribute to the content. He introduced the workshop method: NOW, WOW, HOW. The method helps the participant to uncover current improvement areas (NOW), what the ultimate state would be (WOW) and how you get there (HOW). This workshop showed that the team wanted improved document management, time management, structure in JIRA, definition of projects and planning meetings. The dream scenario would be a strong team with clear project specifications and expecta-

tions. The participants identified solutions and how to get there. Some improvement areas they identified are are connected to ICE, see table 6.1.

Table 6.1: *Workshop connected to ICE*

Identified improvement areas	Connected ICE requirements
Acquiring software tools	ICE 4.6.2 (resources acquired)
Individual feedback on tasks	ICE 1.10.1 (individual feedback), ICE 1.10.2, ICE 1.2.2 (individual contributions)
JIRA structure; feature suggestion	ICE 3.11.1 (communicating ideas), ICE 3.11.2 (assessing ideas)
New member introduction	ICE 2.8.1 (team building activities)
Oral information flow	ICE 1.5.2 (efficient communication channels)
Specify tasks	ICE 2.8.3 (clear team expectations)

For the second part a presentation of Alten's goal documents was held. Each participant filled in a mind map regarding their perception of Alten in relation to domains, methods, tools, market and vision. When they were done individually, the group discussed and made a common mind map on the whiteboard. This encouraged all participants to explain how they perceive corporate goals. However, it seemed hard to apply the goals on an individual level and some thought it was irrelevant for them. The second exercise was similar but this time they had to fill in the mind map regarding themselves. This exercise was meant to stimulate formulation of individual goals and create an understanding of how corporate goals affect on individual level. The team was not able to set team goals, and was therefore postponed to the second workshop.

6.1.2 Member Checking Workshop (WS2)

The second workshop aimed to explain the action plan and perform member checking. The team provided feedback and the action plan was updated (Req4 - *Internal change initiative*). The team environment was indeed dynamic and by this time the team consisted of six team members, of which four members had been included from start. During this workshop they were able to outline a vision and team goals, which is determining for a creative team [69] [37]. The vision was in congruence with Alten's overreaching vision. Goals were formulated with regard to result, learning, activities and creativity.

6.2 Pitch Race

The choice of event was based on the targeted parameters in the questionnaire and connection to the requirements in ICE. The event was inspired by Atlassian's FedEx Day and best practices were used. It has proven to be a successful and appreciated event world wide which also made it easier to motivate. To make it an Alten-event the name was changed to Alten's 24 h Pitch Race (figure 6.2). The participants were four Scrum team members and two master thesis students (at Alten). Two preparing lunch meetings were held and the participants handed in project orders in advance, which was meant to mainly describe what they expected to achieve during the event. Pitch Race started at 2 pm on a Thursday and lasted for 24 hours. Three different projects were carried out.

Figure 6.2: *Logo for Pitch Race*

When Pitch Race was finished the team, audience and business managers gave valuable opinions about the event. The business managers were impressed by the participants and thought it would be beneficial for Alten to continue with these sorts of events. The focus in the future should be 'how to add value' to Alten. The team evaluated the event with regard to the addressed dimensions in the questionnaire and requirements connected to them, see table 6.2.

Table 6.2: *Evaluation of event in relation to targeted dimensions (CCQ) and requirements (ICE)*

Target	**Evaluation of Pitch Race**
Risk taking (ICE 1.5.6)	Opportunity to test things outside routines, take risks, easier to take risks when it is in-house, quick decisions when you need to finish, formal with audience, informal when you are expected to take risks, decision-makers attended, have to present something
Supervisory encouragement (ICE 1.2.2, ICE 1.10)	Engage on all levels, individuals are seen, the audience get to know them better, managers want to invite CEO and take this event further
Idea support (ICE 1.2.1)	All ideas are seen, focus on inspiring each other, open broad concepts, everything is permitted, focus on your own project and are less critical towards others, lunch meetings great for blasting ideas, the company provided resources, need preparations
Idea time (ICE 1.1.1, ICE 1.5.6)	Take time to ideas, you do not always use C-task hours for developing ideas, you come further with a project when you dedicate 24 hours in a row, time is formally dedicated to ideas, good to combine paid and non-paid hours, continuity is achieved if the event is held a few times per year

Chapter 7

Result and Analysis

Results emerged from comparing the questionnaire results, follow up on KPI and analysing the action plan. Also, a final action plan for the Scrum team is presented.

7.1 Creative Climate Assessment: Followup Questionnaire (CCQ2)

The two teams (Scrum team and control group) were asked to fill in the questionnaire once again, about three months after the benchmark questionnaire. The same team members participated in CCQ1 and CCQ2. All gathered data is shown in figure 7.1. The result is also illustrated through comparing the CCQ2 result relatively normalized CCQ1 result, because it shows how much their perceptions have changed in a more comprehensive way. The comparison of the Scrum team's result is shown in figure 7.2 and the control group's result in figure 7.3.

The questionnaire result from the Scrum team was somewhat desired. The scores for the targeted dimensions (idea time, risk taking, idea support and supervisory encouragement) have risen. On the negative side, almost all other dimensions got lower scores. The control group also had some fluctuation in their answers. The control group ranked 'idea time' and 'idea support' considerably lower, which is the opposite to the Scrum team. Some fluctuation was expected and the gap between the scores for non-targeted dimensions between the control group and the Scrum team have decreased. The gap between targeted dimensions on the other hand have increased. A T-test was performed once again to compare the result from CCQ1 and CCQ2. Even if the mean score for targeted dimensions have risen is it not a significant difference between the two questionnaires ($p > 0{,}182$). Only one statement had a significant difference, which was "Risk Taking: People here are able to take bold action even if the outcome is unclear" with $p = 0{,}058$ and mean score difference + 0,75. This statement was targeted and evaluated during the creative event 'Pitch Race'.

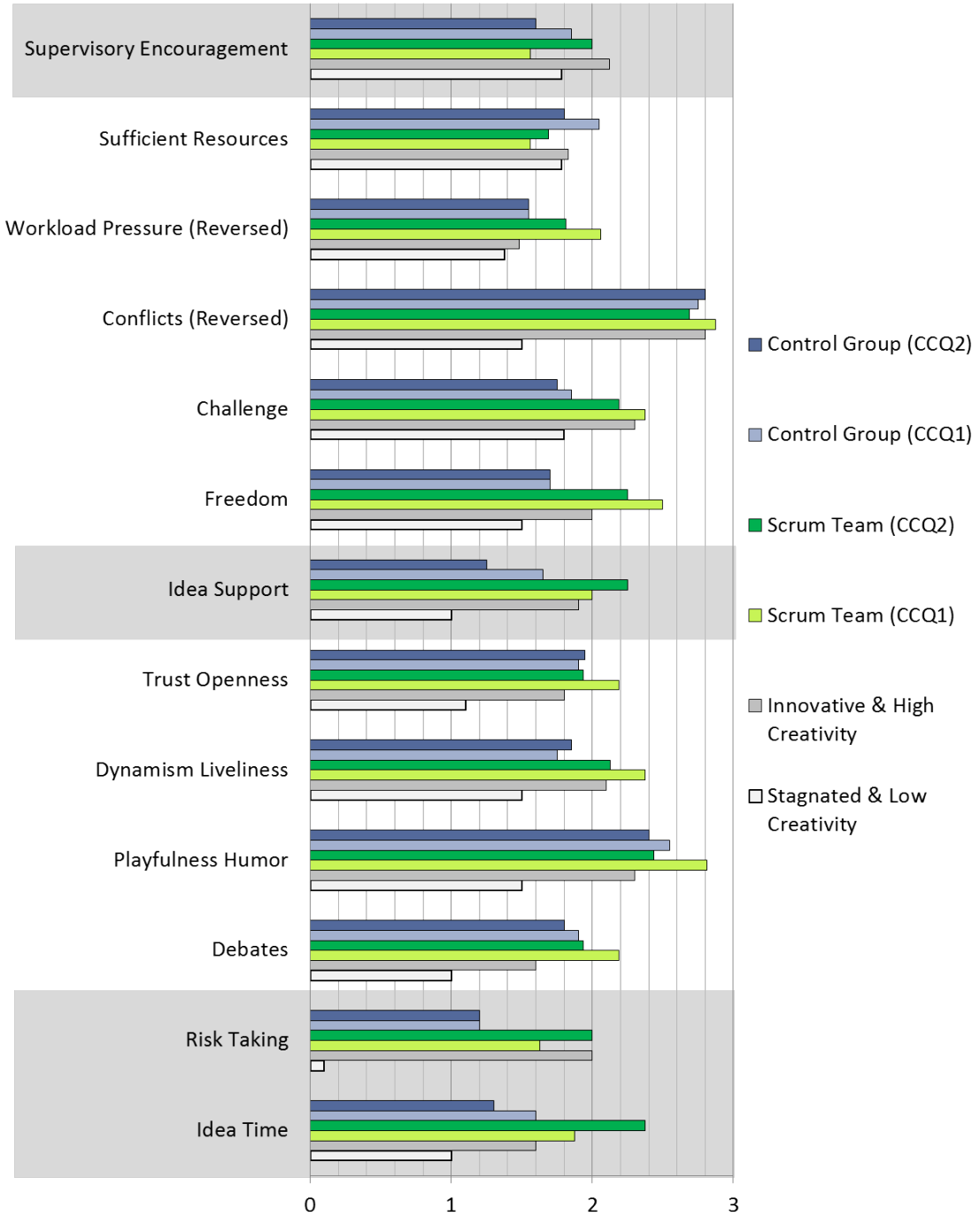

Figure 7.1: *Questionnaire data from CCQ1, CCQ2 and reference values [23] [4]. Targeted dimensions are highlighted with grey.*

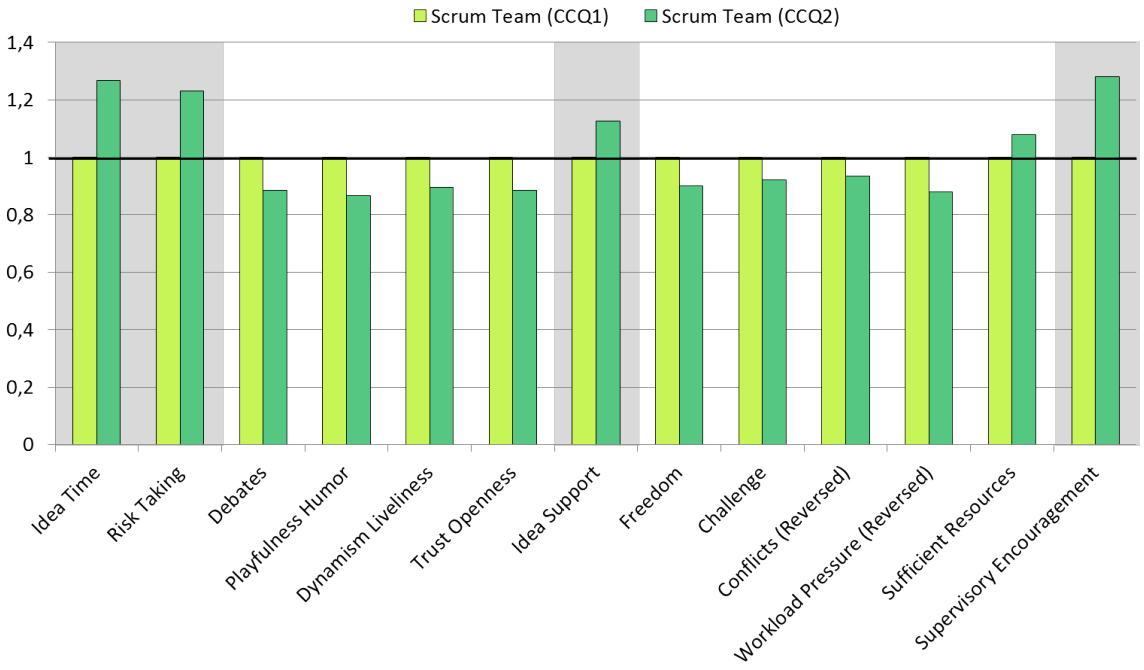

Figure 7.2: *Scrum team: CCQ2 result relative normalized CCQ1 result. Targeted dimensions are highlighted with grey.*

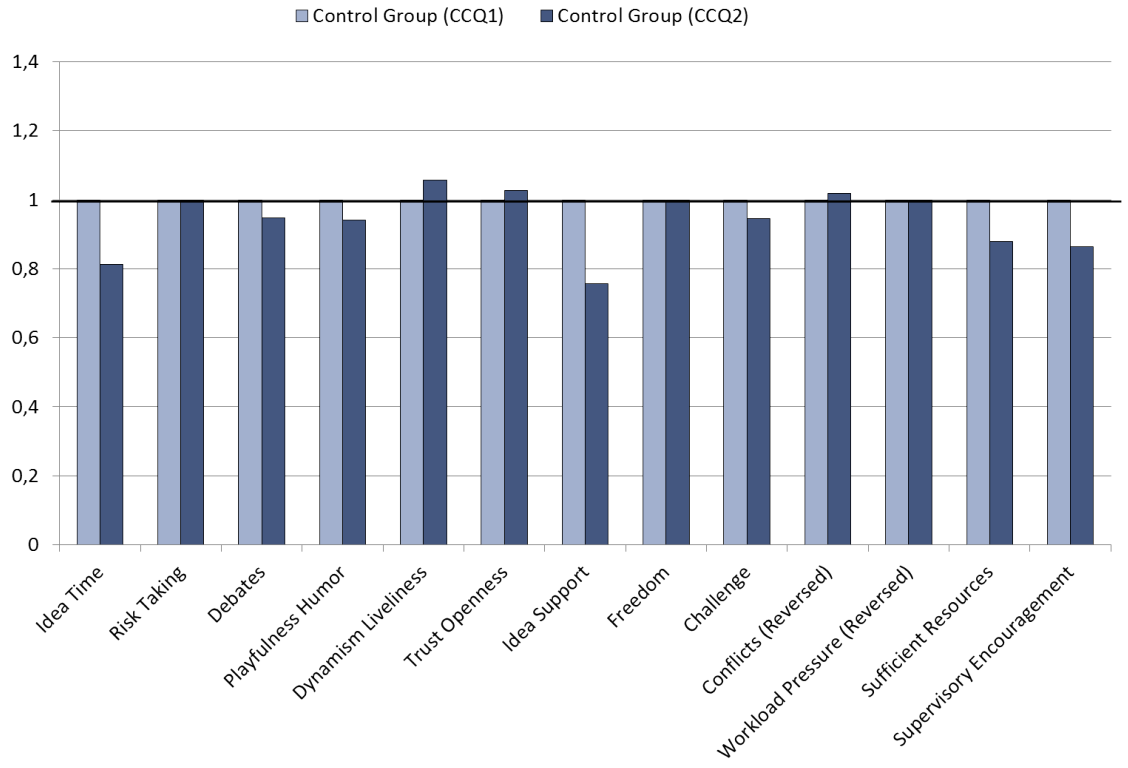

Figure 7.3: *Control group: CCQ2 result relative normalized CCQ1 result*

7.2 Analysis of implemented KPI

The time spent on each prio level (A, B, C tasks) was followed up (from team sprint TS1516) and discussed at a review meeting. In the beginning of the thesis work, they seemed to prioritize A- and B-tasks whereas C-tasks had lower priority, see figure 7.4.

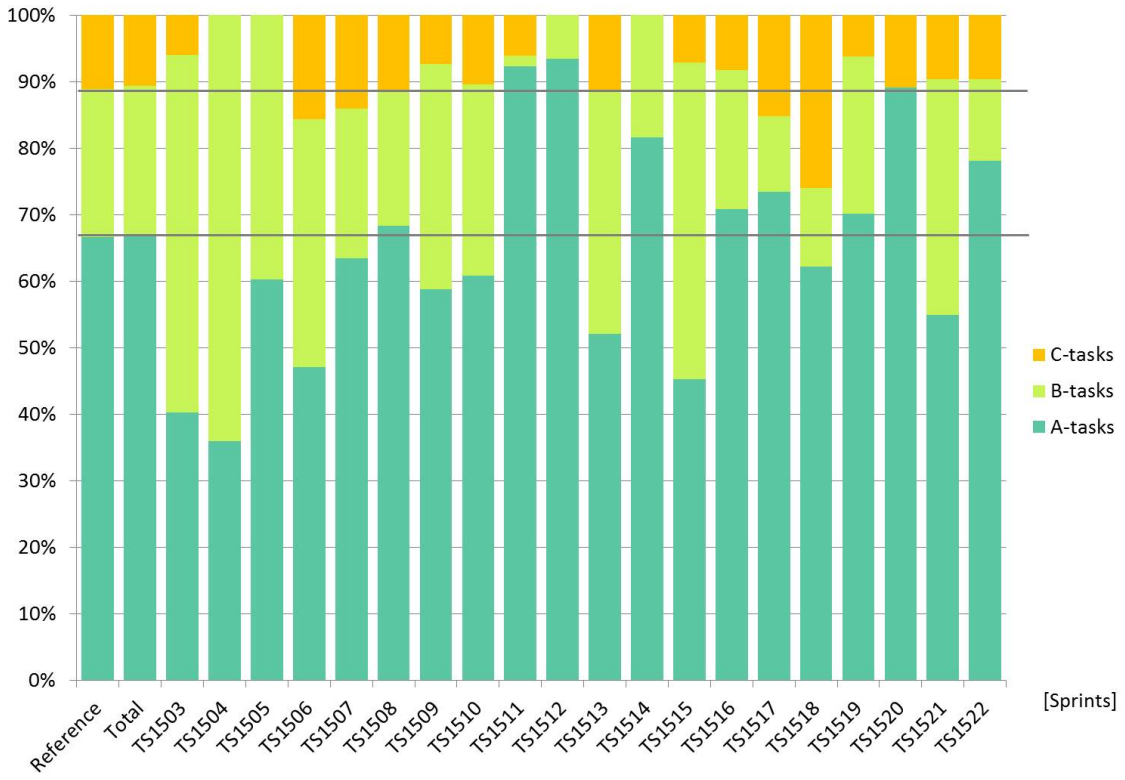

Figure 7.4: *Time spent on each prio level across team sprints (TS15W)*

Some scepticism was noted when the KPI was introduced because they thought it would have a negative influence on the team if they put more time than estimated time on C-tasks. But the KPI in combination with discussions seem to have changed their minds. During the implementation phase the team increased their time spent on C-tasks, from 7,6% to 13,9%. The team should spend 11% (meetings excluded) on C-tasks. Another reason can also be that before the KPI implementation they had to start up a project, which made them prioritize A-tasks.

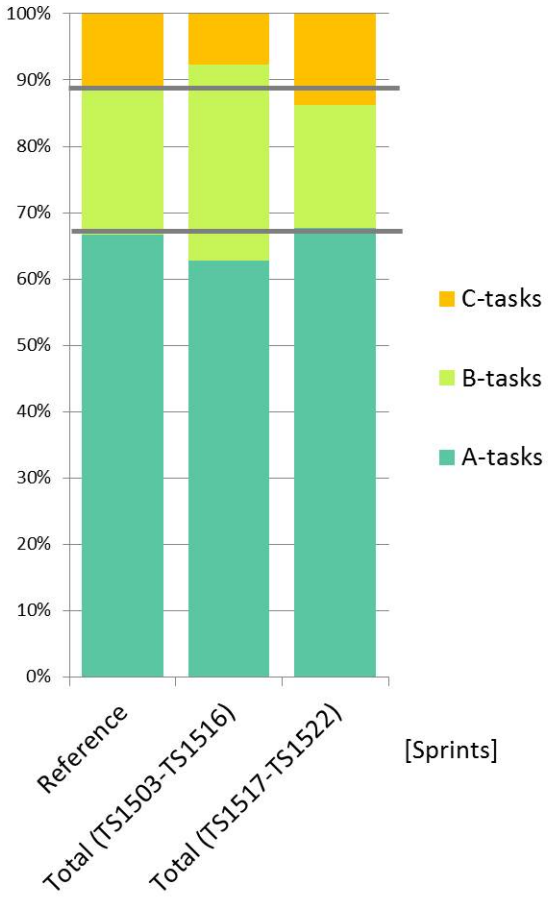

Figure 7.5: *Time spent on each prio level across team sprints (TS15W)*

7.3 Analysis of ICE QR1 Requirements

The limited time available in combination with the intended use of the system were the two determining factors for only including QR1 into the action plan. The system is designed to be implemented chronologically, i.e. starts with QR1, continues with QR2 etc. In figure 7.6 are all QR1 requirements included. Fulfilled requirements are marked with yellow and descriptions of how they are handled are included. 16 out of 28 requirements were perceived to be fulfilled at start, and additional five were fulfilled during the implementation phase (marked with strong yellow). The requirements that were handled or discussed at the workshops are marked with **WS1** or **WS2**. If the result from the questionnaire is included it is either marked with **CCQ1** (benchmark) or **CCQ2** (follow-up).

QR1					
Topic	**Subtopic**	**Short name**	**Description:**	**How this is handled:**	**Fulfilled by:**
1. Time Management	1.1 Available Time	ICE 1.1.1	Employees are allowed to take time for reflection, discussion and test new ideas	B-tasks, C-tasks, Retrospective	Agile practices
2. Sharing Enablers	1.2 Confidence	ICE 1.2.1	Employees feel confident to put forward new ideas	Fairly applicable (**CCQ1**)	Team
		ICE 1.2.2	Employees perceive individual contributions to be appreciated	**WS1** Fairly Applicable (**CCQ2**)	Supervisors
3. Motivational Drivers	1.3 Autonomy	ICE 1.3.1	Individuals are responsible for their working hours	JIRA, Scrum	Agile practices
		ICE 1.3.2 *Example:*	Individuals are responsible for their work-plans *How tasks should be handled*	Team planning, self-managed team	Agile practices
		ICE 1.3.3 *Example:*	Individuals have power and space to improvise *A developer can decide to use one day to explore a new idea without consequences*	Weekly sprints	Agile practices
4. Goal Setting	1.4 Understanding of goals	ICE 1.4.1	The team has commonly formulated goals and vision	**WS2**	Team
		ICE 1.4.2	Corporate goals are easily accessible	Intranet (inside)	Corporate structure
		ICE 1.4.3	Individuals can explain corporate goals	**WS1**	Team
5. Knowledge Management	1.5 Communication	ICE 1.5.1	Various communication channels are used for different purposes	Scrumboards, JIRA, IRC, Intranet (Inside), Skype business, email	Agile practices and corporate structure
		ICE 1.5.2	Communication channels are perceived efficient	**WS1**. Action plan	
		ICE 1.5.3	Amount of communication channels is perceived appropriate	Yes, but some are inappropriate for Linux	Corporate structure
		ICE 1.5.4	Employees can easily contact people across the organization	Availability, contact info on intranet	Corporate structure
		ICE 1.5.5	There is room for sharing opinions and thoughts	Team planning, retrospective, workshops, workstations together	Agile practices
		ICE 1.5.6	There is room for sharing and pitching ideas	Action plan	
6. Internal Capabilities	1.6 Creative traits & benefits	ICE 1.6.1 *Example:*	Employees are aware of creative personally traits *Individuals can mention at least 5 creative traits*	Action plan	
		ICE 1.6.2 *Example:*	Employees are aware of potential creative benefits for themselves and the organization *"I get a feeling of self-fulfillment when I solve a complex problem"*	Action plan	
7. Applied Learning					
8. Internal Relations	1.8 Positive climate	ICE 1.8.1 *Example:*	Employees perceive the work environment to be filled with positive energy *Tasks are joyful and stimulating. Jokes and laughter is common.*	Applicable to high extent (**CCQ1**)	Corporate environment

QR1 Continued					
Topic	**Subtopic**	**Short name**	**Description:**	**How this is handled:**	**Fulfilled by:**
9. External Relations	1.9 Awareness of environment	ICE 1.9.1 *Example:*	Employees identify sources of useful information *Interviews, research papers, market analyses, field trips, news, technical specifications, patents etc.*	Cross-functional team	Agile practices
		ICE 1.9.2	Employees have resources (time, tools, budget) for scanning environment and simple testing	**WS1.** Action plan	
10. Managerial Support	1.10 Supervision	ICE 1.10.1	Supervisors provide individual feedback regularly	**WS1.** Action plan	
		ICE 1.10.2 *Example:*	Supervisor values individual contributions *Gives specific feedback on resolved tasks*	**WS1**. Fairly applicable (**CCQ2**)	Supervisors
		ICE 1.10.3 *Example:*	Supervisor encourages innovation *Recognizes creative efforts, search for innovative work packages*	Perceived encouragement from supervisor	Supervisors
		ICE 1.10.4	Supervisor provides a work model that is embraced and used by the team	Fairly applicable (**CCQ2**)	Supervisors
11. Idea Management	1.11 Idea Process	ICE 1.11.1	There is a defined processes for problem finding	**WS2.** Action plan	
		ICE 1.11.2	There is a defined processes for development of ideas	**WS2.** Action plan	
		ICE 1.11.3	There is a defined processes for implementation of ideas	Scrum, deliver in sprints	Agile practices
		ICE 1.11.4	There is a defined processes for decision making	Review meeting	Agile practices

Figure 7.6: *Fulfilled requirements QR1*

The requirements that were not fulfilled are also included in figure 7.6. A proposal of how these requirements should be dealt with are presented in the action plan in the subsection 7.3.1. The purpose of the questionnaire was to evaluate the creative climate, but it also helped to evaluate requirements in ICE QR1. The connections (QR1) are shown in table 7.1.

Table 7.1: *Connection between QR1 in ICE and targeted dimensions in CCQ*

Targeted dimensions	**Connection to ICE**
Risk taking	ICE 1.5.6
Supervisory encouragement	ICE 1.2.2, ICE 1.10.(1)(2)(3)(4)
Idea support	ICE 1.2.1
Idea time	ICE 1.1.1, ICE 1.5.6

Several requirements were perceived to be fulfilled by their working method Scrum. Agile practices support 9 requirements in total, which are included in:

- 1.1 Available time
- 1.3 Autonomy
- 1.5 Communication
- 1.9 Awareness of environment
- 1.11 Idea process

Supervisory encouragement got considerably higher scores on CCQ2, which resulted in that ICE 1.2.2 and ICE 1.10.2 were fulfilled by the implementation. The remaining fulfilled requirements were achieved through corporate structure, the team and their supervisors. The most requirements that were not fulfilled in the ICE system were not something the team could change immediately.

7.3.1 Final Action Plan

The action plan was a document that incited discussions and was updated during the implementation phase. The final action plan is presented here (table 7.2) and its purpose is to support the Scrum team with future improvements.

The team expressed that they want externals to have increased insight into their work. The team was sceptical towards "ICE 1.2.2 Employees perceive individual contributions to be appreciated" because they want to be seen as a unit. However, it was explained that if externals get more insight into their work they are able to appreciate all contributions they do. The team used various communication channels, but the team wanted the planning tool JIRA to be more supportive in project management. The team also believed they could improve documentation of oral communication (ICE 1.5.2). New ideas are appreciated and supported by their supervisor, but the team would like to have an idea area for gathering ideas and suggestions (ICE 1.5.6). Creativity is perceived to be something fuzzy which prevented them from see the benefits of it (ICE 1.6.1, ICE 1.6.2). For testing and scanning the environment were often open source programs used. They were unsure about how to acquire equipment, tools and programs for their C-task projects, mainly because they would not have a specific project to connect it to and hard to motivate. Time however, is perceived to be available (ICE 1.9.2). The team would like to increase individual feedback and know what their supervisors expect from them (ICE 1.10.1). The topic "1.11 Idea Management" needs to be applied onto the current context. The agile teams at the office receive work packages or research projects to work on in-house, which mainly involves idea implementation. However, the team should have a defined way of conducting pre-studies (ICE 1.11.1) and visualize their way of working (ICE 1.11.2).

Table 7.2: *Final action plan*

Requirement	**Action**
ICE 1.5.2	Agree with PO how JIRA can be improved Agree on how oral communication should be documented and spread to the team Agree on desired document templates
ICE 1.5.6	Suggest suitable idea area for new ideas and suggestions, select one Example: can it be included in existing tool? Such as "new-feature" function in JIRA
ICE 1.6.1	Read and reflect upon master thesis report
ICE 1.6.2	Read and reflect upon master thesis report
ICE 1.9.2	Formalize way to acquire resources for B- and C-task projects Talk with stakeholders how they would like to receive an inquiry, create a template to hand in
ICE 1.10.1	Enable supervisors to give feedback through involving them into work Example: Set information strategy, create promotion material, invite BMs and POs to review meetings
ICE 1.11.1	Define how you work (accessible to team and organisation) Example: How do you start a project? Is there a defined way to conduct a pre-study?
ICE 1.11.2	Example: Improve flow schedule of WoW

Chapter 8

Evaluation

The thesis work has been rather extensive and holistic, mainly due to the assignment and intended usefulness of the deliverables. The scientific strength of conducting a holistic study is that the reality is holistic and the creative process is a complex situation that is determined by a range of factors. It is therefore more truthful to conduct a covering study. Creativity can be applied in almost any organizational context since it is a cognitive ability, and has proven to be even more crucial than expected.

8.1 Evaluation in Comparison to Literature

The empirical study can strengthen some of the shared success factors (in bold) that were stated in the literature study, see subsection 3.3. According to the CCQ did the team perceive their climate to support **trust** (trust and openness), **interpersonal skills** (playfulness and humor), **response to change** and **flexibility** (dynamism and liveliness). These are not necessarily strengthen by agile practices but the Scrum team had scored higher than the non-agile control group and innovative reference values.

The implementation phase uncovered which innovation principles in QR1 that are supported by agile practices. An action plan was established to target the non-fulfilled requirements. **Empowerment** (ICE 1.3 Autonomy) is fulfilled by agile practices, such as; Scrum, team planning, self-managed team and weekly sprints. Autonomy also enable the team to prioritize **learning** and was determining for **motivation**. Review meetings strengthen **customer collaboration** and requires the client to be involved in the process. The team members briefed each other at the team planning meetings, which strengthens **knowledge management**. The team implemented ideas by deliver in sprints which is equal to be **iterative**. When they had to start up a new project, less time was put on C-tasks and planning meetings took hours. This strengthen the contradiction **external pressure**, since the team did not prioritize learning and own projects (less creativity). This is probably not only a problem for agile methods, but since the group was autonomous they had

power to down-prioritize creative work. The team believed individual feedback could be improved, which proves that feedback is not automatically introduced by using agile methods. On the other hand, the team expressed a desire to increase feedback which shows that it has potential to improve the creative climate and the agile process, but that was not investigated further in this work. The contradictions that were not examined did not occur as problem areas during the study. These contradictions are mainly present when introducing agile methods and adoption was not an issue in this case since the team has applied Scrum for a long period of time.

A discovered shared success factor was **Reflection** (ICE 1.1.1). Review and retrospective meetings enabled the team to take time for reflection and discussion. If they wanted to test new ideas their B- and C-task hours were used. The scrumboards (physical and virtual) enabled the team to have oral and visual communication daily, this emerged as a new success factor; **communication channels** (ICE 1.5.1). The team also believed they were able to identify sources of useful information by being cross-functional (ICE 1.9.1). Cross-functionality is therefore introduced as a shared success factor, called **diverse insight**.

Two contradiction between agility and innovation were also found; **documentation** and **processes and tools**. These were perceived to be the Scrum team's biggest challenges, and they are in relation to the values in the Agile Manifesto "Working software over comprehensive documentation" and "Individuals and interactions over processes and tools" [9]. Documentation activities should not be too extensive, but the team has three major reasons why they need to put more effort into documentation and defining processes. Firstly, defined processes of problem finding and idea developing are proven to increase likeliness of innovation [69]. The most straight forward way to define a process is to illustrate it. Secondly, the team members need to share the same vision regarding their processes, which is easier if there is a document to discuss. The third reason is the high dynamism in the team. When new team members arrive they need to understand the way of working and should not be dependent of other team members who have potential to leave the team at any time. If all established team members get consultancy opportunities at other sites, all generated insights and knowledge will disappear. These contradictions are handled in the final action plan together with other occurred hindrances.

A clarification of emerged factors, strengthen factors, not examined factors and weakened factors can be seen in figure 8.1.

SHARED SUCCESS FACTORS			CONTRADICTIONS	
NEW: DIVERSE INSIGHT	NEW: COMMUNICATION CHANNELS	NEW: REFLECTION	NEW: DOCUMENTATION NEW: PROCESSES AND TOOLS	NEW
RESPONSE TO CHANGE FLEXIBILITY INTERPERSONAL SKILLS	CUSTOMER COLLABORATION ITERATIVE KNOWLEDGE MANAGEMENT	TRUST EMPOWERMENT MOTIVATION LEARNING	EXTERNAL PRESSURE (OVERCOMMITMENT)	STRENGTHENED
INTEGRATION	EXPLORATIVE	SIMPLE FLEXIBLE TECHNIQUES	SPECIALIZED HIGH INDIVIDUAL AUTONOMY LARGE ORGANIZATIONS EXPERIENCE	NOT EXAMINED
FEEDBACK				WEAKENED

Figure 8.1: *Evaluation of shared success factors and contradictions between creativity/innovation and agility*

8.2 Evaluation of ICE System and Implementation

The design of the system was intended to be applicable onto a real context and straight forward, in contrast to research guidelines that often are generic and unspecific. It could therefore have been misconceptions when formulating the system since it had to be adapted to the context. Two requirements that got extra attention were 'ICE 1.2.2 Employees perceive individual contributions to be appreciated' and 'ICE 1.10.2 Supervisor values individual contributions'. The requirements have arisen from Amabile [4] who stated that supervisors should value individual contributions to elevate creativity. Moreover; Bessant and Caffyn [10] and Madjar et al. [41] argue for that the organization should believe anyone can contribute to creative work, which requires individuals to be seen. The team thought these requirements would create tensions in the group and a competitive climate. The team's reasoning was in congruence with Jiang and Zhang's research, who state that it is hard to judge ownership in a creative team [37]. This was solved by not focusing on prizing individuals, but rather create insight for stakeholders into their work and enable them to give feedback.

The majority of the requirements in QR1 ICE were already perceived to be fulfilled

before the implementation started and the team scored high on the benchmark CCQ1, this was strengthen by ten statements that were significantly different.

The Scrum team's mean scores for the targeted dimensions were higher for CCQ2. The targeted dimensions were discussed several times and were evaluated after the creative event Pitch Race. Maybe the team realised that they had even better support for ideas than they initially thought, but they also believed the event contributed to improve all targeted dimensions. The workshops brought up improvement areas, alerted concerned stakeholders and goals were formulated, which probably have affected the team positively. Even if the outcome was desired was it not possible to statistically confirm the result with a T-test. Only one requirement regarding risk taking had a significant difference. There are probably two reasons why the T-test gave this result. The first reason is few participants, this problem could not be dealt with since the targeted group was limited to one Scrum team which was highly dynamic. The second reason is short period of time. Changes take time, which is in accordance to earlier literature [10] [46].

An explanation to why the Scrum team has scored lower on the non-targeted dimensions might be the turbulent environment. The four team members with fixed salary have been included in the team the whole period, but many others did come and go. When they were nine team members they tried to split the team into two, but just a few weeks later they had to merge the teams again. This situation has presumably affected the team in a negative manner, which is reflected in 'Debates', 'Playfulness and Humor', 'Conflicts' and 'Workload Pressure'. However, these differences are not statistically proven.

The design of ICE and the questionnaire are based on theory. It could have been appropriate to analyse the reality and then search in the literature for suitable guidelines. At this point there can be improvement areas that are not included. On the other hand, that could have left out important research findings and be highly biased. The system has been applied onto the context, but there have been struggles with trying to change the group behaviour when the setting has been highly dynamic. A more stabilized environment is desired to establish the ICE system and take real advantage of it. Agile team members are also less interchangeable than in traditional team [22], which should be a factor to consider. As stated in section 8.1 are documentation, processes and tools a challenge that should be carefully considered. These challenges should be dealt with to increase likeliness of innovation but not inhibit agile practices.

The questionnaire wass based on Ekvall's ten creative climate dimensions and three dimensions of Amabile's et al. KEYS. The questionnaire helped to evaluate some requirements, but it would have been good to have a questionnaire to evaluate all requirements in the ICE system. This was temporarily solved through conducting workshops and discussing the action plan, but it should be examined continuously. The member checking workshop was perceived to be a good way to implement the system without being overwhelming.

The team contributed with valuable inputs when implementing the system. They evaluated the requirements and applied them onto their context. The implemen-

tation of the system was therefore fairly easy since the team interpreted the requirements from their position. The hindrances that occurred were how they should value individual contributions and how a consultancy firm can take advantage of idea generation and development.

8.3 Validation

The validation plan support the evaluation of the work performed and to state if the work has contributed with benefits for Alten, KTH and the student. See Appendix A for validation requirements. The requirements in the validation plan are validated through:

Val1: The ICE system was designed by combining literature and empirical findings. It cannot be stated if the team became more competitive but they perceived increased support for creativity, which can be seen as an essential factor.

Val2: Requirements in ICE are based on research guidelines

Val3: Time plan and milestones with deliverables supported the work to be carried out on time

Val4: New knowledge is presented in theory chapter and experience achieved through empirical studies

Val6: Report structure shows the systematic approach

Val7: The work had a holistic approach. The data is gathered from various researchers and evaluated in regard to empirical findings. The empirical findings rely on multiple methods. Research questions are answered from both the team's and observer's perspective.

Val9: Report structure and language

Val10: Being present on a daily basis for more than twenty weeks and implement research guidelines

Val11 Member checking for evaluating system and positive response

Val5 and **Val8** are not relevant in the report.

Chapter 9

Summary, Conclusions and Further Work

This is the final chapter of the thesis. First, a short summary is included. Thereafter are conclusions presented and further work discussed.

9.1 Summary

The result of the literature study clarify the concepts of creativity, innovation and agility. Creative performance refers to idea generation, whereas innovation refers to successful implementation on an organizational level [5] [3]. Conboy [17] defined agile as a method that rapidly create change, embrace change or learn from change while contributing to perceived customer value in terms of economy, quality and simplicity. The interrelationships were investigated and several similarities between innovation and agile principles emerged. In some cases agile methods even seemed to enhance innovation. Identified shared success factors for agile, creativity and innovation were; motivation, trust, interpersonal skills, feedback, response to change, flexibility, learning, empowerment, simple flexible techniques, integration, customer collaboration, knowledge management, explorative and iterative. Contradictions found were external pressure, high individual autonomy, large organizations, customer demand and specialized.

The research findings of creativity and innovation were condensed into 37 topics. For each topic were guidelines extracted to support the design of the ICE dimension in the QR System. It was crucial that the formulation of ICE requirements took agility into account. The final design represents 79 requirements, spread over five quality ranks.

Multiple methods were used to understand and analyse the environment at Alten, including observations, interviews and questionnaire. Case studies are preferred when analysing ongoing procedures since it brings a holistic view of the ongoing events, processes, relationships and changes [78]. The questionnaire was inspired by

Ekvall's ten creative climate dimensions [23] and Amabile's et al. creativity assessment tool KEYS [4]. The result from the benchmark questionnaire CCQ1 showed that the team perceived their climate to be more supportive than the innovative reference even before the implementation. Significant differences for 12 statements between the Scrum team and the control group were statistically proven. There were 4 dimensions targeted to be improved; Supervisory encouragement, idea support, risk taking and idea time. They were chosen upon improvement potential and distinguishing for a creative climate.

It was chosen to focus on implementing QR1. The main part of the implementation was to evaluate the ICE system in relation to the Scrum team. Two workshops were held, primarily to establish an action plan but also to create goals in the team. It was shown that nine requirements were fulfilled by agile practices. The creative event Pitch Race was chosen upon the targeted dimensions and connection to the requirements in ICE. The team evaluated the event and discussed the purpose. The final action plan focuses on agreeing on documentation and communication.

The follow-up questionnaire indicated that the targeted parameters were improved. The control group made sure the result reflected the effect of the thesis work and not organizational changes. However, even if the mean scores were improved were they not statistically strengthen by the T-test.

9.2 Conclusions

The main conclusions of this work are related to the stated research questions that were targeted to be answered.

9.2.1 (RQ1) In what way are agile methods impediments or facilitators when it comes to innovation?

There are both agile drivers of innovation and shared success factors between the concepts, i.e. some agile practices support innovation and creativity whereas others are crucial for both to prosper. Response to change, customer collaboration, flexibility, iterative, empowerment, motivation, knowledge management and learning were achieved through applying agile practices. It should be emphasized that empowerment, motivation and learning are closely connected. Trust and interpersonal skills are crucial for working agile and for creativity but it is not proven that agile practices contribute to achieve them. Diverse insight, communication channels and reflection were three discovered agile drivers of innovation. Most innovation and creativity impediments that seem to arise when applying agile practices concern the introduction of the method. However, this could not be examined since the team did not face these challenges. The identified contradictions were instead external pressure, documentation, processes and tools. When the external pressure was high they down-prioritized exploration of ideas and competence development. Defined

processes of problem finding and idea development increase innovation, which was not supported by agile practices. It was even perceived to be an agile hindrance of innovation.

9.2.2 (RQ2) To which extent was it possible to implement research guidelines for innovation onto an agile team within the context of Alten?

The team was highly involved in the creation of the action plan. The requirements in ICE QR1 opened up for discussion. Most requirements could be adapted to fit their context and agile practices supported 9 out of 27 requirements in QR1. The team was sceptical regarding the requirements that considered individual contributions since it had potential to endanger the group dynamics. This was solved by including stakeholders into their work instead of pinpoint champions. Process definitions of idea generation, development and implementation was also a discussed topic. The team was assigned on work packages which required them to focus on implementation. The approach towards these guidelines had therefore to be changed and adapted to their situation. Instead should the team formalize their way of conducting pre studies and extend the illustration of way of working. The business managers agreed that innovation is essential for Alten's survival. However, Alten is a consultancy firm and does not have its own products to launch. Innovations can therefore be expressed as processes or through their clients.

9.2.3 (RQ3) Did the implemented guidelines give an effect?

The comparison between the questionnaires that examined how the team perceived their environment indicated that the implementation had an effect. The greatest difference was noted for idea time, risk taking and supervisory encouragement. Idea support and sufficient resources were also positively affected. Idea time is considerably better than the reference value for innovative firms. Risk taking was scored equally high as the innovative reference, which is outstanding and determining for a creative climate. However, that only regards a comparison of the mean scores. There was only one statement that had a statistically significant difference between CCQ1 and CCQ2 which was 'Risk Taking: People here are able to take bold action even if the outcome is unclear'. This statement is clearly connected to the conducted thesis work.

9.3 Further Work

Creativity is definitely a mindset that needs encouragement, which was perceived to be supported at Alten. Continued work should therefore examine how innovations can be a part of Alten's strategy and goals. Appropriate measurements for innovation should also be applied.

The ICE system can be used to its full potential if the teams at the office stabilize. The QR system was quite complex and extensive, it should therefore be evaluated in order to simplify the usage of the system. One important reason is that agile components must not detract from simplicity. It should also be routines for how to use the system and introduce continuity. The ICE system was based on reviewed literature and a holistic approach was taken, which implies that there is potential to extend the topics in the system more exhaustively. The questionnaire was made before the design of the system was set. A questionnaire that reflects all the requirements should therefore be developed.

A question that emerged was; how can agile teams work with documentation, processes and tools but still be agile? Bureaucracy should be used as a tool to facilitate work, but it is crucial to not endanger the benefits that emerge from agile methods. It should also be investigated if the agile drivers and success factors for innovation are related to Scrum exclusively or if other agile methods support the same innovation determinants. Probably would even more shared success factors emerge if all levels in the system were evaluated, which brings up an opportunity for future work.

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Appendix A

Validation Plan

Who	Label	What	Validation
Alten	Val1	Design framework to foster creativity and innovation to achieve competitive agile teams	Research questions are answered by conclusions from literature and interviews
			Member checking: Conclusions are tested on members. Participants revise & clarify earlier statements. Validation when interviewees' statements overlap
KTH	Val2	Academic Study	Research contains only peer reviewed papers from academic journals
Process:	Val3	Independently plan and carry out work within timeframe	Make time plan and log work on Jira (agile planning tool)
	Val4	Independently identify needs for new knowledge and obtain these skills	Achieve saturation: point when no new information in the literature emerges
	Val5	Good ability to understand new material and formulate relevant and constructive criticism	Thoughtfully execute opposition and contribute with interesting discussion about the other student's work
Engineering and scientific content:	Val6	Based on the research problem and methodology, show a strong ability to systematically apply engineering and scientific skills such as problem definition, modeling, analysis, development and evaluation in a systematic way	Carry out project as planned
	Val7	In context to the topic, demonstrate an awareness of social and ethical aspects, including economic, social and ecological sustainable developments	Use triangulation: Multiple data sources, subjects and methods. Answer research questions from various perspectives
Presentation:	Val8	Good oral presentation skills, with clear arguments and analysis, and the ability to discuss work	Prepare and hold presentation at Alten and KTH. Discuss work with opponent.
	Val9	Establish a well-structured report, with an explicit statement of work and results, clear analysis and reasoned argument, using good language skills, plus formal and scientific accuracy	Make a report outline to achieve a structured report. Validated through feedback from supervisors
Student	Val10	Gain professional experience	Use agile method and tools (scrum). Attend other scrum team's meetings
	Val11	Framework generates positive impact	Practitioners evaluate the framework

Appendix B

Creativity and Innovation Determinants

Indicators	
Determine appropriate indicators	*SIS-16555*
Simple measurements	*Bessant and Caffyn, 1997*
Input indicators	*Carayannis and Provance, 2008*
Process indicators	*Carayannis and Provance, 2008*
Questionnaire for team creativity	*Anderson et al., 2014*
Appropriate performance metrics	*O'Connor, 2008*
Measure performance	*Kim et al., 2012*
Secondary data for org. creativity	*Anderson et al., 2014*
Financial indicators	*SIS-16555*
Non-financial indicators	*SIS-16555*
Output indicators	*Carayannis and Provance, 2008*
Performance indicators	*Carayannis and Provance, 2008*
Understanding of Goals	
Understandable vision	*Anderson and West ,1998*
Everyone can explain strategy, goals, objective	*Bessant and Caffyn, 1997*
Creative teams have uniform goals	*Jiang and Zhang, 2014*
Intention of being creative	*Dobni, 2008*
Understand internal and external customers	*Bessant and Caffyn, 1997*
Autonomy	
Allowed to express creativity	*Dobni, 2008*
Flexible working hours	*Anderson et al., 2014, Mumford, 2000*
Diverse work tasks	*Anderson et al., 2014, Mumford, 2000*
Self-defined work plans	*Anderson et al., 2014, Mumford, 2000*
Power to improvise	*Dobni, 2008*
Communication	
Effective communication channels	*SIS-16555, Taggar, 2002*
Diverse knowledge base	*Damanpour and Schneider, 2006*
Wide range of communication channels	*Bessant and Rush, 1995*
Org. structure and communication	*Saulina and Juhani, 2012*
People make contacts in the org.	*Ekvall, 1996*
Process management	
Too much customer demands endanger creativity	*Gassman et al., 2006*
Too much process management endanger creativity	*Gassman et al., 2006*
Group creativity is determined by task and structure	*Pirola-Merlo and Mann, 2004*
Use formal problem finding and solving cycle	*Bessant and Caffyn, 1997*
Stable and detailed routines for improvement	*Kim et al., 2012*
Flexible routines for emerging market	*Kim et al., 2012*
Creativity management, have principles about: generating ideas, selection, development and implementation	*SIS-16555*
Decision making processes	*Saulina and Juhani, 2012*
Routines that support learning base	*Kim et al., 2012*
Time	
Time to reflect	*Paulus and Yang, 2000*
Flexible long-range planning	*Singer and Adkins, 1984*
Sufficient time	*Amabile, 1988, Amabile et al.,1996*
Time to think	*Mumford, 2000*
time people can and do use	*Ekvall, 1996*
Time to discuss and test impulses	*Ekvall, 1996*
Time to develop ideas	*Singer, Adkins 1984*
Negative workload pressure: extreme time pressure, unrealistic productivity, distractions	*Amabile et al., 1996*

Job complexity	
Most creative when combining: creativity traits, challenging assignments and supportive supervising	*Oldham and Cummings, 1996*
Job complexity key to creativity: skills, variety, task significance, task identity, autonomy, feedback	*Anderson et al., 2014*
Management style	
Leaders train to manage creative enterprises	*Mumford, 2000*
Appropriate leadership	*O'Connor, 2008*
Establish innovation strategy to inspire	*SIS-16555*
Top managers' attitude towards: change, competition and entrepreneurship	*Damanpour and Schneider, 2006*
Culture	
Creative org. sometimes hold back on policies	*Singer and Adkins, 1984*
Appropriate culture	*O'Connor, 2008*
Dynamism and liveliness: things happen all the time	*Ekvall, 1996*
Idea implementation context: ability to execute value-added ideas	*Dobni, 2008*
Top management set appropriate culture	*SIS-16555*
Culture affect team creativity	*Anderson et al., 2014*
Organizational climate and culture	*Saulina and Juhani, 2012*
Creative org. is decentralized, diversified and different	*Singer and Adkins, 1984*
Individuals understand/mindset towards innovation	*SIS-16555*
Everyone feels responsible for its growth	*SIS-16555*
Open climate	
Open information sharing	*Taggar, 2002*
Freedom, most prominent promoter for creativity	*Amabile, 1988*
Dynamic and open corporate system	*Steiber and Alänge, 2013*
Organizational creativity: open channels of communication, contact with outside sources	*Singer and Adkins, 1984*
Organizational creativity: Climate marked by collaboration across levels and divisions	*Bessant and Caffyn, 1997*
Creative and productive organization	
Separate creative from productive functions	*Singer and Adkins, 1984*
Divide exploration and exploitation between domains	*Gupta et al., 2006*
Ambidexterity, both exploration and exploitation	*O'Reilly and Tushman, 2008*
Creativity and productivity through continuous learning	*Adler et al., 2009*
The learning organization	
Higher innovation in companies that provide training	*Anderson et al., 2014*
Continuous learning across organization	*Adler et al., 2009*
Gap-driven learning: where are we now and what is the ideal state	*Adler et al., 2009*
Recognition	
Reward to encourage creativity (ex. skill development)	*Mumford, 2000*
Org. encouragement and support for innovation	*Pirola-Merlo and Mann, 2004*
Innovation prized and failure not fatal	*Amabile, 1988, Amabile et al.,1996*
Award creativity	*Amabile, 1988, Amabile et al.,1996*
Reward affect team creativity	*Anderson et al., 2014*
Creativity needs encouragement	*SIS-16555*
Creativity is an internal source of ideas	*SIS-16555*
Encouragement and reward	*Kaufman and Sternberg, 2007*
Management recognize continuous improvement	*Bessant and Caffyn, 1997*
Support and recognize creativity	*SIS-16555*
Top management establish recognition system	*SIS-16555*

Recognition continued	
Performance based pay system	*Anderson et al., 2014*
Desired external motivators:	*Amabile, 1988*
deadlines, evaluation, surveillance, reward, feedback, recognition, guidelines	
Communication	
Effective communication channels (SIS-16555)	*SIS-16555*
Complex structure:	*Damanpour and Schneider, 2006*
diverse knowledge base and communication	
Creativity factor: effective communication	*Taggar, 2002*
Wide range of communication channels	*Bessant and Rush, 1995*
Organizational structure and communication	*Saulina and Juhani, 2012*
Discuss problems and alternatives	*Ekvall, 1996*
People make contacts in the organization	*Ekvall, 1996*
Top management support communication:	*SIS-16555*
means for openness internally and externally	
Confidence	
Creative people are appreciated and valued resource	*Singer and Adkins, 1984*
Believe everyone can contribute to improvement	*Bessant and Caffyn, 1997*
Organizational constituency:	*Dobni, 2008*
level of engagement in innovation – how employees think of themselves	
Creative work generated by anyone: should be encouraged	*Madjar et al., 2002*
Individual seeks opportunity for learning and development	*Bessant and Caffyn, 1997*
Positive climate	
Employees have fun	*Singer and Adkins, 1984*
Workplace climate to motivate and support employees to:	*Singer and Adkins, 1984*
recognize, develop and utilize ideas	
Positive mood	*Madjar et al., 2002*
Spontaneity, relaxed, jokes, laughter	*Ekvall, 1996*
Creativity traits	
Awareness of creativity traits: able to improve	*Taggar, 2002*
Creative performance is on individual level	*Oldham and Cummings, 1996*
Individual creativity and knowledge	*Saulina and Juhani, 2012*
Traits: Persistance, curiosity, energy, intellectual honesty,	*Amabile, 1988*
self-motivation, creativity skills, risk orientation, synergy,	
diverse experience, domain skills, social skills, naïveté, brilliance	
High innovation through intrinsic motivation	*Amabile, 1996*
Traits: expertise, creative thinking, intrinsic motivation	*Anderson et al., 2014*
Traits: motivated, autonomous, curious,	*Mumford, 2000*
do changes in approach, interest	
Traits: originality, fluency, flexibility, high motivation,	*Singer and Adkins, 1984*
openness to feelings, curiosity, questioning, persistence,	
concentration, tolerance of ambiguity, knowledge, problems, analyze, imagine	
Idea reflection	
Challenge your opinion, look for new relationships	*Singer and Adkins, 1984*
rearrange elements, train on pitching ideas, period of no interruption	
Creative process: Evaluating and testing ideas	*Torrance, 1993*
Simple tools/techniques to support continuous improvement	*Bessant and Caffyn, 1997*
Creativity factor: Focus on task, readiness for creative tasks	*Taggar, 2002*
Attention to others' ideas	*Paulus and Yang, 2000*
Skills development	
Everyone learns from experience	*Bessant and Caffyn, 1997*
Review competencies and required competence acquired	*Bessant and Caffyn, 1997*
Ongoing skill development, incentive for exploration	*Mumford, 2000*

Skills development continued	
Use learning mechanisms	*Bessant and Caffyn, 1997*
Skill development and expertise for work and creative efforts	*Mumford, 2000*
Skills and talent development	*O'Connor, 2008*
Commitment	
Creativity factor: Team commitment	*Taggar, 2002*
Emotional involvement, joy, meaningfulness and invest energy	*Ekvall, 1996*
High innovation through employee involvement	*Anderson et al., 2014*
People participate in continuous improvement	*Bessant and Caffyn, 1997*
Involve employees into change	*Bessant and Caffyn, 1997*
Participation in problem solving and synthesis of ideas	*Taggar, 2002*
Idea management	
Document ideas to support organization in selection of ideas	*SIS-16555*
Systematic idea management process:	*SIS-16555*
scope, frequency of collection, evaluation and selection	
Fact founded approach, ideas evaluated on merit not person,	*Singer and Adkins, 1984*
use blind votes, suggestion system and brainstorming	
Merge idea generation and idea implementation activities	*Anderson et al., 2014*
Mechanism for considering new ideas	*Amabile, 1988, Amabile et al.,1996*
Trust to be heard: ideas are considered and some implemented	*Clegg et al., 2002*
Creative process: Revising and communicating result	*Torrance, 1993*
Assess proposed changes to org. objectives before implement	*Bessant and Caffyn, 1997*
Governance and decision-making mechanism	*O'Connor, 2008*
Negative on creativity: ideas neglected or poorly integrated	*Taggar, 2002*
On team level are ideas implemented collaboratively	*Jiang and Zhang, 2014*
Supportive climate, suggestions received in a supportive way	*Ekvall, 1996*
listen, positive climate	
Idea support from top management	*SIS-16555*
Manage conflicts	
Coordinating conflicts	*Kim et al., 2012*
Appropriate conflict management	*Taggar, 2002*
Manage emotional and process conflicts	*Isaksen and Ekvall, 2010*
Personal and emotional tensions: negative impact on creativity	*Ekvall, 1996*
Top management have conflict consciousness	*SIS-16555*
Supervision	
Creativity factor: Provide feedback	*Taggar, 2002*
Identification with leader	*Wang and Rode, 2010*
Good work model, support group, value individual contribution	*Amabile et al., 1996*
Leaders often have misconception about giving feedback	*Elvnäs and Edgar, 2013*
Organizational practices: Review and giving feedback	*Mumford, 2000*
Team perceives sufficient support for innovation	*Anderson and West, 1998*
Supervisory support	*Madjar et al., 2002*
Group creativity is a complex and social setting:	*Woodman et al., 1993*
creative synergy if managed right	*Woodman et al., 1993*
Team goals	
Goal setting preperations	*Taggar, 2002*
Integrate team creative thinking, action and outcome	*Jiang and Zhang, 2014*
Appropriate goals from supervisor	*Amabile et al., 1996*
Use organizational goals to prioritize improvements	*Bessant and Caffyn, 1997*
Creative teams have uniform goals	*Jiang and Zhang, 2014*

Innovation responsible	
Innovation responsible group	*O'Connor, 2008*
Define innovation responsible person or group	*SIS-16555*
Org. establish architecture to develop and sustain innovation	*Dobni, 2008*
Resources	
Allocation of time, money, space and other resources	*Bessant and Caffyn, 1997*
Top management: resource responsibility	*SIS-16555*
Heterogeneous personnel policy	*Singer and Adkins, 1984*
Appropriate resources	*Mumford, 2000*
Sufficient resources that are accessible: funds, material, facilities, information	*Amabile et al., 1996*
Infrastructure to support innovation	*Dobni, 2008*
Learn by failures	
Look for reasons instead of blaming	*Bessant and Caffyn, 1997*
Problems as opportunities, learn by failure	*Adler et al., 2009*
Top management have failure tolerance and focus on learning	*SIS-16555*
Not punishing mistakes, encourage learning from them	*Bessant and Caffyn, 1997*
External collaboration	
Idea stimuli through collaboration with externals	*SIS-16555*
Collaboration and external links	*Saulina and Juhani, 2012*
Open innovation: external innovation potential captured	*Chesbrough, 2003*
Systematic approach to assess information outside company	*Gassman et al., 2006*
Creative organization invests in basic research	*Singer and Adkins, 1984*
Risk taking	
Managing risks	*SIS-16555*
Tolerance of uncertainty, decisions and actions prompt, experimentation and opportunities taken	*Ekvall, 1996*
Innovation	
Make changes in something established	*Singer and Adkins, 1984*
Successfully implemented creative idea on organizational level	*Anderson et al. 2014* *Hennessey and Amabile, 2010*
Application of knowledge, ideas, methods and skills that generate unique capabilities and competiveness	*Kim et al., 2012*
Implementation of improved product, process, marketing method, business practices and external relations	*SIS-16555*
Innovativeness: constantly renew products and business models	*Steiber and Alänge, 2013*
Process innovation: ability to exploit resources and capabilities	*Wang and Ahmed, 2004*
Product innovation: novelty and meaningfulness of new products	*Wang and Ahmed, 2004*

Appendix C

Extracted Guidelines

Understanding of goals
H1.1 Shared vision and goals increase creativity
H1.2 Understanding of existing (corporate) goals increase creativity

Autonomy
H1.3 Autonomy in terms of being responsible for working hours and work-plans increase creativity
H1.4 Power to improvise increase creativity

Communication
H1.5 Effective and wide range of communication channels increase creativity
H1.6 Freedom to contact people in the organization increase creativity
H1.7 Openness increase creativity

Awareness of environment
H1.8 Awareness of external environment and market increase creativity

Awareness of creative benefits
H1.9 Believing that creativity contributes to corporate success increase creativity

Confidence
H1.10 Employees who feel appreciated and have confidence have higher probability to be creative

Positive climate
H1.11 Employees who enjoy and have fun working have higher probability to be creative

Creativity traits
H1.12 Employees with creativity traits increase creativity at work
H1.13 Awareness of creativity traits enable employees to improve on them

Process management
H1.14 Defined processes for idea generation, selection, development, implementation, decision making, learning base, problem finding and solving cycle increase probability of innovation.

Available Time
H1.15 Creativity is increased if developers have sufficient time to reflect, discuss and test new ideas

Supervision
H1.16 Supervisor who provides feedback/values individual contributions enhance employee creativity
H1.17 Supervisory support through providing good work model and appreciation of innovation increase creativity

Debate
H2.1 Debates and appreciation of others' opinions increase creativity

Trust
H2.2 Employees who show trust by support increase creativity

Team
H2.3 Creative synergy requires team building, cross functionality, clear expectations, diversity and cohesiveness.

Idea reflection
H2.4 Reflection upon own and others' ideas increase creativity
H2.5 Test, challenge and evaluate ideas enhance creative thinking

Skills development
H2.6 Continuous skill development increase creativity

Commitment
H2.7 Employees who are committed are more likely to contribute with creative efforts

Used time
H2.8 Creativity is increased if time for ideas is used

Customer focus
H3.1 Increased potential for innovation through customer orientation
H3.2 High customer involvement solves innovation obstacles

Explorative learning
H3.3 Working explorative increase creativity
H3.4 Sharing and deploying what has been learned increase creativity

Idea management
H3.5 Mechanism for considering, assessing and communicating ideas increase creativity

Manage conflicts
H3.6 Conflicts must be properly managed to sustain creativity

Team goals
H3.7 Creativity in increased if team formulates goals to integrate thinking, action and outcome with regard to organizational goals

Job complexity
H3.8 Challenge and job complexity through task variation and significance increase creativity

Innovation responsible
H4.1 The organization has innovation responsible person or group who is in charge for sustaining innovation

Management style
H4.2 Leader inspires with knowledge, strategy and attitude towards innovation, change, competition and entrepreneurship facilitate innovation

Culture
H4.3 A decentralized and diversified culture aimed towards innovation is beneficial for innovation
H4.4 Innovation is facilitated if everyone has a mindset towards innovation and feels responsible

Open Climate
H4.5 An open corporate climate where people make contacts across levels and divisions facilitate innovation

Resources
H4.6 Required resources (budget, facilities, personnel) are recognized and acquired by management
H4.7 A heterogeneous workforce increase innovation

Learn by failures
H4.8 Innovation is benefited if problems are seen as opportunities and failures as learning

The learning organization
H4.9 Innovation is facilitated if the company provides training across organization

Creative and productive organization
H4.10 Innovation is facilitated if creative and productive functions are separated
H4.11 Innovation is facilitated if the company focuses on both creativity and efficiency through continuous learning

Recognition
H4.12 Creativity needs encouragement and recognition, is valued by the company

Risk taking
H5.1 Risks are taken and managed properly increase probability of innovation

External collaboration
H5.2 The company has established relationships with external market and invest in potential innovations

Innovation
H5.3 Increased probability of innovation through application of knowledge, ideas, methods, skills
H5.4 Constant implementation of improved products, processes, marketing methods,
business practices and external relations facilitate innovation

Appendix D

Business Management Interview Material

Interview Question	Coded Material
1. What does innovation mean to you?	**Disruptive thinking**, organizational support, customer values, **impact**
2. How important is innovation and creativity to Alten?	**Essential,** outside usual, disruptive thinking, fundamental, **stay updated**, competency development, **competitive**
3.1 How do you currently encourage innovation and creativity at Alten?	Needs improvement, autonomy in agile teams, **personal development**, news, Intranet, organizational development, financial rewards
3.2 If yes, what kind of tools do you have to make the innovation activities as good as possible?	**Communication channels**, rewards, no tools, autonomy
4.1 What expressed goals do you have (for improvement)?	Improvement area, tacit goals, **personal goals**, quantitative, corporate goals, business plan, customer satisfaction index, **increase work packages**, increase courses, improve clarity of goals and strategy and plans, improve information accessibility
4.2 What sort of innovation goals do you have?	**Personal goals**, patents irrelevant, new markets, new customers, organizational innovation, business management goals, employee marketing
4.3 Does the scrum team have common goals?	No common goals, customer objectives in future
5.1 Why have you chosen to have agile teams at the office?	Efficient, **up-to-date**, society movement (lean), customer demand, simultaneous work, appropriate to tasks, increase customer satisfaction, checking, software development, no short specific projects, offer teams to client
5.2 Which advantages are the greatest with agile methods?	Quality assurance, decentralizing decisionmaking, efficient, joy, involvement, **motivation**, dynamisms, team work, self-development, increase competency, common goals
5.3 Do you see any disadvantages with agile methods?	Need social skills, unrelated work assignments, widespread, undefined target, organize team, requires appropriate assignments
5.4 How far have you come with the implementation of agile methods?	**Well implemented in software development teams,** do what the customer wants, change quickly, need to benchmark, desire to spread to business management, desire to spread to organization, need clear empirical benefits, bottom-up
6.1 How often do you receive improvement suggestions at the office?	Every week, conferences, by the coffee machine
6.2 From whom do you receive improvement suggestions?	Senior consultants (confidence), expertise from interest, trials, experimentation, mostly management colleagues, sometimes consultants, all employees

6.3 How are the suggestions considered or implemented?	Encourage consultants to implement their ideas themselves, filter and process ideas, technical idea easier to assess, **improvement suggestion portal**
7.1 How often do you provide feedback to the scrum team?	Once a month for individuals, organizational distance, **project manager's responsibility to provide feedback**, feedback to project manager who transfers to team, weekly team retrospective (peer feedback)
7.2 How often do you provide feedback to others (if not responsible for scrum team members)?	Monthly meetings, yearly personal performance review, today, once a week, **spontaneous meetings**, breakfasts
7.3 What kind of feedback?	Results, solved problems, indirect feedback, salary based on performance, satisfiedcustomer-index, satisfied-employee-index, receive feedback from customer, give feedback about Alten, give feedback to person, collective feedback, direct feedback for presentations and ideas
8. Who guarantees that the team have the required resources?	**Project manager, business management acquire resources**, reaches management through written request
9.1 How do you involve the customer into in-house projects?	Agile method, weekly report, invite customer to retrospective, document all decisions with customer, customer decide what to do and solve, no opinion of how we work, requirement specification, feedback every second week, **upcoming project is first in-house agile customer project**
9.2 How do you assure that the developers have customer focus?	Customer meetings, see the product, meet the customer, discussions with customer, understand situation, **continuous feedback**, specific persons have contact with customer
10. How do you manage failed projects?	**Lessons learned, Delivery centre; assure structured projects and follow-up**, develop imperfect processes, learning organization, improvement areas, management responsibility, long-term teams, SWOT-analysis, evaluate reasons, involve customer in projects
11. How do you manage conflicts at the office?	**Constructive,** discuss conflicts, clear about conflicting opinions, try to solve it yourself before involving management, unbiased first then chose side, discuss solutions, happens rarely, situation dependent, individually dependent, solve conflicts fast, coaching leadership; involvement and development

Appendix E

Questionnaire

Likert grading scale:

Not at all applicable (0)
Applicable to some extent (1)
Fairly applicable (2)
Applicable to high extent (3)

Challenge. Statements:
The people I work with understand and are involved in the company's long term goals and visions
The work atmosphere here is filled with energy [Isaksen et al., 1999]
People here experience joy at work
Most people think their job is meaningful and stimulating

Freedom. Statements:
The people I work with have sufficient opportunity to make their own decisions, find information and show initiative
People here make choices about their own work [Isaksen et al., 1999]
The people I work with contact other people in the organization themselves to discuss problems and suggestions
There is a great feeling of freedom here

Idea Support. Statements:
The people I work with are actively encouraged to put forward new ideas and suggest improvements
People here receive support and encouragement when presenting new ideas
Many new ideas are presented here
New ideas are considered without fault finding and obstacle raising

Trust and Openness. Statements:
People here do not steal each other's ideas [Isaksen et al., 1999]
There is support for the initiative so you feel encouraged to take new one
Many different voices are heard here
Communication here is open and straightforward

Dynamism and Liveliness. Statements:
Alterations between ways of thinking about and handling issues often occur
There is a sense of "full-speed" and "go" in the organization
News are quickly embraced in the business
There are often new projects here

Playfulness Humor. Statements:
I work in a relaxed environment
People laugh and joke with each other.
People here have a sense of humour [Isaksen et al., 1999]
You see many happy faces here

Debates. Statements:
I believe that the people I work with raise and actively debate issues
We don't have 'taboo' subjects
Many different points of view are expressed here [Isaksen et al., 1999]
Unusual ideas often occur in the discussions here.

Conflicts. Statements:
There is a great deal of personal tension here
There are power and territory struggles here [Isaksen et al., 1999]
There are a lot of people here who cannot stand each other
Plots and traps are usual elements in the everyday work

Risk Taking. Statements:
The people I work with are prepared to take risks in implementing new ideas.
People here are able to take bold action even if the outcome is unclear
Decisions here are prompt and rapid
Concrete experimentation is preferred to detailed investigation and analysis here

Idea Time. Statements:
Time is available to explore new ideas [Isaksen et al., 1999]
The People I work with take time to explore new ideas
It is possible to think outside instructions and planned routines
People here have time to discuss and elaborate new ideas

Workload pressure. Statements:
People here have too much work to do in too little time.
There are unrealistic expectations for productivity here
There are distractions here that prevent creative work
Time pressure here is perceived as externally introduced and controlled

Supervisory Encouragement. Statements:
Our supervisor sets appropriate goals
Our supervisor provide us with a good work model
Our supervisor values individual contributions
Our supervisor shows confidence in the work group

Sufficient Resources. Statements:
Generally, I can get the resources I need for my work.
The resources allocated in our projects shows the organization's strong belief in our work
We have the required competence in our team
If new skills are required, we have time and support to acquire them

What do you think is important for a creative climate ?

My department has contributed to an implemented improvement
(eg. in the work environment , new products, processes or services) in the past year ?
Yes (1-2)
Yes (3-4)
Yes (5 or more)
No
Comment :