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Team Set Up and Ways of Working at Ericsson

A Study on System Test Teams

Bachelor's Thesis in the Bachelor's Programme
Economics and Manufacturing Technology

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

This study carried out at Ericsson and four of their system test sections testing the latest software version (LSV). The sections studied are MME ST LSV Lindholmen and MME ST LSV Shanghai, which perform system testing on the MME (Mobility Management Entity), and EPG ST LSV Lindholmen and EPG ST LSV Shanghai which perform system testing on the EPG (Evolved Packet Gateway) product. Their ways of working have a strong foundation in Lean and Agile principles, but there are deviations from theory and insecurity regarding to what extent the theory should be applied. Moreover, the team set up vary greatly between the sections, from well thought out teams to no teams at all. Therefore, the purpose of this study is to research the system test teams set up and ways of working at Ericsson, and how this affects efficiency according to the theoretical framework. The study answers the following research questions:

- What do the teams look like today?
- How are the teams different between sections?
- What do the teams look like compared to theory?
- How can the team set up affect team efficiency?
- How much knowledge do the employees have about Lean and Agile principles?
- When and how are Lean and Agile principles appropriate to use?

When collecting data, three main methods were used; literature review, interviews and a web poll. Through this a picture of the current team set up and ways of working evolved. The conclusion made is that the team set up is over all well connected to theoretical models and doesn't need to change drastically. However, there are some factors like enhanced motivation and team feeling that could increase team efficiency. Furthermore, the research showed that neither Scrum or Kanban is the perfect match for system test, however together Scrum and Kanban can complement each other. Therefore, a combination of the two is recommended. Additional improvement possibilities found regarding ways of working is the low support for Lean and Agile among employees and the risk of being too resource efficient.

Keywords: agile, kanban, lean, scrum, system test, team.

Acknowledgements

Finalizing this Bachelor's thesis also means finalizing our Bachelor's degree in Economics and Manufacturing technology. The three years we spent at Chalmers University of Technology have been educational - both academically and on a personal level. We are truly grateful for the opportunity the university has given us. The experiences of the last three years have given us a stable foundation for the beginning of our careers in engineering.

Writing this thesis was of great pleasure to us, since we were finally able to use the skills we have obtained during the course of our education. The thesis would not have been possible without Ericsson giving us the opportunity to do our research on their teams, and for that we thank them. We would especially like to thank Bengt Strömberg, our supervisor at Ericsson, who kindly guided us through the organization and always offered a helping hand when needed. Secondly, we would like to thank all of the interviewees who were kind enough to answer all of our questions with great analysis - without you this thesis would not have been possible.

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Karolina Erhardsson & Olivia Ljungberg
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List of Abbreviations

EPG – Evolved Packet Gateway

LN – Lindholmen

LSV – Latest Software Version

MME – Mobility Management Entity

OPO – Operative Product Owner

SH – Shanghai

ST – System Test

TTC – Technical Test Coordinator

Table of content

1. Introduction

The introduction presents the background of the study, its purpose and what research questions that have been treated.

1.1 Background

The company Ericsson have four sections that work with latest software version system testing. Their ways of working have a strong foundation in Lean and Agile principles, but there are deviations from theory and insecurity regarding to what extent the theory should be applied.

This study focuses on the products EPG (Evolved Packet Gateway) and MME (Mobility Management Entity) and the sections that perform the final system test on the products before the software release. The sections that have been studied are MME LSV ST LN, MME LSV ST SH, EPG LSV ST LN and EPG LSV ST SH, which are two pairs of twin offices located at Lindholmen, Sweden and Shanghai, China. The sections will be referred to as MME ST Lindholmen, MME ST Shanghai, EPG ST Lindholmen and EPG ST Shanghai, for clarity and simplicity.

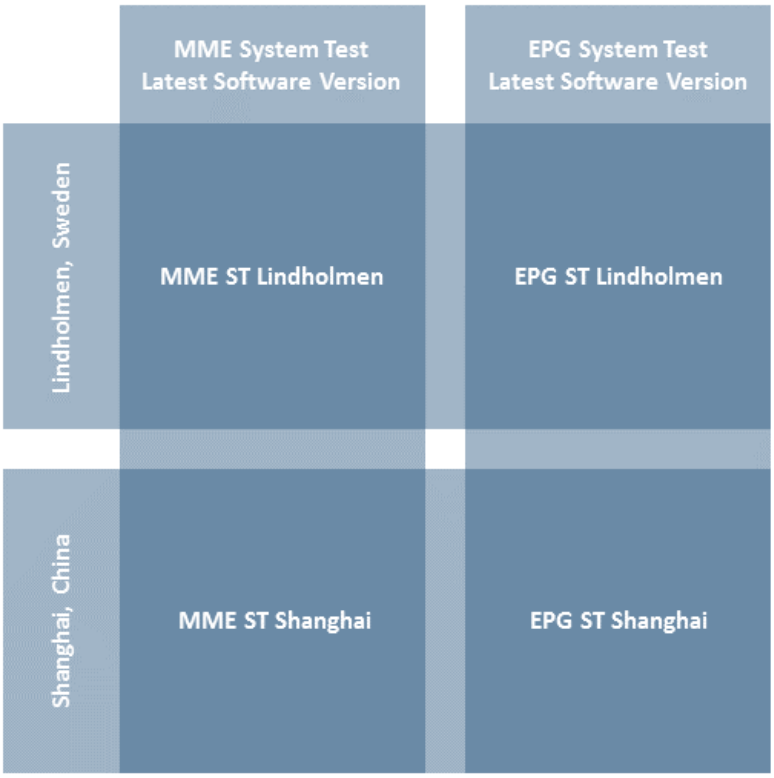

Figure 1. Venn diagram over the sections. *The sections work at two different locations - Shanghai, China and Lindholmen, Sweden and on two products - the EPG and the MME.*

The two products that the sections test are both part of the Packet Core network, but they are completely different from each other. They have different hardware and programming language, however, the sections share the main target to test the entire system, and how they choose to approach their task is very different. It is above all notable that there is a great difference between the two locations in the same sections, even if they work on the same task. The difference between section is obvious in teams, team composition, competence within the teams, how the teams are controlled and ways of working.

EPG - Lindholmen currently consists of twenty people divided into teams of five to seven members, with two teams located at the Lindholmen premises and one team off-shore. At MME ST Lindholmen however, the 16 employees are divided into informal teams and it is difficult to determine if the section consists of one or two teams. The sections in Shanghai is very team oriented, with two teams of six and seven people at MME ST Shanghai and two teams of five and six people at EPG ST Shanghai. Teams at all sections can be considered as permanent, as they generally work together for months or years. At MME ST Shanghai, there is for example a requirement for a team to exist for at least six months.

The teams work with different tasks, for example developing test equipment, quality insurance and execution of test cases. The sections have in common that they work with Lean and Agile principles, but it differs from section to section in what way. One example is that MME ST Lindholmen uses a Backlog where most tasks are put in - but not all of them.

EPG - Lindholmen has a Product Owner who is responsible for their Backlog, and who supervises the team's process and progress. They also have a Scrum Master responsible for Daily Scrums, visualisation, creating motivation for team members and reducing obstacles to simplify everyday tasks for the teams. MME ST Shanghai and EPG ST Shanghai also have Scrum Masters, even if the teams are autonomous in performing tasks. MME ST Lindholmen one the other hand has an informal Product Owner like function called a Technical Test Coordinator who prioritize and hand out tasks to the teams. Sometimes the teams are autonomous enough to choose a task on their own, if they know it’s high priority.

One notable difference between sections is also how they choose to put together their teams. The sections currently have no guidelines as to how the teams should be set up, which leads to the teams having great variation of competence, defined as experience and level of knowledge. At MME ST Shanghai, the teams are put together according to competence, performance and team members’ relationship to each other. They also have a rule of thumb that the team should include at least one to two members of high competence and experience. EPG ST Shanghai share a similar point of view, where the Line Manager puts the team together according to competence, since it is a high priority for them to have cross competence teams.

The section in Sweden aren’t as black and white. EPG - Lindholmen shifts teams occasionally according to need, even if they generally are permanent. Their team members all have a primary competence and one to three secondary competences that are considered when the

team is being put together. MME - Lindholmen is even more informal, and have previously let team members compose their unofficial teams themselves. There is however an idea that there should be complementing competences within the teams. They have the mind-set that the teams should have a mutual knowledge base, but it is impractical for “everyone to know everything” because of the complexity of the tasks.

There is a wide spectrum from organized team composition to a more informal process. This has led to the question if it is profitable to have a clearer structure and guidelines regarding team set up, and above all what factors will be affected, both positively and negatively by these guidelines.

1.2 Purpose

The purpose of the study is to research the system test teams set up and ways of working at Ericsson, and how this affects efficiency according to theory.

1.3 Research questions

- What do the teams look like today?
- How are the teams different between sections?
- What do the teams look like compared to theory?
- How can the team set up affect team efficiency?
- How much knowledge do the employees have about Lean and Agile principles?
- When and how are Lean and Agile principles appropriate to use?

2. Literature review

The literature review presents the theory that is relevant to the study.

2.1 System test

System testing is the process of testing an integrated system to verify that it meets specified requirements (Black, Graham, Van Veenendaal and Evans, 2006). It tests the full system or product and ensures the features works together as a whole. Usually the system test is the last test requested by development in order to confirm that the system complies with the specification and to find possible defects. The test ensures that the system works together with other systems - as well external as internal. It is performed by an independent test group consisting of specialised system testers.

2.2 General Team Set Up

General team set up presents the basic theory behind groups, teams and what makes them effective.

2.2.1 The definition of a team

"A team can be defined as a limited number of individuals with complementing competences, engaged in a mutual task and with a mutual responsibility to reach a goal" (Bruzelius and Skärvad, 2011).

The difference between a group and a team is that a team has a stated goal, which isn't necessarily the case for a group, which is defined as "two or more individuals who are dependent on each other and affect each other in social interaction". Therefore, a team is always a group by default, but a group isn't always a team (Bruzelius and Skärvad, 2011).

Team structures benefit the quality of work life in many ways for employees, and they are also beneficial for organizations as a whole (Glassop, 2002). Being in a team unlike a working group creates both individual and mutual responsibility. This leads the joint performance level of the team to be higher than all of the individual performances by a group combined (Katzenbach and Smith, 1993).

2.2.2 The development of a group

The level of maturity of a group is closely associated with the efficiency of the group. A high level of maturity in group is usually a sign of high efficiency, and it is above all expected that a high level of maturity comes with a high level of efficiency. The development process for a group to reach maturity is often divided into five development stages according to the classic book "Development sequence in small groups" (Tuckman, 1965). The five stages presented by Tuckman are in their respective order, "forming", "storming", "norming", "performing" and "adjourning".

Forming - The group is immature
"Forming" is the stage when the group takes shape. Signs of a group in the forming stage includes caution and insecurity surrounding the purpose of the group and role distribution. Individual signs of a person in a group in the forming stage includes being cautious while searching for their role and trying to orientate in general in the new environment.

Storming - The group is fragmented
A group in the "Storming" stage is characterized by conflict. Conflicts at this stage in the group development often include goals, level of ambition and priorities. It is of essence that these conflicts can be resolved in a civil manner, for the group to be able to move forward.

Norming - The group is characterized by participation
Group members at this stage are eager to cooperate and feel coherence towards the group. Issues that have previously led to conflict have been clarified to reach this stage, and there is now a developing trust between group members.

Performing - The group performs
The group have settled into their respective roles with a clear goal mind-set. They are united in achieving the set goal and put their time and energy into performing and helping each other as a team.

Adjourning - The group dissolves
The state of adjourning aims at describing the properties of a group that is about to stop existing. The reasons behind this can be many, but commonly a group dissolves after finishing a goal that was the purpose of the group. Individual feelings associated with this stage vary from person and situation. If a project or task has been finalized, that is usually associated with happiness and a sense of achievement. However, if the group is dissolved against the group members will, or if the group have developed a strong sense of belonging, feelings such as grief and sadness will appear.

2.2.3 Team effectiveness

Characteristics of effective groups include the right competence within the group, a clear objective and open, honest communication (Bruzelius and Skärvad, 2011). Other important factors include acceptance of difference between group members, listening to each other, that struggles of power do not occur and that the group evaluates their work and performance. The result of the characteristics can be summarized as three main objectives (Bruzelius and Skärvad, 2011):

- That the performance of the group leads to goals and objectives being accomplished.
- That the group and the group process increases the group members' ability of future cooperation and learning within the group.
- That the group experiences and the group collaboration contributes to growth, development and well-being for the members of the group.

The factors that have been accounted for are characteristic for effective groups, and because a team can be defined as a group, the characteristics are applicable on effective teams as well. However, characteristics of effective teams can be defined in a different, more specific manner. Studies from University of California (Lawler, 1996) account for three basic conditions that are essential for effective teams:

- Teams must be aware of that they are expected to accomplish and be given clear tasks to solve.
- Teams must work with meaningful tasks to become motivated and because of the motivation, become effective.
- The team members must be able to function as a team.

A clear sense of mission is said to be to the most significant indicator of an effective team (Pinto, 2013). It is important to have a clear sense of mission as an individual, but is of equal importance to share the same sense of mission as a team.

A study by Buchholz and Roth (1987) is even more specific and presents eight characteristics that are typical for high performing teams.

- *Clear and shared objective.* The team members share their interpretation of what the team's task, purpose and objective is.
- *Joint responsibility.* All team members share the responsibility to reach the set goal. They have the mind-set to help each other if needed.
- *Supportive leadership.* The leader creates freedom within responsibility and creates a feeling of being included and joint responsibility.
- *Open and intense communication.* The team members communicate frequently in an open and honest manner. They share the ability to ask, listen and respond.
- *Focus on the future and willingness to adapt.* Team members work proactively while focusing on the future.
- *Target focus.* The team focus on finishing the task at hand while continuously being aware of the outcome of their work.
- *Good individual performance.* Team members receive additional attention if they have performed particularly well individually.
- *Quick acting.* A short time span between thought and action.

2.2.4 Autonomous groups

Autonomous work groups are defined as “groups of interdependent workers, who regulate much of their own task behaviour around relatively whole tasks. These groups are generally allowed to select and train new members, set their own work pace, supervise most of their own activities, and often trade jobs among themselves” (Rao, Thornberry and Weintraub, 1987).

Autonomous groups are characterised by making decisions regarding values within the group, coordinating the work process and decisions regarding how to increase their level of autonomy (Bruzelius and Skärvad, 2011). Autonomous groups are generally characterised by the individual work being clearly cohesive with the main task, and the work requires certain competence and skill.

Sociotechnical systems advocate autonomous groups (Börnfelt, 2009). The purpose of the autonomous group is to increase democracy in the workplace and increase the quality of life at the workplace (Bruzelius and Skärvad, 2011). Autonomous groups have proven to be effective in the right conditions. For an autonomous group to be successful it is of importance that the individuals in the group have the right competence and motivation as well as a clear overview of the task.

2.2.5 Cross-Functional teams

Cross-functional teams, sometimes referred to as multidisciplinary teams, are composed by team members of different levels of knowledge. The purpose of the cross-functional team is to be composed of a group of individuals with complementing competences, to create an optimal team. A successful cross-functional team creates skills that no team member possesses individually (Parker, 2003).

Cross-functional teams are beneficial in many ways. According to Parker (2003) the benefits of Cross-Functional teams can be summarized as 6 competitive advantages.

- *Speed.* Cross-functional teams are faster at performing a task.
- *Complexity*. Cross-functional teams are better at solving complex tasks.
- *Customer focus*. Cross-functional teams are able to focus the organization's resources on fulfilling the customer's needs.
- *Creativity*. Because of the different experiences within the team, it is easy for creativity to thrive.
- *Organizational learning*. The team members of a cross-functional team are able to learn new skills from each other because of their different background. The skills can be both technical and personal.
- *Single point of contact.* The cross-functional team is a single identified source of information about a project or customer.

2.3 Implementing and motivating change

This section of the literature review presents motivation theories as well as strategies for implementing change.

2.3.1 Motivation

There are a number of theories regarding motivation in the workplace, but the two most basic approaches are internal and external motivation (Börnfelt, 2009).

2.3.1.1 External motivation

The use of external motivation is built on the theory that human beings don't want to work and avoid working when possible (Börnfelt, 2009). Because human beings lack motivation, they must be controlled or threatened to work towards the goals of the organization. Managers who advocate this theory work with control, detailed management and maintaining rules. Physical rewards are also classified as external motivation, for example payment or other benefits.

2.3.1.2 Internal motivation

The theory of internal motivation is built on believing that people want to work (Börnfelt, 2009). Physical and mental efforts come naturally to human beings and motivation comes from the drive to achieve self-gratification and self-fulfilment. Most people have the ability to be creative and solve problems and they also seek responsibility. Managers who believe that working with internal motivation is more efficient than external motivation, want to create a creative environment where employees can grow. They motivate their employees with challenging tasks, responsibility and authority. According to the job characteristics model by Hackman and Oldham (1976), see figure 2, five core dimensions affect personal and work outcomes.

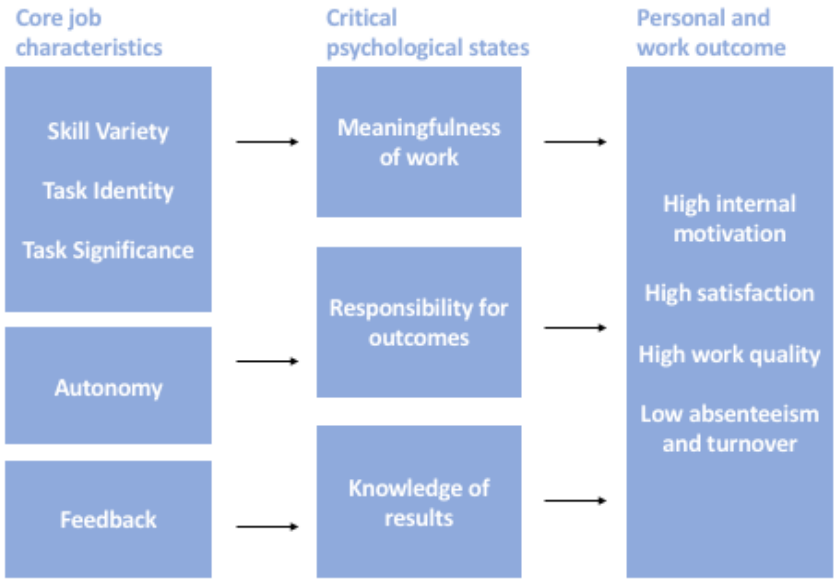

Figure 2. Hackman and Oldham's job characteristics model. *The model presents the core job characteristics presented by Hackman and Oldham. The three job characteristics skill variety, task identity and task significance leads to a psychological state of meaningfulness of work, autonomy leads to responsibility for outcomes and feedback leads to knowledge of results. The three psychological states in turn leads to a personal and work outcome of high internal motivation, high satisfaction, high work quality and low absenteeism and turnover.*

- *Skill variety.* The degree of which a job requires different tasks and skills.
- *Task identity.* The degree of which the person performing the task can view the task as whole and see its outcome.
- *Task significance.* The degree of which the tasks impacts the lives and work of others.
- *Autonomy.* The degree of which the person performing the job is able to be independent in scheduling work and deciding how the job should be performed.
- *Feedback.* The degree of which a person who performed a task get information on the outcome and effect of the task.

If the degree of the five job characteristics is high, it will lead to a positive psychological state. A high degree of skill variety, task identity and task significance will lead to psychological state that feels meaningfulness of work, autonomy leads to a feeling of responsibility for outcomes and feedback lead to knowledge of results. The three psychological states combined create a positive personal and work outcome with high internal motivation, high satisfaction, high work quality and a low degree of absenteeism and turnover (Hackman and Oldham, 1976).

2.3.2 Implementing change

The ability to develop, change and improve is a significant part of an organization's long term survival and success. Change is often met by resistance, which can be both useful and problematic. Resistance to change is a natural psychological response to something that seems unsuitable or something unexpected that creates uncertainty and the feeling of lost control (Bruzelius and Skärvad, 2011). The employees view of the change proposals depends on what kind of change it is and how the proposal is presented. Changes that often causes negative reactions are:

- When the background, purpose and meaning of the change is unclear.
- Radical changes.
- Unexpected and sudden changes.
- When people believe the change is an disadvantage for them.
- When people have negative experiences of past changes.
- When people have a strong belief in the current concept.

It isn’t unusual that improper changes are implemented or that the change is implemented the wrong way, which leads to failure. It is crucial that the proposed change is reviewed, presented and implemented thoroughly. When there is a need for change, it should be implemented and it should be implemented fully (Bruzelius and Skärvad, 2011). Moreover, the model introduced should be adapted to the company's needs and situation. Changes and approaches that can create resistance or failed implementations are:

- When the changes aren’t communicated well enough. The management has failed to communicate, explain and motivate the change to the organization. The employees

don't understand the reason why the change should be implemented and don't feel like it will make positive contributions. A change must never be perceived as a change for the sake of change. In order to clarify the purpose and convince objectors, management should have direct and personal contact with the employees.

- When management doesn't visibly support the change resulting in employees not believing the change is significant.
- When implemented change doesn't show any quick results. If it takes too long before positive results are visible, the employees might lose faith in the change. In order to motivate the employees, easy changes that quickly lead to visible results should be implemented first.

Furthermore, it is significant to realize that real change takes time and effort. The change process requires energy and endurance. The energy supply needed is at its peak at the beginning of the change process and then decreases until the process only needs energy occasionally (Bruzelius and Skärvad, 2011). This can be compared to a snowball pushed over a hill, see figure 3. Most power is required in the beginning, pushing the ball up the hill. When the ball has passed the top, it rolls without power needed.

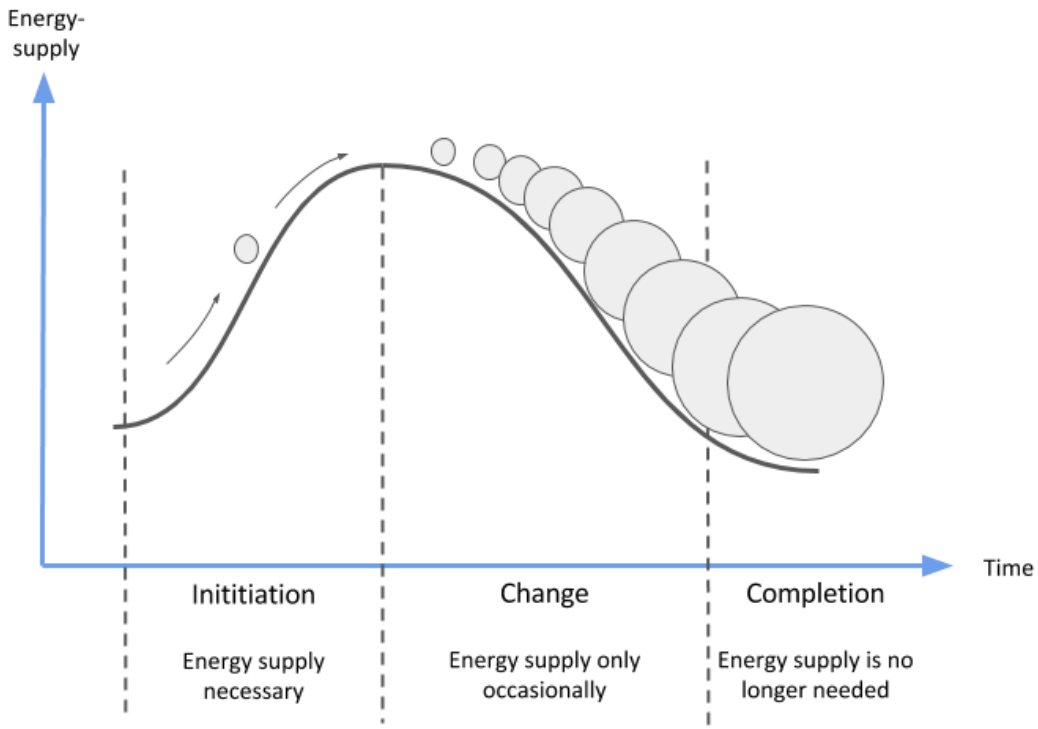

Figure 3. Energy supply needed during the implementation of change. *The energy supply needed is at its peak at the initiation of the change. The energy need then decreases to only need energy now and then. This can be compared to a snowball being pushed over a hill. Most power is required in the beginning, pushing the ball up the hill. When the ball has passed the top, it rolls without power needed.*

2.4 Lean and Agile Ways of Working

The chapter presents the theory behind Lean and Agile ways of working.

2.4.1 Agile Project Management

We live in a world that is constantly changing. Technology is developing rapidly, the products have shorter life cycles, there is great competition in the market and customer requirements and demands changes constantly. This means that companies need to be flexible and adaptable (Pinto, 2013). Most traditional project management models assume that all information needed is known prior to the project start. However due to the changing environment this is usually not true.

In software development and IT projects the traditional project management is based on the waterfall planning process, see figure 4 (Pinto, 2013). This is a linear sequential life cycle consisting of different phases of the project. Before continuing to the next phase the previous phase must be completed. The model assumes that the requirements are clear and fixed, which is often not the case in IT projects. The requirements in the beginning of the project might not be the same throughout the project because of evolving customer needs. Therefore, a new, more flexible way of delivering projects, Agile Project Management, has developed and become more popular in recent years. Agile Project Management uses iterative, incremental cycles to be able to respond quickly to opportunities and threats. The most common Agile approach is Scrum.

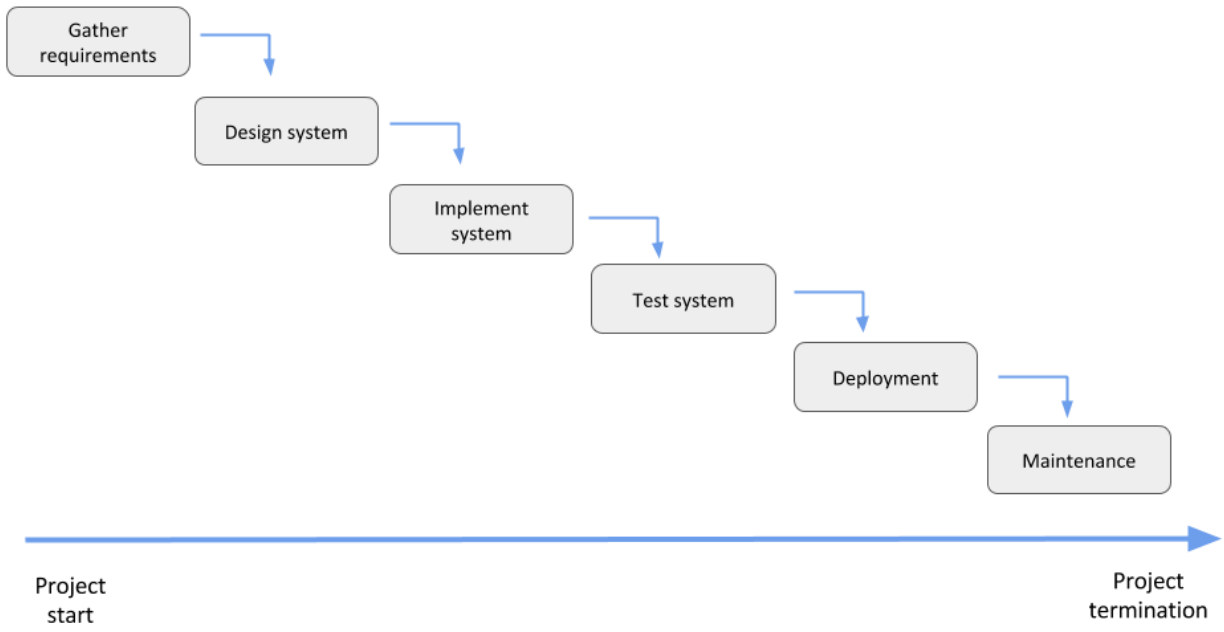

Figure 4. The waterfall model*. This is the traditional project management model and it assumes that the requirements are known at the beginning of the project. It consists of different stages and before moving on to the next stage the previous one must be completed.*

2.4.2 Scrum

Scrum is an Agile framework and is based on the team working in iterative Sprints during the project's progress (Scrum.org, 2017). Prior to each Sprint a Sprint planning meeting is held where number of tasks to be done and how they will be done is decided. During the Sprint the Scrum Team works with the tasks they have taken on to achieve the set Sprint goal. No one is allowed to disturb the team with new tasks during the Sprint. When the Sprint comes to an end the Sprint is reviewed and possible changes in customer requirements are updated before the planning of the next Sprint starts. The Sprint should be no longer than one month to avoid the risk of not being sufficiently updated on the customer's changing needs and requirements.

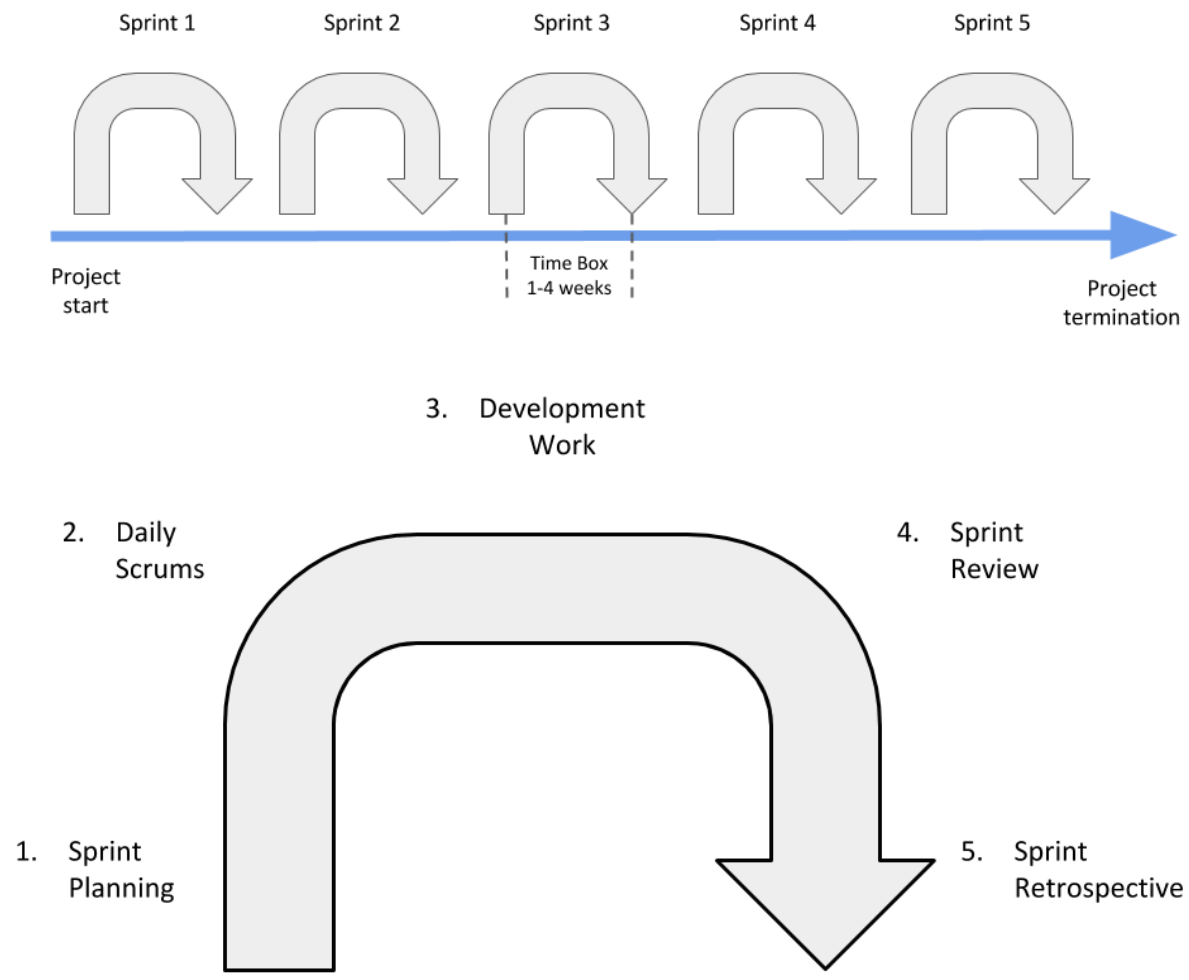

Figure 5. The Scrum process and the Sprint and its stages. *The Sprint process consists of iterations of 1-4 weeks called Sprints. In the beginning of each Sprint a Sprint Planning meeting is performed to decide the scope of the Sprint. Every day the team have a short meeting called Daily Scrum making sure no team member has encountered an obstacle. When the Sprint comes to an end requirements are updated in the Review meeting. At last possible improvements for next Sprint is discussed at the Retrospective meeting.*

2.4.2.1 Scrum Master

The Scrum Team is led and coached by a Scrum Master. The Scrum Master fully understands Scrum and is responsible it is applied (Schwaber, 2001). The role of the Scrum Master is to be

supportive and guide the team through the Sprint. This is done by leading planning-, start-up-, Retrospective- and Daily Scrums. It is the Scrum Masters obligation to remove all impediments that prevents the team from doing their work and to make quick decisions that allow the team to work on and reach the Sprint goal.

Furthermore, the Scrum Master's job is to communicate with management, other teams and the rest of the organisation. Together with management the Scrum Master forms Scrum Teams and appoints a Product Owner (Schwaber, 2001).

2.4.2.2 Product Owner

The Product Owner is responsible for coordinating the Product Backlog. This involves arranging backlog tasks according to priority order and ensuring that the list is available for all. It's vital that the organization respects the Product Owner's decisions (Scrum.org, 2017). If someone in the organization thinks that the priority order should be changed, he or she must persuade the Product Owner of this, and not the team. This way the team doesn't get interrupted with new tasks during a Sprint that has already started.

2.4.2.3 Product Backlog

The Product Backlog is a list of everything that might be a desired feature to the product. The features are evaluated and ranked by priority and then further specified. The list is never complete and constantly evolves to meet customer needs and to be competitive. The Product Backlog can be seen as a description of work to be done on the product before future releases. Prior to the Sprint the team chooses the number of backlogs it considers itself to have time for during the Sprint. Several Scrum Teams often work on the same product and therefore pick tasks from the same Product Backlog.

The Product Owner is responsible for the Product Backlog and to set the priority and ensure the list is visible to everyone (Scrum.org, 2017).

2.4.2.4 Daily Scrums

Daily Scrum is a daily meeting conducted by the Scrum Master. This meeting occurs at the same place and time each day and takes about 15 minutes. All team members are obligated to attend the Daily Scrums (Schwaber, 2001). The purpose of the meeting is for the Scrum Master to find out the following:

- What the team has been doing since yesterday.
- What they plan on doing until the next meeting.
- If they have encountered any obstacles.

By finding out these answers the Scrum Master will know if the team are making progress or not and if any obstacles needs to be removed.

2.4.2.5 Sprint Review

After each Sprint a Sprint Review meeting is held where the Scrum Team, Product Owner and key stakeholders meet to discuss the product and update the Product Backlog (Scrum.org, 2017). The Product Owner presents which Backlog tasks were finished and which were not. The Scrum Team performs a Sprint Demo, that is they demonstrate the finished work and answers questions about it. They also examine what went well and what obstacles they encountered during the Sprint. Furthermore, possible changes in the market and customer needs are examined. Based on this the group decides what should be done next in order to create value and the Product Backlog is updated and defined.

2.4.2.6 Sprint Retrospective

The Sprint Retrospective is a meeting where the Scrum Team evaluates itself to find opportunities for improvements, enabling them to become more effective in the next Sprint (Scrum.org, 2017). All team members must attend this meeting which takes place after the Sprint Review and prior to the Sprint Planning. The Retrospective addresses the following:

- Inspection of what went well and what did not during the Sprint.
- Identification of potential improvements.
- How to implement the improvements in the next Sprint.

The Retrospective inspects tools and processes as well as people and relationships. Moreover, the team members try to find ways to improve product quality and to make the next Sprint more effective. At the end of the meeting a plan on how and what improvement will be implemented in the next Sprint should've been created. Improvements can be implemented at any time, however the Sprint Retrospective is a formal occasion that stimulates continuous improvement.

2.4.2.7 Sprint Planning

Before the Sprint starts the Sprint Planning occurs. At this meeting the work to be performed during the next Sprint is decided. The work is selected from the Product Backlog. The plan of how to get the work done is created by the Scrum Team (Schwaber, 2001). The purpose of the Sprint Planning is to answer the following:

- What can be done the upcoming Sprint?
- How will the work be achieved?

2.4.2.8 Team

According to Scrum the team should be autonomous (Schwaber, 2001). No one but the team can determine what can be done in a Sprint. Therefore, the team chooses the number of backlog tasks they will take on during the Sprint. They also decide how the objective is reached and have the complete power to to do whatever it takes to achieve the goal. The team have the right to ask the Scrum Master to remove obstacles that prevent or complicate their chances of reaching the objective.

Team setup

Scrum advocates cross-functional teams containing all types of competence needed to reach the Sprint goal. The team organizes themselves and decides who is responsible for each task. Everyone on the team contributes with their knowledge to create the highest productivity and result as possible. It is recommended that at least one of the members have extensive experience (Schwaber, 2001). He or she will function as a coach for the less experienced on the team and guide them. Replacing or adding members to the team reduces productivity that has been built up through the organization created by the team. This should therefore be avoided. If anyone is underperforming or if missing knowledge is required, the change of the team should be done by the end of the Sprint and with careful consideration.

Team size

The team should ideally exist of seven persons, plus minus two (Miller, 1956). If the team have more than eight members it is recommended to split the team in two smaller teams. Large teams risk reducing productivity and it can be difficult for the Scrum Master to lead effective Daily Scrums as they require extensive coordination (Schwaber, 2001). Teams larger than nine team members isn't recommended as they are too complex to manage. Teams consisting of three members or less isn't recommended because of the risk of competence constraints and decreased interactions (Scrum.org, 2017).

2.4.2.9 Working environment

The team should be equipped with the best tools, resources and working environment as possible for it to be easy for them to perform their work. The working environment must be open and the members close together to simplify communication and collaboration skills (Schwaber, 2001).

2.4.3 Kanban

Kanban is a Japanese word which translates as "signboard" and was originally developed by Taiichi Ohno for the Toyota Production System (Gross and McInnis, 2003). By using Kanban cards, they created a pull-system and could manufacture JIT, just-in-time (Jonsson and Mattsson, 2011). Anderson (2010) realized that Kanban could also be applied to software development. Kanban can be implemented in software development without any changes of the current roles or processes, since there are no specific roles or processes in Kanban (Olausson, Rossberg, Ehn and Sköld, 2013). This makes Kanban a method that removes the fear of change, which makes it easier for employees to approve and embrace it. Anderson (2010) discovered five basic characteristics that every successfully implemented Kanban method had in common.

2.4.3.1 Visualization

A vital part of the Kanban method is to visualize the workflow. The most common form to do this is by using a Kanban board consisting of cards, called Kanban cards, and columns. Each card represents a specific work task and the columns represents the different stages of the work, see figure 6 (Olausson et. al., 2013).

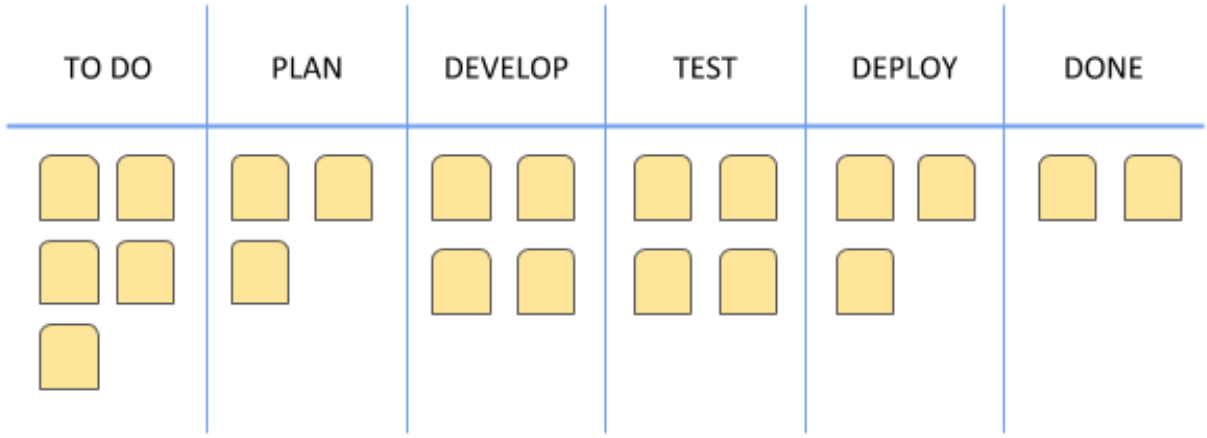

Figure 6. A Kanban Board. *The board consists of cards representing different work tasks and the columns represents different stages of work. When a specific task is done in one stage the corresponding card is moved to the column to the right.*

2.4.3.2 Work-in-Process Limit

The main difference between a Kanban board and a Scrum board is that the Kanban board limits the maximum allowed work tasks in progress (Olausson et. al., 2013). This is called Work-in-Process limit, WIP-limit, and regulates the number of cards in each column, see figure 7. If a column is full no new card can be brought into that column until another card is finished with that step and pulled into the next column. This creates a complete form of pull-system and makes it possible to see the work flow and identify bottlenecks. This in turn leads to discussions on how to improve the process of creating a better flow. Anderson (2010) writes that it is a mistake not setting a WIP-limit since this results in a loss of continuous improvement. According to him, teams that implement WIP-limits have delivered frequent, high quality results and increased in effectiveness. Teams with no WIP-limit on the other hand often struggle and only achieve limited success and improvement (Anderson, 2010).

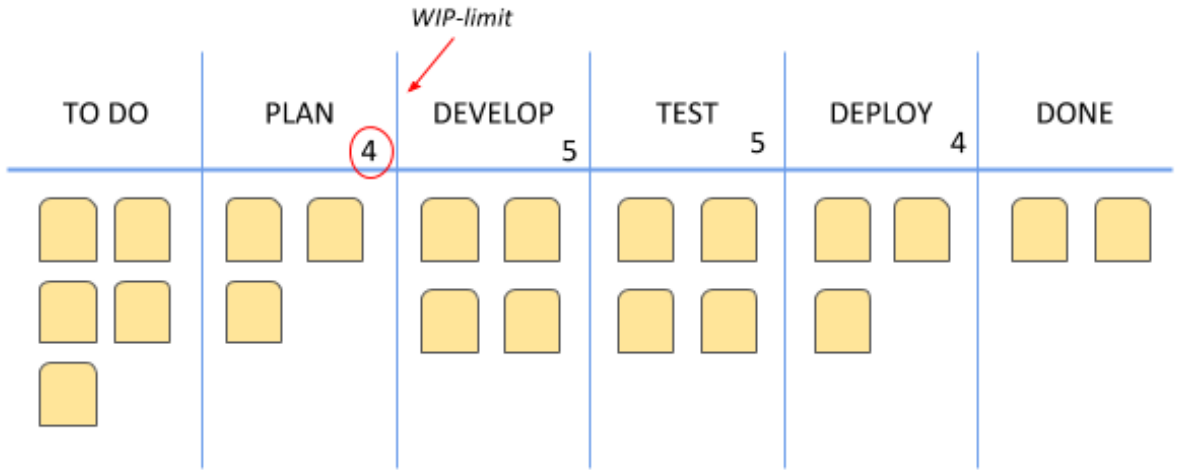

Figure 7. A Kanban board with WIP-limits*. WIP-limit stands for Work-in-Process limit. This means that the number of cards in one column aren't allowed to exceed the WIP-limit.*

2.4.3.3 Manage Flow

If one of the columns is often full and the columns to the right are empty, then chances are the full column is a bottleneck, see figure 8 (Olausson et. al., 2013). Without the Kanban board to visualize the workflow, bottlenecks might not be as easy to discover. The Kanban board creates an effortless way to follow up and measure workflow and problem comes to light as they arise. This stimulates continuous improvement to the system.

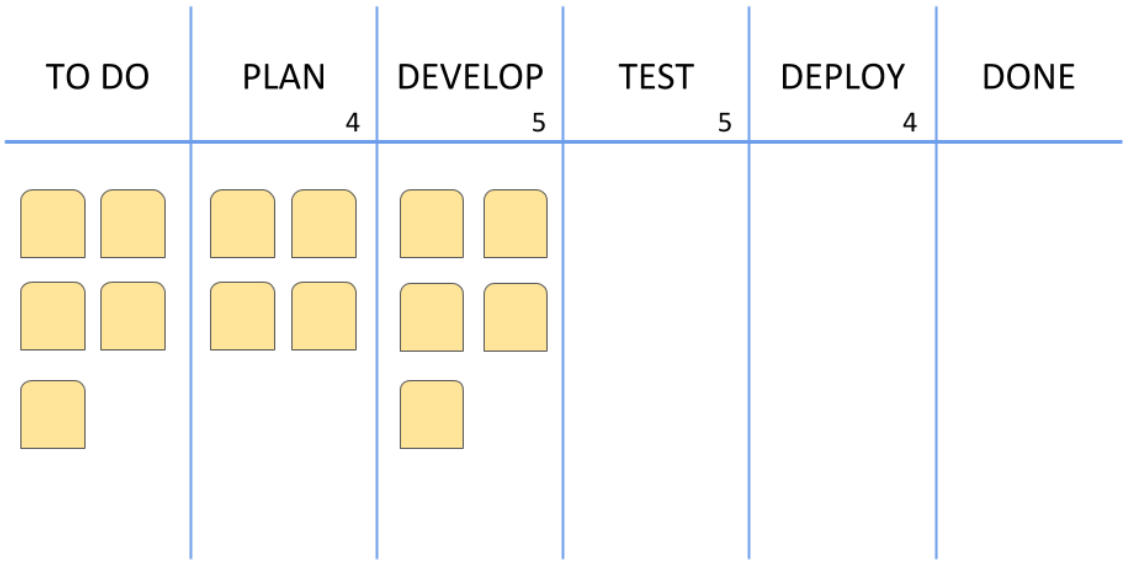

Figure 8. A bottleneck. *By visualizing the workflow with the Kanban board a bottleneck is discovered in the development stage.*

2.4.3.4 Make Process Policies Explicit

Before improvement work can begin it is vital that everyone understands the process. Therefore, the process should be made explicit to create knowledge of the workflow and the ways of working. This contributes to a better understanding of the improvement proposals, which means that improvements can be implemented more efficiently (Olausson et. al., 2013).

2.4.3.5 Use models to recognize improvement opportunities

Team members should comprehend the applied models and theories when implementing Kanban. Common models and theories applied when introducing Kanban often include knowledge of workflow, processes, waste and risk management (Anderson, 2010). Furthermore, it is important that the team share the same opinions on the meanings of the models.

2.4.3.6 Virtual Kanban board

A Kanban board doesn't have to be a classic whiteboard, it could also be a virtual electronic system on the computer. When teams are located in different geographical places a virtual Kanban board is necessary (Anderson, 2010). An organization where the employees can work from home is also recommended to use a virtual system. Furthermore, an advantage of virtual Kanban boards is that it allows tracking and data gathering. This is vital for analysing

processes and evaluating past periods to find improvement possibilities. Teams aiming for higher levels of organizational maturity are strongly recommended to use electronic tracking (Anderson, 2010).

2.4.3.7 Urgent tasks

Sometimes unforeseen external events occur that impact the team's work. This could be because of a mistake in the company's internal process or due to an unexpected customer request. These unforeseen events can result in expedite requests the team needs to deal with. Unexpected, urgent tasks cause increased mean lead time and variability, and reduces throughput and predictability (Anderson, 2010). Even if it's supposed to create value, urgent tasks aren't desirable.

One way of handling urgent tasks is to have an extra horizontal lane on the Kanban board where expedite requests can flow through, see figure 9. This lane should be reserved for highly urgent tasks only (Hüttermann, 2012). The expedite lane must have a WIP-limit in order to avoid tasks that might not be urgent enough to be in the lane and prevents flow. Let's say there are two urgent tasks in the expedite lane and the WIP-limit is set to two. If an additional urgent task appears the highest prioritized task should be completed first (Hütterman, 2012). If the number of incoming urgent tasks keeps exceeding the WIP-limit it will become clear that it should be examined why so many unforeseen tasks arise. Setting a WIP-limit will teach the organization that they can't urge whatever they feel like (Anderson, 2010). It will force upstream sections to take responsibility on how to avoid urgent tasks in the first place. If a delivery fails because the WIP-limit for urgent tasks is exceeded, they will learn that they have to work harder and gather enough information in order to be able to do a standard request. However, if upstream sections can demand an infinite number of urgent tasks they will have no reason to improve.

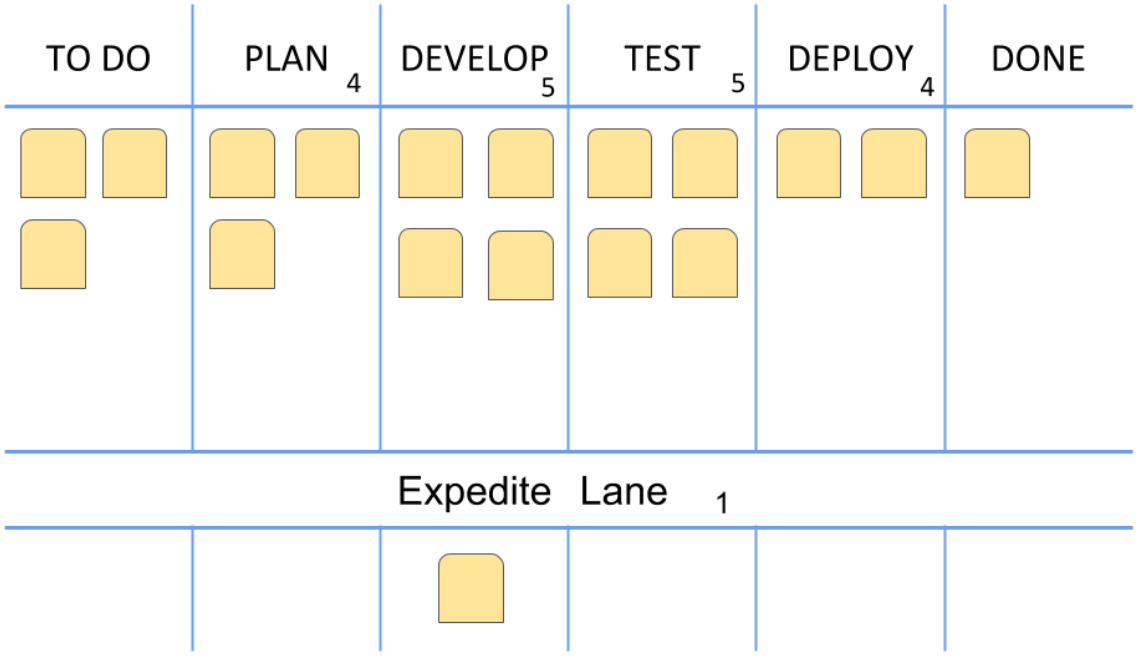

Figure 9. A Kanban board with an expedite lane. *To be able to handle expedite requests an expedite lane can be employed. This lane is reserved for highly urgent tasks only, allowing the expedite task to flow through smooth even if the main lane is full.*

2.4.4 Scrumban

The phrase Scrumban was first introduced by Ladas (2008) who applied the method to his team. Basically, it is a combination of Scrum and Kanban, where the work is visualized by a Kanban board and some of the standard Scrum ceremonies or roles might be missing in order to find a method that is adapted to fit the team's needs. Furthermore, the Kanban cards in Scrumban visualizes the value of each task contrary to the original Kanban where all tasks seem to be of same importance (DeMarco Brown, 2013).

2.4.5 Resource efficiency and flow efficiency

The most common form of efficiency focus among organizations is resource efficiency. The aim is to utilize all resources as much as possible and reduce resources that don't add value. Resource efficiency is defined as how much a resource is utilized during a specific time period (Modig and Åhlström, 2013). The main reason to optimize the usage of the resources is to avoid economic loss. If an organization isn't using its resources to its fullest, they waste money they could have spent on something else.

Another form of efficiency focus is flow efficiency. The aim is to make the unit flow through the system as smooth as possible in order to satisfy customer needs. It is defined as the sum of value-adding activities in comparison to throughput time.

Resource efficiency and flow efficiency are both important. However, it is very complicated, if not impossible, to achieve both, se figure 10 (Modig and Åhlström, 2013). To create high resource efficiency all resources must be utilized as much as possible. This means the resources must be busy all the time and in order to achieve this there need to be a buffer of units. Buffer of units in the system leads to a longer throughput time which in turn leads to a low flow efficiency.

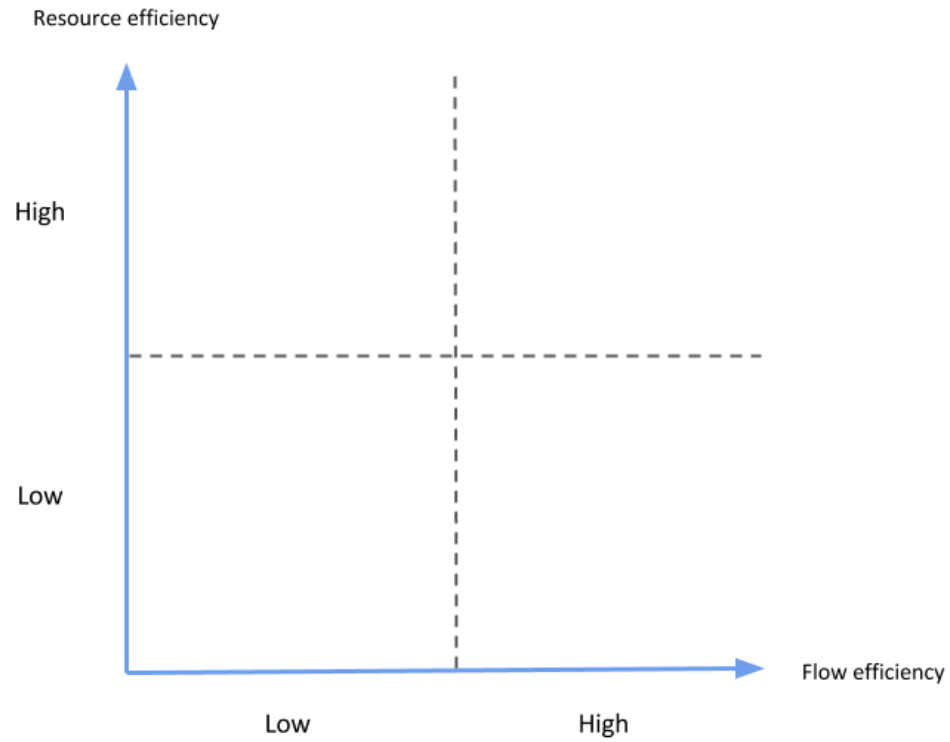

Figure 10. The relationship between resource efficiency and flow efficiency. *High resource efficiency leads to low flow efficiency. Similarly, high flow efficiency leads to low resource efficiency. The ideal state is to reach the top right corner of the figure, being both resource- and flow effective. However, in reality this is extremely difficult, if not impossible.*

An additional problem when focusing too much on resource optimization is that it might result in numerous problems and extra work. For example, long throughput time can lead to lost opportunities and new needs. Many units in flow can lead to employees handling to many things at once resulting in stress and mistakes. According to Modig and Åhlström (2013) there are four possible ways to improve flow efficiency:

- Eliminate what causes queues and the number of units in the process will decrease.
- Work faster which will lead to a shorter cycle time.
- Increase the number of resources in order to increase capacity and reduce cycle time.
- Erase, lower and handle variation in the process.

3. Method

This section gives a presentation of the workflow and the method process.

3.1 Process

Figure 11 presents how the study was executed, in the shape of a process map.

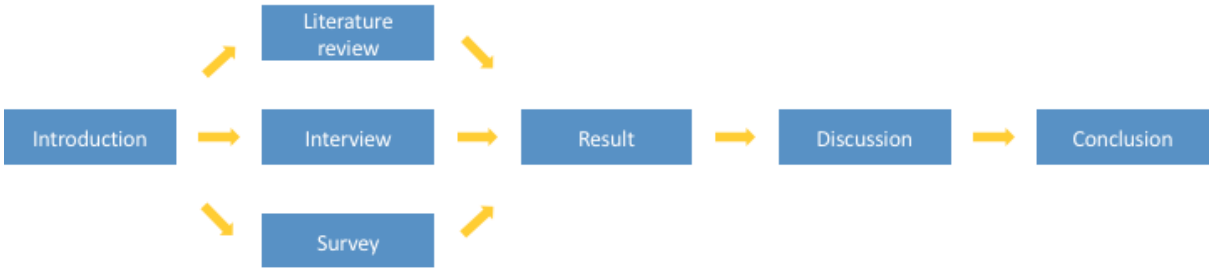

Figure 11. Process map. *The study was executed by gathering data through a literature review, interview and a survey. The result of the data collection led to a discussion which in turn led to a conclusion.*

3.2 Data collection

When collecting data, three main methods were used; literature review, interview and survey. The methods are presented closer below.

3.2.1 Literature review

To gain a deeper knowledge about Agile principles and theoretical team set up, relevant literature was searched for through databases and libraries. The supervisor at Ericsson also recommended a number of books that were relevant to the study. The literature created the foundation for the theoretical framework of the study and the creation of interview questions.

3.2.2 Interview

To get an understanding of the current situation and increased knowledge about the team's state, a number of interviews was performed. The interviews also clarified the respondents' thoughts and experience in working with Agile principles that are connected to teams. The interviews were semi structured, which means that the questions were created in advance, with the opportunity to add additional questions if needed, and for the respondent to elaborate on their answers. The selection of interviewees was created to be as broad as possible and give an accurate description of the current state. The respondents were therefore selected in consultation with the supervisor at Ericsson to ensure the right people were interviewed. To ensure diversity in the selection of people, employees from different teams, sections and positions were interviewed. During the interviews notes were taken and the conversations were also recorded. From the notes and recordings, the information relevant to the study could be gathered and compiled.

3.2.2.1 Interviewees and background at MME ST Lindholmen

The interviews at MME ST Lindholmen was conducted with the Product Development Leader, who is also the Line Manager of the section, as well as two System Testers. The Line Manager has worked with similar tasks at Ericsson for almost ten years as a permanent employee, and was previously hired as a consultant for the company for the same amount of time. He considers his knowledge in Lean and Agile principles to be extensive, both theoretically and practically, having worked with it since the late 80's in different ways. The System Testers are both highly experienced in system test from working at the section for 10 and 17 years respectively. The System Tester who has worked for 17 years has basic knowledge in Lean and Agile principles and understands the general concepts. The other System Tester considers himself to have similar basic knowledge, but has more in depth analysis about how and when the principles are applicable.

3.2.2.2 Interviewees and background at EPG ST Lindholmen

The main purpose of EPG ST Lindholmen is to perform regression system test on the EPG product to ensure the entire system operates correctly. Three employees of different positions at EPG ST Lindholmen were interviewed; the Line Manager, the Operative Product Owner (OPO) and a System Tester. The Line Manager has worked at Ericsson for 17 years and considers herself to have reasonable knowledge on Lean and Agile principles. The OPO has been OPO at EPG ST Lindholmen for about half a year, however she has worked at Ericsson for 18 years and has a lot of experience from similar positions. She has basic knowledge of Lean and Agile principles and understands the main idea of it. The System Tester is a certified Scrum Master and has extensive knowledge about Agile principles.

3.2.2.3 Interviewees and background at MME ST Shanghai

The interviews at MME ST Shanghai were conducted with the Line Manager and two senior system testers. The system testers are also the Scrum Masters of the two teams at the section. The Line Manager is experienced in Lean and Agile ways of working and has been working with it for the last five years. The Line Manager is also the person who ran basic training in Lean and Agile ways when they started implementing it at the section. One of the senior system testers has worked at her job for three years, but has worked with similar system test work before. She has recently become a Scrum Master at this job but has had the role before at other jobs. Her knowledge of Lean and Agile ways of working is comprehensive. She has had training in the area as well as having read books on the topic. The interviewee, who is also a System Tester and a Scrum Master, has worked at the section for a year. He has previously worked at Ericsson for five years on a different product and has had the Scrum Master role before. The first time he got in contact with Lean and Agile ways of working was when he started at Ericsson six years ago. At that point, he received the basic training that is required at Ericsson and he has since then taken additional training to become a Scrum Master.

3.2.2.4 Interviewees and background at EPG ST Shanghai

The function of EPG ST Shanghai is to secure the EPG-product delivery by performing system tests. Three employees of different positions were interviewed; the Line Manager, a Project Manager/OPO and a System Tester. The Line Manager has worked at Ericsson for nine years and has been the Line Manager for four years. He came across Lean and Agile principles when he first joined Ericsson in 2008 and after that he has participated in several trainings and courses of different levels. The Project Manager, who also functions as the OPO, has worked at Ericsson for more than six years and at EPG ST Shanghai since last February. He has participated in the basic Lean and Agile training and doesn't have a strong background in it. The System Tester has worked as a consultant at Ericsson since 2010 and was employed by Ericsson 2015. He has participated in the basic Lean and Agile training.

3.2.3 Survey

To complete the interview and reach a larger target group, a survey in the form of a web poll was sent out via e-mail. The survey contained one question with set response alternatives and the rest of the web poll contained open answer questions.

The web poll was answered by 26 people, some of which had already participated in longer interviews. The answers were generally basic, vague and coincided with the opinions of the interviewees. Because of this the current state is predominantly based on the longer interviews since their opinions were similar but the analysis was deeper.

3.3 Analysis method

Figure 12 presents how the research was analysed, in the shape of an analysis model.

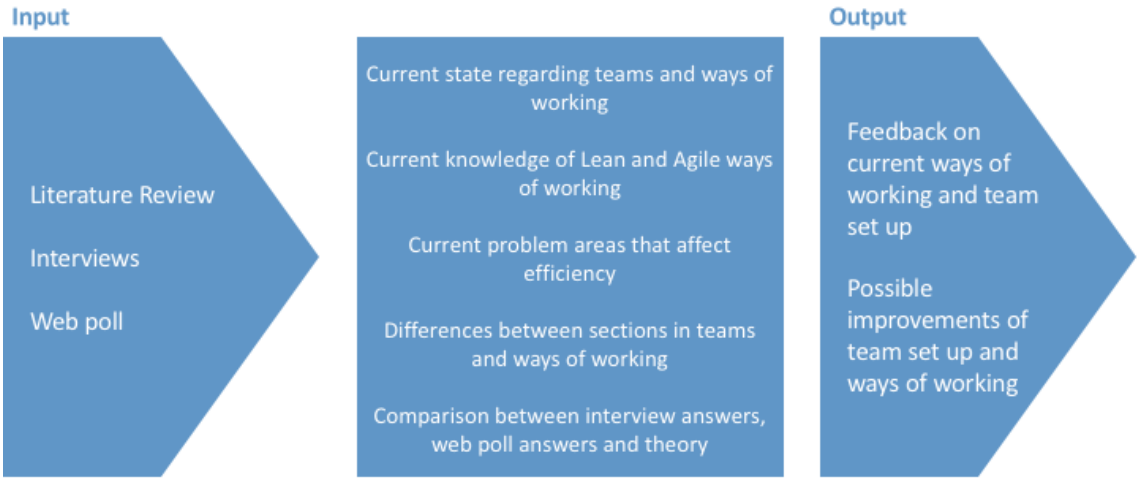

Figure 12. Visualisation of the analysis method. *The data collection of the study provided current state. This current state was analysed and created the output of the study.*

4. The current state at Ericsson

The current state at Ericsson is presented by the four sections respectively. The information about the current state has been gathered by three extensive interviews with employees of different positions at each section. Furthermore, their answers were completed by the result of a web poll that all the employees at the sections had the opportunity to answer.

4.1 The current state at MME ST Lindholmen

The current state at MME ST Lindholmen describes how the section chooses to work with teams and what ways of working they have.

4.1.1 Teams

At the MME ST Lindholmen site there are currently 17 employees, but the number varies greatly from about 13-20 depending on how many employees currently are lent out to other projects. Figure 13 shows an organizational chart over the employees. The employees are loosely divided into groups according to what current tasks are being performed, but they aren't divided into official teams. The section could however be considered as one big team and will be referred to as a team for clarity. The decision of who works with what task is based on the competence of the employees and also by what the employees prefer. The team can be considered to be permanent as you are not only employed for a specific period of time. It is uncommon that the team changes.

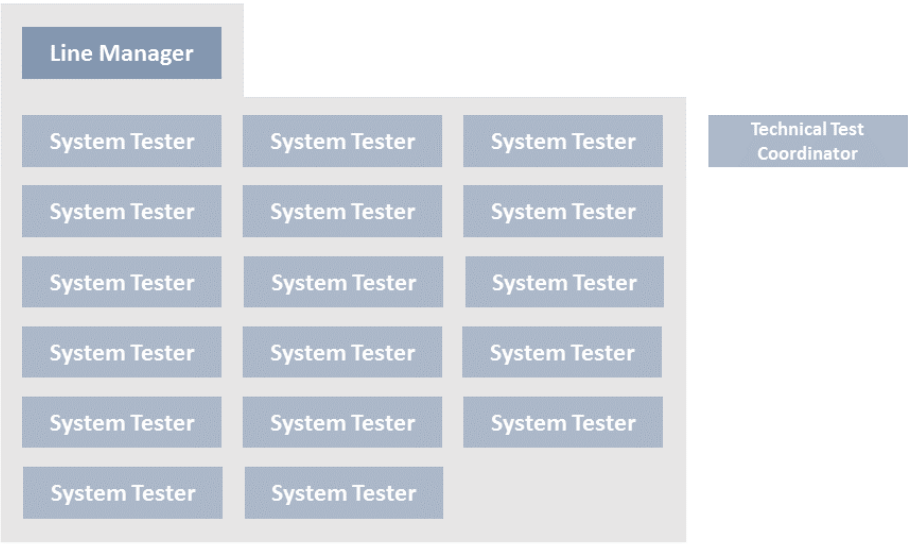

Figure 13. Organizational chart over MME ST Lindholmen. *The system testers at MME ST Lindholmen aren't divided into teams. They have a Line Manager who is a part of the section as well as a Technical Test Coordinator who isn't a part of the section.*

The employees at this section form a very mature team, with most of them having worked there for about a decade. The newest employee has worked there for around four years, and the most experienced in the team has been there for almost 20 years. The maturity of the team

leads to highly autonomous work, with the employees having great instincts of what tasks need to be done. At this state, there is little need of controlling the unofficial teams. On paper, there is a Technical Test Coordinator (TTC), who has the same tasks as an Operative Product Owner, who controls the team by demanding some tasks to be finished earlier than others. The TTC isn't a part of the section. The team is also controlled by the Line Manager who require growth within the team and improvement in work methods.

Because of the team's high experience, it is also high in competence. The competence varies from person to person but they all have basic system test knowledge. However, some employees need more help than others and some employees are good at coding while others cannot code at all. This isn't a problem since the section strives to have completing competence within the team, and feels it would be unnecessary for everyone to know everything. The Line Manager notes that if the section would reorganize into teams they would strive to have teams that are equal in competence, so it would be possible for any team to take on any task.

At the moment, the majority of the section doesn't feel like teams are necessary in their ways of working. One of the System Testers mentioned that the section is comfortable with not having appointed roles, and would rather have the roles develop naturally, saying:

"We work a little more with the teams being controlled by the task you have, rather than a team being appointed a task so to speak."

The section would rather have the team set up be controlled by the task instead of having a team be appointed a task. It is also mentioned that it seems to be difficult to have a team focus on one single task. The employees are afraid that the teams could choose to go in their own direction, and the whole section would not have the same group feeling that it has today. If they go off in their own direction, it seems uncertain if they will deliver.

Having teams however, is believed by the interviewees to be beneficial in many ways. Being in a team can improve motivation by having a sense of belonging and wanting to be a team player. Having formal teams could also make it easier to hire new employees, since you know exactly what position needs to be filled, and what kind of person who is needed to complement the rest of the team. If you are in a team it is also easier for new employees to learn their new tasks, since you have the support from your team. One of the system testers feels like implementing new teams could be difficult. He thinks that a lot of responsibility will be put on the teams to make the implementation work, without the support needed. For this implementation to be successful, he feels like it needs to be well structured by management. The section is eager to question new ways of working, and needs new methods to be well motivated for them to apply it on their tasks. It is important for the section to have continuous pressure from management to continue using new ways of working.

4.1.2 Ways of Working

Even though the employees at MME ST Lindholmen are very autonomous, they are controlled by a Technical Test Coordinator. The work tasks of the TTC are the same as the tasks of a Product Owner and is therefore sometimes referred to as the OPO. It is the responsibility for the TTC to make sure that the Demo is released in time for the customer, and in connection with that they control the Backlog. The Line Manager also requires that the employees improve their ways of working and competence. The employees at this section have similar ways of working, with no notable differences. They have a Backlog that is shared with MME ST Shanghai, but no Sprints or Daily Scrums. They do however have weekly meetings to synchronize with MME ST Shanghai, and meetings within the section when needed. The employees are performing their daily work in an open office environment. Because of the maturity of the team, they have an open climate where it is easy to ask for help if needed. As a result of the open climate it is believed that team meetings aren't necessary on a smaller level than the section.

The amount of knowledge of Lean and Agile principles vary from person to person, but everyone in the section share the same basic knowledge. The section works with some basic Scrum ceremonies and use a Backlog. However, they do not have a Scrum Master. Because of this, everyone is aware of basic Scrum ceremonies and how to use a Backlog, even though the section could use the Backlog more than they do today. One of the interviewees said:

"I also believe the Backlog could be utilized more effectively, but I am unsure of how far one should go on applying Lean and Agile. If you only look at this team you can go as far as you want but if the rest of the organization isn't adapted to Lean and Agile principles then it doesn't matter what we do"

There is a competence gap regarding knowledge of Lean and Agile principles. However, the section isn't convinced that it is a problem, since they deliver on time. When the company decided to start working with Lean and Agile principles the employees were required to read a book on the topic. The reason they decided to go Agile was to be able to produce faster for the customer. Their Agile ways have made it possible to push their release time from once every two years to monthly releases. From the customer's perspective they seem very Agile, however they do not consider themselves to be fully Agile. The full theoretical model isn't implemented, and it doesn't need to be. The section feel like they have a balance between theoretical Agile principles, and what is applicable at Ericsson. One of the interviewees mentions:

"This happens very easily at a workplace, but we don't have the theoretical model implemented - that isn't exactly how we work. But I think we have a good balance between what we feel work for us and what we do to follow the pattern."

They have found that what works for them is a mix between Scrum and Kanban. The reason they believe that the theoretical model isn't applicable is because it is a model developed for

developing teams. System Test doesn't involve a clear period of time which is essential when using Scrum and Sprints, that is why Kanban is added. The general idea at the section is that Scrum is hard to apply but Kanban is easier.

Another aspect mentioned when discussing what could be improved in the section is more resources. The section does deliver on time but feel like they are at a limit with resources. When unexpected tasks appear, it is difficult to work effectively. It would be appreciated at the section if they had more resources, however, they realize that a greater amount of resources is costly.

4.2 The current state at EPG ST Lindholmen

The current state at EPG ST Lindholmen describes how the section chooses to work with teams and their ways of working.

4.2.1 Teams

The EPG ST Lindholmen section consists of two teams and one additional team off-shore. Each team currently consists of seven people and one of the seven is also the Scrum Master, see figure 14. The teams aren't completely autonomous and need some guidance and controlling. Most team members have only worked at the section for a short time and have limited experience and therefore need support. The Line Manager says she strives towards more empowered teams who take initiative.

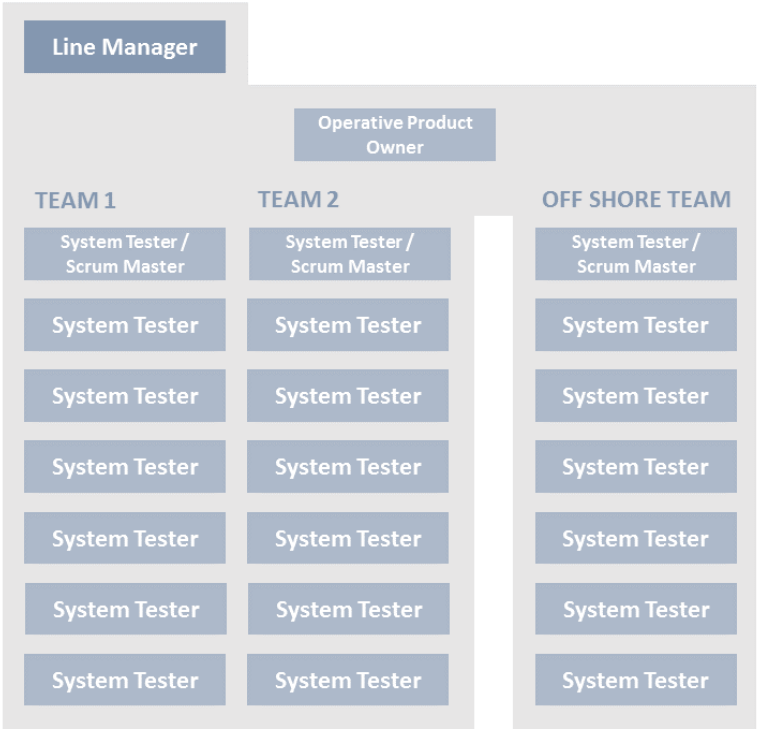

Figure 14. Organizational chart over EPG ST Lindholmen. *The section has two teams in house and an additional team off-shore. The section also includes a Line Manager and Operative Product Owner.*

The teams are put together by the Line Manager by competence, experience, gender, ethnicity, personality and inputs from team members. They strive to have flexible and cross-functional teams. The Line Manager wishes the section consisted of a wider range of personality profiles and greater diversity in age, experience, ethnicity and gender to be able to put together the best possible teams. The OPO also advocates teams of various personality types. At one time, when the team got the opportunity to choose the team set up themselves, it resulted in very homogenous teams. This worked out quite well since the team members understood each other. However, the team lacked a driven person who could take initiative. This is a recurring issue that the section has and currently one of the teams lacks a driven person.

The aim is that the teams should be as permanent as possible so they can grow together and maintain a high level of efficiency. However, a common problem is that team members leave system test to seek new challenges, or that a member becomes selected by the organisation to participate in a project. Therefore, the teams aren't as stable as they desire. The Line Manager would like the organisation to pick a whole team instead of picking individual people from different teams. On the other hand, the Operative Product Owner says it may also have an advantage in that new people can bring new ideas and ways of thinking to the team.

The experience among the team members differs from twelve years to one year. Overall there are too many inexperienced system testers in relation to experienced. This is because of the EPG product is relatively new compared to the MME product, which means there are few who have extensive experience of it. Since the system test tasks are quite repetitive, some employees leave the section to find new challenges. Moreover, the demand of the product is also increasing which means they have to recruit new employees. The team members who have worked at the section for a long time constantly have to train new employees. They try to broaden the team's competence by encouraging everyone to know at least one extra area in addition to their main area. This way they can back up each other if someone is sick or leaves the team.

According to the Operative Product Owner the team is officially a team, but in reality they work individually. She explains:

"I want them to act like a team and feel responsibility. You have this task, you decide who does what - not me. I don't want to tell Pelle to do this and tell Stina to do that. You are supposed to do this together. Unfortunately, they are more of a team on paper than in reality."

They choose a task as a team and delegate the subtasks among the members, but after that they work separately. If someone is sick or similarly, no one takes responsibility for this person's tasks because they see it as that person's job and not the teams. Some members are better than others to ask team members for help and solve the problem within the team. However, there are many examples of when they have not asked for help or taken

responsibility for someone's work when they've been out of office which has led to that test cases have not been executed. This, the OPO believes, is because they focus too much on their own work. The Line Manager also mentions that she thinks the team members aren't cooperating enough. In contrast to the OPO and Line Manager the System Tester thinks they have a very good and open communication in the team. They mostly ask each other for help and are open to help and update each other on the current situation according to her.

4.2.2 Ways of Working

EPG ST Lindholmen employs Kanban with some elements of Scrum, which they refer to as "Scrumban". For example, they perform Retrospectives weekly, have a Backlog and each team has a Scrum Master. For competence and improvement tasks they use two weeks Sprints, however for test cases they do not use Sprints at all. Furthermore, they do not perform Sprint Demo or Sprint Review since they don't find it applicable on system test. The Operative Product Owner, OPO, controls the Backlog and synchronizes it together with the OPO at EPG ST in Shanghai. The Operative Product Owner decides the scope where some test cases are to be executed after different frequencies. The team picks a new task from the Backlog when they're done with the previous one and decides how the work should be organized among team members.

The teams working methods are similar to each other, which is necessary to facilitate the OPO's work. To ensure that the teams at the section are working in the same way and to learn from each other, the Line Manager, the Scrum Masters and the OPO have Retrospective meetings every week where they discuss possible improvements and share knowledge. The Scrum Masters are responsible for communicating the content of the meeting to the rest of the team. However how well the Scrum Master does this varies from time to time.

The section also have a lot of knowledge exchange with EPG ST Shanghai, even though their ways of working differ. Shanghai works in Sprints, and which test cases should be executed in which Sprint is strictly decided by the OPO. At EPG ST Lindholmen they're more flexible. However, they have no or little communication and knowledge exchange with MME ST Lindholmen. The reason for this is said to be that they are at different stages in different issues. For example, EPG ST Lindholmen uses automated testing, something MME ST Lindholmen has not yet transitioned to.

The interviewees all agreed that full-scale Scrum is more suited for development teams than system test teams. The OPO believes that Kanban is more applicable than Scrum and that a combination of the two works well. The Line Manager have similar opinions and says that Lean and Agile principles can complement each other. She believes the teams are familiar with the Lean and Agile ways of thinking and that everyone has been assigned books on the subject. Nevertheless, she thinks the team members have more knowledge of Lean principles than Agile principles. The OPO thinks the team members understand the main idea of Lean and Agile principles, but that most people lack depth knowledge and understanding.

The System Tester, who is a certified Scrum Master, doesn't think they're sufficiently Agile and that the teams aren't aware of the Agile mind-set. She says:

"They aren't very Agile. They aren't aware of the Agile mind-set even - as they should be. But maybe it's because it's not very applicable for this type of team and this type of task. So maybe that's why there is a gap."

She believes this might be because it's not very applicable in the work they perform. However, she is of the opinion that it is possible to be more Agile in system test. They need to understand and deploy it in a way that fits their ways of working and they must put much more effort in it if they want to strive to be Agile.

All interviewees acknowledged that they're too resource optimized and not enough flow oriented. They often receive unpredictable tasks, which means their workload can vary greatly from time to time. Also, since they release the product on fixed deadlines they're not very flexible, which the OPO pointed out isn't according to the Lean and Agile principles. They would like to work less according to deadlines and have a buffer enabling them to be more efficient. The OPO says:

"You should have a buffer of resources. Resources at all should be a bit bigger than the need to be flexible and manage occasional peaks, and still manage to get some breathing space. This we haven't applied at all. From that point of view, I don't feel that we are Agile, since we lack the flexibility."

4.3 The current state at MME ST Shanghai

The current state at MME ST Shanghai describes how the section chooses to work with teams and their ways of working.

4.3.1 Teams

At the section MME ST Shanghai, there are two teams of six and seven people, and they can be considered as permanent. Figure 15 shows an organizational chart over the team set up. Sometimes if there is an urgent task, the Line Manager will choose employees from the teams to create a temporary team that can solely focus on the task at hand, but it doesn't happen frequently. The Line Manager is very encouraging if a team member wishes to switch teams. It isn't common, but if there is a need for it, the team members are able to apply for a rotation of team members in the teams. It is very easy since the two teams already sit together and share an office space. It is encouraged to have less permanent teams so they are able to be flexible according to business need.

Figure 15. Organizational chart over MME ST Shanghai. *The section consists of two teams, a Line Manager and an Operative Product Owner.*

It is the Line Manager who creates the initial teams. He likes to put different people together and looks at personality, gender, how open minded and outspoken they are, as well as their competence. The competence level at the section is currently lower than wished for, since a couple of team members recently transferred from other sections. They still have the required competence, but they aren't fully used to the ways of working at the section. Other than the transferees, the team members have spent between two and five years working for MME ST Shanghai. Working at the same job for that long is uncommon in China. Young people in the country like to change jobs often, since the society evolves fast and young people are eager to learn. The section is also generally younger than the corresponding section at Lindholmen. The average age is about 10 years younger in Shanghai than at Lindholmen, with most employees being around 30 years old.

The two teams are very similar in competence. The section aspires to have them as equal as possible to make sure both teams can take on any task. The teams are very close to each other and can easily ask the other team for help if needed. They sit in an open office environment together with the Line Manager, and aspire to have an open climate where it is easy to discuss projects and show each other what they are currently working on.

The teams aren't fully autonomous, they consider themselves to be somewhat independent, but they are still controlled by the Scrum Master, the Operative Product Owner and the Line Manager. Both teams have internal Scrum Masters who are working with that role 20% of their time. The teams are able to choose a task from the Backlog according to interest, but

they have to run it by the Scrum Master first. The Scrum Masters are very supportive of team members who take on tasks that they aren't fully comfortable with, and pushes them to get out of their comfort zone, so they can increase their competence.

4.3.2 Ways of Working

MME ST Shanghai have a more structured way of working, than their twin office at Lindholmen. They work more actively with Lean and Agile ways of working. They have a Backlog that is controlled by the OPO. When they started using a Backlog a year ago, the OPO simply handed out tasks to the teams and they were unaware of what tasks were being performed at MME ST Lindholmen. Today the two sites share a Backlog, so it isn't a problem anymore. Currently, the Scrum Masters of the two teams discusses what each team should do and divide the tasks between them. The team members are able to choose any task they want, according to interest, as long as they run it by the Scrum Master first. This gives the Scrum Master the opportunity to push the team members to take on tasks they aren't comfortable with, to increase competence. The Scrum Master also encourages the teams to learn new technology and asks MME ST Lindholmen for help if they have different competences.

The section has Daily Scrums in the morning as well as weekly meetings for synchronization with the Lindholmen site. The Daily Scrums are 15 minutes, which some feel is too short. They use the meeting to track the process and share problems that appear. It is a chance for team members to communicate what they have done and what they will be doing. The section also works with Sprints. Each Sprint is four weeks and involves, Sprint Planning and Sprint Retrospective where the team discusses what went well, what can be improved and receive feedback from the Scrum Master and OPO. They also do Sprint Reviews every two or three Sprints. They don't do Sprint Demos because they feel like it isn't applicable on System Test teams.

The section also work with Kanban, using both virtual and physical Kanban boards. They have previously worked with Scrum on its own, but feel like Kanban is an easy way to track their progress and are glad they made the change. The negative aspect of Kanban according to one of the interviewees is that it isn't suitable for a process with deadlines, and that is why they mix Scrum and Kanban. It is notable that another interview feel like Scrum is difficult because system test doesn't have a clear target. They do however agree that working with Kanban has made it possible to make more frequent releases.

The section isn't fully mature in Lean and Agile ways of working. One interviewee felt like the team members do not understand that Lean and Agile is more of a culture than a way of working, and think it is only a guideline on how to do their tasks. The general opinion at the section however, is that they feel like they are very aware of how to work by Lean and Agile ways. When they started working in Agile ways five years ago, the Line Manager who was interviewed ran basic training for the section to get them to fully commit. He felt like it was difficult and that there is still a lot of room for improvement. Another interviewee mentioned that the section is probably not as Agile as they think they are. Even though the section shares

the same knowledge and training, and understand the important key principles, they have a different understanding of how to use it in their daily work. One idea by an interviewee is to hire an Agile coach to help them realize what they are missing in their daily work.

The interviewees presented some ideas that can improve productivity and daily work at the section. One of the Scrum Masters feels very strongly that it should be the Scrum Master's responsibility to look after the team members' feelings and relationships, saying:

"I think team member relationship is very important. If someone doesn't like someone and they are in the same team, they will not feel comfortable and maybe they will not support each other. It will affect the team's progress and competence level."

By encouraging the team members to share their opinion and creating a safe space, a more pleasant environment will be created where innovation is encouraged and daily work will run more smoothly. It is also important to always think about how to improve teams. The interviewees also feel like the Lean and Agile ways of working always should be adapted to the company and situation. The same ways of working are rarely suitable for different teams.

4.4 The current state at EPG ST Shanghai

The current state at EPG ST Shanghai describes how the section chooses to work with teams and their ways of working.

4.4.1 Teams

EPG ST Shanghai has two system test teams in house and two system test teams off-shore. The teams in house consist of five to six people and the teams off-shore consist of six to seven, see figure 16. Every team has a Scrum Master who has a coaching team leader role. The OPO controls the Backlog and prioritizes the tasks that the team can pick from.

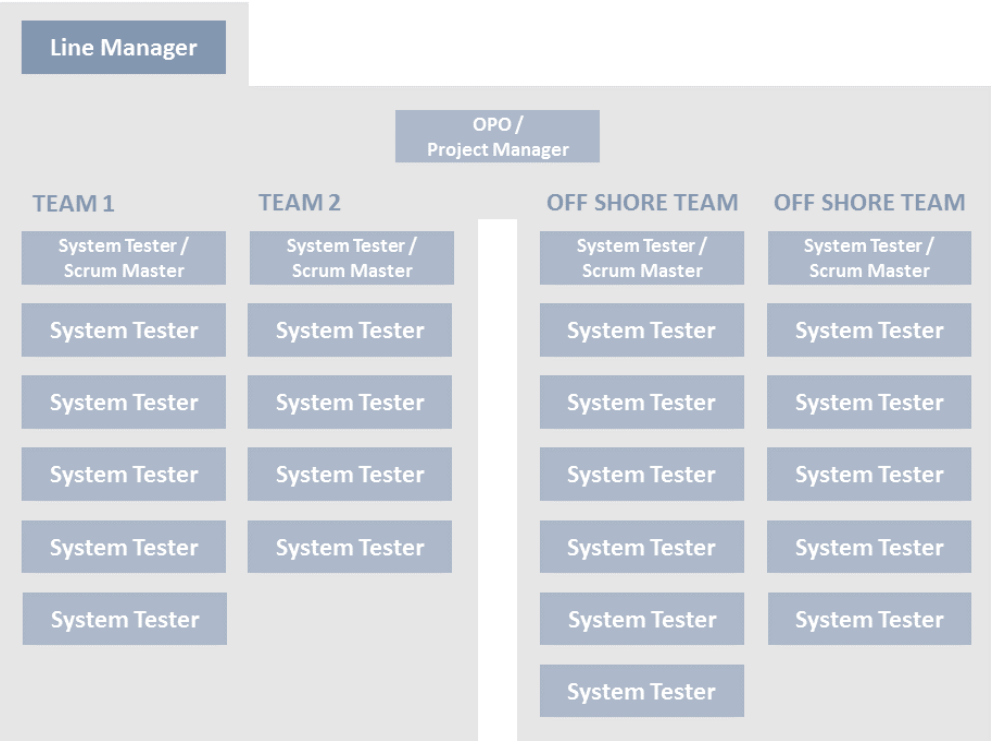

Figure 16. Organizational chart over EPG ST Shanghai. *The section has two teams in house as well as two teams off-shore. The section also consists of a Line Manager and an Operative Product Manager who is also referred to as a Project Manager.*

The team is set up by the Line Manager by looking at competence profiles. They strive to be as cross-functional as possible and want the team to be able to take on all tasks. Previously, the employees only had one main test area. Now they try to broaden the knowledge and want the employees to explore all test areas. The Scrum Master encourages the team members to take on challenges. One exception can be if someone has expertise knowledge in one area, then this person can work as a trouble-shooter. Otherwise the teams are diverse and consist of people with different backgrounds and experience. There are some team members who joined the team quite recently and therefore have less experience. The most experienced employee on the team have worked with system test for about eight years. The teams are permanent and the Line Manager tries to keep them as stable as possible. The exception is if a team member wants to change team or section because of for example personal development.

The Line Manager believes the team members have no problem of asking each other for help and the System Tester confirms this as well. They also describe the teams working methods as very similar since both of them use Scrum.

4.4.2 Ways of Working

EPG ST Shanghai employs Scrum and has Sprints of two weeks' iterations. Prior to each Sprint they have Sprint Planning, during the Sprint they have Daily Scrums and after each Sprint they perform Retrospective. The Project Manager says they have some adaptions and

aren't using full scale Scrum. For example, it is hard to perform Sprint Demos with pure testing teams.

Previously the teams at Lindholmen and Shanghai shared Backlog and picked tasks from the same Backlog in order to try to be more as one section instead of two separate ones. However, it was difficult to communicate enough, partly because of the time difference, and information could get lost on the way. Therefore, they decided to let the OPO at Lindholmen and Shanghai synchronize the Backlog together and divide the tasks between the sections in two section specific Backlogs. The OPO then prioritizes the tasks in the Shanghai Backlog and decides what should be done in the next Sprint and puts it in the Sprint Backlog. The Sprint Backlog is very clear and the team members picks tasks from it during the Sprint.

Sometimes unforeseen urgent tasks need to be fixed. These urgent tasks will deprioritize the other Sprint Backlog tasks that the team has committed to. The OPO will appoint the urgent task to one of the team members even though they're in the middle of a Sprint, which isn't according to Scrum. This results in the team being very work loaded. The Line Manager talks about this problem and thinks Kanban is better suited for urgent tasks than Scrum. He says:

"With the Scrum ways of working it's hard to get used to urgent tasks. Kanban is more suitable for that. Scrum is more static if the Sprint is committed. In this case, it is hard for the team and the OPO to get urgent tasks done."

However, they tried using a Kanban board for the urgent tasks and it didn't work out well. The team members forgot to look at the board regularly and didn't update it. The Kanban Board was a simple whiteboard and they have not tested a virtual Kanban Board yet. Today they reserve 20% of the workforce for urgent task in order to handle unforeseen problems.

In the beginning of a Sprint each team member commits to do a number of tasks during the Sprint. The Line Manager says this is very inflexible which means it isn't very Lean or Agile. For example, if someone is sick no one will do this person's work. He would like the team members to commit daily or every other day instead, in order to become more flexible and handle urgent tasks or other unpredictable needs. The Line Manager says:

"In our current ways of working each person commit to their own Sprint tasks in the beginning of the Sprint. This isn't very Agile I would say. For example, if someone is sick they can't finish their tasks. What I would like is for the team to commit daily or every two days to create flexibility to handle urgent tasks or needs within in the team."

The Line Manager doesn't think a solution is letting the team committing to the tasks as a whole team instead of individuals. He says the risk is that it becomes unclear who is responsible for what task and that tests will not be executed because one thinks someone else did it.

The Line Manager sees some problems with applying Scrum to a pure test team. He thinks the Sprint Demo is the most important ceremony in Scrum since it makes the team feel they have achieved something. It makes them understand the business value they've contributed with by the delivery they made. A pure testing team doesn't perform Sprint Demos which makes it more difficult for the team to feel like they have accomplished something. The Line Manager believes the team needs to feel like they achieved something in order to stay motivated.

In each team, they share small knowledge mouth-to-mouth since they sit close to each other. Bi-weekly they have Retrospectives where they discuss what they have learnt and what they can improve until the next Sprint. They also have knowledge sharing with EPG ST Lindholmen through Technical Forum, a skype meeting for System Testers where they can exchange experiences.

The System Tester believes they need more cooperation with teams upstream. If teams earlier in the stream send products that aren't sufficiently thorough it will be a lot of work for the System Test teams, which are the last step before release to customer. It might seem like the previous teams in the chain are effective but they only push the problems to the final team. The System Tester thinks the earlier teams should do more quality check before sending the product, this way the System Test teams could focus more on their tests and the efficiency would improve a lot.

Every year they run the basic Agile training and all new employees execute the basic Lean and Agile courses. The employees can do additional online courses and the Line Manager can assign training if needed, which means most team members have at least basic knowledge in Lean and Agile principles. The Line Manager says that it's not easy and a lot of time is required to change people's mind-set. The OPO adds that many employees only do Lean and Agile because the company promotes it and that many don't agree on pure Lean and Agile. He believes the high-level managers must adapt the Lean and Agile methods to fit Ericsson prior to promoting it to the rest of the company. He says they focus too much on the process and not the result and need to find a balance between the two.

5. Discussion and conclusion

Discussion and conclusion presents the result of the study as well as recommendations for the company.

5.1 Team set up

This section of the study discusses the differences between the team set up at the four sites, as well as their team set up compared to theory. The section also presents a recommendation of how the sites should work with team set up.

5.1.1 Differences in team set up between sections

The Line Manager of each section is the person who employs new team members and puts the teams together. All the sections have in common that they strive to have cross functional teams and also that the teams are similar to each other in terms of competence, to enable any team to take on any task. MME ST Lindholmen, who doesn't currently work with teams, share the same mind set and would apply it if they had teams.

What separates the sections the most regarding team set up, is the fact that MME ST Lindholmen doesn't work with teams at all. The section is loosely divided into groups according to what task is being performed, but there are no official teams. The other sections however are very similar in number of teams and number of team members. Each of the other three sections consists of two in house teams. The teams at MME ST Shanghai consist of six and seven team members, EPG ST Lindholmen have seven team members in each and the teams at EPG ST Shanghai consist of five and six team members respectively. Another thing that the sections have in common is that the teams are permanent. All of the sections agree that it is profitable if a team is as permanent as possible, so they can grow together and maintain a high level of efficiency.

MME ST Lindholmen also differs from the other sections because of its stable employees. The team is a very mature group, with the average time spent at the section around a decade, and some employees have up to 20 years of experience. The EPG ST Lindholmen teams are experienced up to twelve years and the Shanghai teams are even lower in experience with teams that have worked at the sections for around five years. The difference is said to exist because of culture changes between Sweden and China, where the Chinese are more likely to change jobs sooner, to learn as much as possible. Because of this the Shanghai teams aren't as high in competence as their Swedish counterparts.

This affects how autonomous the teams are. MME ST Lindholmen consider themselves to be highly autonomous and do not feel like they need any form of controlling. The other sections however feel like they need guidance and controlling, even if team members at MME ST Shanghai for example consider themselves to be somewhat independent.

Communication within the teams is generally good. All sections agree that they strive towards an open climate where team members can ask each other for help. Communication is easy since all teams sit close together in open office environments. The general opinion is that the sections all feel like they have good and open communication. The exception is one interviewee at EPG ST Lindholmen who feels like it is common for the team members not to communicate with each other, and that it varies from person to person if they communicate well. However it is important to note that the other interviewees from this section do not feel the same way.

5.1.2 Comparison between theory and the current state

Three of the sections work with cross-functional teams. The fourth, MME ST Lindholmen, who doesn't work with teams, agree that if they were to reorganize the section into teams, the teams would preferably be cross-functional. Working with cross-functional teams is beneficial, and can be a competitive advantage for an organization (Parker, 2003). Cross-functional teams are faster at performing their tasks, better at solving complex tasks, able to focus resources on meeting customer needs, their diversity leads to creativity and they can learn from each other. In extension, this leads to a higher level of efficiency. Cross-functional teams are also advocated by Scrum, which believes that completing competences within the team makes it easier to reach goals (Scrum.org, 2017).

The three sections who work with teams, MME ST Shanghai, EPG ST Lindholmen and EPG ST Shanghai, are optimized in terms of team size. According to Miller (1956) teams should ideally exist of seven team members, plus minus two, which is the case for all of the teams, since team sizes currently range from five to seven. MME ST Lindholmen however doesn't follow this rule. If the section is considered to be one team, its 17 team members create a team that is too large. Teams that are larger than eight members are recommended to split into two teams (Miller, 1956), since large teams are difficult to manage and require too much coordination (Scrum.org, 2017). Reorganizing into teams can also benefit the section in other ways, since it improves quality of work life for employees as well as productivity (Glassop, 2002). Team structures create joint responsibility as well as individual responsibility, which leads to a higher level of performance (Katzenbach and Smith, 1993). According to Buchholz and Roth (1987), joint responsibility is one of the eight main characteristics of high performing teams. This is also notable since one interviewee at EPG ST Lindholmen mentioned that the team members often work as individuals and do not feel joint responsibility. This is only one person's opinion, but since it is the opinion of the OPO it can be assumed that the opinion is correct.

The four sections are unanimous in trying to keep their teams as permanent as possible, which is positive. Replacing and adding members to a team reduces productivity that has been built up by the team (Schwaber, 2001). Because of this aspect, the Lindholmen sections have an advantage towards their counterparts in Shanghai, because of cultural differences that makes team members in Shanghai more likely to leave the team.

Permanent teams lead to maturity within the group, which is closely associated with the group's efficiency (Bruzelius and Skärvad, 2011). The development process for a group to reach maturity are commonly divided into five development stages, referred to as "forming", "storming", "norming", "performing" and "adjourning" (Tuckman, 1965). The desired stage to be in is the performing stage, where team members have found their respective role and the team is united and effective. To reach this stage, the teams must go through the previous three stages, which are associated with insecurity, caution and conflict, all of which inhibit efficiency. Replacing or adding team members leads to the team going through the phases more frequently, which in turn reduces efficiency. This is especially an issue at the sections in Shanghai, where the teams are less permanent. Because of this, it is of importance to motivate the team members to remain in the team. According to the job characteristics model by Hackman and Oldham (1976) absenteeism and turnover can be decreased by increasing the five core characteristics of the job; skill variety, task identity, task significance, autonomy and feedback.

At EPG ST Lindholmen it was mentioned that one reason for employee turnover is the skill variety. System test tasks are quite repetitive which causes team members to leave and seek new challenges. However, the sections strive to decrease this issue by encouraging team members to learn new skills. A broader competence opens up for the opportunity to take on more varied tasks. The degree of task identity can be considered as relatively permanent, since system testers test the product as a whole, and doesn't have a task that is just one small fragment of the whole picture. How significant the task is for an employee is very individual, but since the system test is the final stage of the finished product, it can be assumed that the System Tester is very aware that it is the final stage before the product release, and that the stage is crucial. It is also safe to assume that the system testers are aware of what the product does, and the impact it has on its customers. MME ST Shanghai is the only section that has Sprint Review meetings, where the market and customer needs are discussed. Feedback is currently available at several different levels, in the shape of Daily Scrums at all of the sections except MME ST Lindholmen, Sprint Reviews at MME ST Shanghai and Retrospective meetings or Sprint Retrospective meetings at all sections.

Autonomy is also important as the final characteristic in the model by Hackman and Oldham (1976). MME ST Lindholmen is currently the only section that considers themselves to be highly autonomous. MME ST Shanghai consider themselves to be somewhat independent but feel like they still need some guidance. EPG ST Lindholmen and EPG ST Shanghai agree that they need guidance and controlling to perform well. Autonomous groups are advocated by many since they increase democracy in the workplace as well as the quality of life at the workplace (Bruzelius and Skärvad, 2011). However, it is important to note that they are only effective in the right conditions. Autonomous groups aren't successful if the group doesn't contain the right competence, enough motivation or a clear overview of the task.

Another factor that affects the team's ability to perform is communication. Characteristics of effective groups include the right competence within the group, a clear objective and open, honest communication (Bruzelius and Skärvad, 2011). It is of importance that team members

accept each other's differences, listen to each other and that power struggles do not occur. Buchholz and Roth (1987) also mention open and intense communication as one of the eight characteristics that are typical for high performing teams. The sections currently have an open climate and they all agree that it is easy to ask for help if needed. One interviewee from EPG ST Lindholmen feels like the team members aren't always good at communication, and work as individuals as opposed to teams. However, the other interviewees at that sections do not feel that way. Another thing the sections have in common is the open office environment where the team members sit close to each other. According to Scrum the working environment must be open and the members close together to simplify communication and collaboration skills (Schwaber, 2001).

5.1.3 Recommended team set up

It is obvious that the team set up at Ericsson system test MME and EPG is well connected to a lot of theoretical models on team set up. The sections are unanimous in working with cross-functional teams, which is profitable to increase efficiency (Parker, 2003). Since they are also working by Scrum, the teams should be cross-functional to follow Scrum guidelines. Scrum advocates cross-functional teams since they make it easier to reach goals. (Schwaber, 2001).

The teams are generally also optimized in terms of team size. A team should ideally exist of seven team members, plus minus two (Miller, 1956) and if the sections are interested in following Scrum guidelines, they should not have teams with more than eight team members, since they are difficult to manage and require too much coordination (Scrum.org, 2017). The teams at MME ST Shanghai, EPG ST Lindholmen and EPG ST Shanghai are currently within the range of the optimal theoretical team size, and it is recommended that they stay that way. MME ST Lindholmen can currently be considered as one big team of 17 team members, which isn't recommended. The team members are very mature, autonomous and high in competence at the section, which is why they feel like teams aren't necessary. Some team members prefer to have the task create the team, instead of teams being appointed a task. They are also concerned that teams could go in their own direction, and reduce the general team feeling that is currently present and that includes everyone.

However, the negative aspects mentioned by team members doesn't seem to outweigh the positive aspects that can come from teams. Team structures generally improve quality of work life for employees as well as increasing productivity (Glassop, 2002). Reorganizing into teams, creates joint responsibility for the teams as well increasing the feeling of individual responsibility, leading to a higher level of performance and productivity (Katzenbach and Smith, 1993). Interviews with members of the section also showed that some employees view reorganizing into teams as something positive. It is believed that being in a team can improve motivation, as well as making it easier to employ new team members, since it is known which type of person and competence is missing.

Since MME ST Lindholmen currently is very autonomous and high in competence, creating a team structure may not be necessary, however it would not do any harm either, and teams

would be beneficial in the long run. The composition of employees at the section will eventually change, and employees that aren't as highly competent will benefit from team structures. One opinion from the section is that it would be easier for new employees to learn their new task if they had support from a team. Therefore, we recommend reorganizing into teams.

One interviewee was however hesitant towards reorganizing and feels like the section is eager to question new ways of working, and needs it to be well motivated. For an implementation of new ways of working to be successful, it is important for the team members to have continuous pressure from management, otherwise they are likely to slip back into their old ways. This aspect is important to remember for the implementation to be successful.

In terms of permanent teams, MME ST Lindholmen has an advantage towards the other sections. All sections strive towards permanent teams, but MME ST Lindholmen has succeeded in a way that the others have not. That is however only true if you consider the sections as one big team. They have created a permanent team in their own way, even if they don't follow theoretical frameworks in the same way as the other sections. One of the main reasons behind the more permanent team at MME ST Lindholmen, seems to be cultural differences, since several of the interviewees mentioned that the Chinese are more likely to change jobs sooner than their Swedish counterparts. According to the interviewees, the turnover at the sections in Shanghai is lower than China in general and they are happy with how long their team members choose to stay. The other reason explaining MME ST Lindholmen's maturity is the fact that the MME is an older product than the EPG.

Even if the teams are quite permanent, it is always a good idea to try and motivate team members and increase permanency. Over time, a permanent team builds up productivity and replacing or adding members reduces that productivity (Schwaber, 2001). Because of this, it is important to continuously motivate team members, since increasing internal motivation decreases absenteeism and turnover (Hackman and Oldham, 1976). The key factors that seem to be able to increase internal motivation is the skill variety, feedback and autonomy. A low degree of skill variety was mentioned as a reason for high turnover at EPG ST Lindholmen and is assumed to be applicable on the other sections as well. It is important to continuously push team members to improve their competence by taking on tasks they aren't completely comfortable with. This will lead to work being less monotonous, as well as the feeling of having useful skills that are appreciated.

Team members can also be motivated by feedback. Feedback currently exists in the shape of Retrospective meetings at all sections, Daily Scrums at all sections except for at MME ST Lindholmen, as well as Sprint Review meetings at MME ST Shanghai. It is important to make room for feedback at the meetings. One interviewee at MME ST Shanghai mentioned that Daily Scrums sometimes can be too short, and that there isn't time for everything that should be covered at the meetings. It is important to prioritize feedback for the sake of the team members psychological state. Feedback on the outcome and effect of the task will lead to higher internal motivation as well as higher quality of work (Hackman and Oldham, 1976).

A higher degree of internal motivation can also be achieved by autonomy, since autonomy leads to a feeling of responsibility for outcomes (Hackman and Oldham, 1976). It is desirable that the sections strive towards autonomy, but it doesn't happen overnight. MME ST Lindholmen consider themselves to be autonomous, while the others feel that they need a certain amount of guidance and controlling. It can be assumed that the reason behind this is because of the maturity and competence within the sections. Autonomous teams aren't successful unless they contain the right competence, enough motivation, and a clear overview of the task (Bruzelius and Skärvad, 2011). It seems as if the other sections currently do not meet the requirements, but it is something to strive towards. All factors are affected by experience, and if motivation can be increased in other ways, it will decrease turnover and in turn teams will gain experience and be able to increase their autonomy.

Good communication within the team is a key characteristic for high performing teams (Buchholz and Roth, 1987). Even if the general view is that communication is good within the teams, it is mentioned by one interviewee at EPG ST Lindholmen that even if they are officially a team, they work individually. It is good that all sections have open office environments where the team members sit close together. This simplifies communication and makes it easier to collaborate. However, since one interviewee mentions that a sense of team isn't always apparent, it is one important aspect to focus on. It is recommended to make room for teambuilding exercises and careful consideration of what it is that leads to team members working individually as opposed to a team.

5.2 Ways of Working

This section of the study discusses the differences between ways of working at the four sites, as well as their ways of working compared to the theoretical framework. The section also presents a recommendation of future ways of working.

5.2.1 Differences in Ways of Working between sections

Table 1. Comparison in ways of working. *The ways of working that are implemented at the sections are marked with green checks. A red cross signal that it isn't currently implemented.*

	MME ST Lindholmen	MME ST Shanghai	EPG ST Lindholmen	EPG ST Shanghai
Operative Product Owner	×	✓	✓	✓
Technical Test Coordinator	✓	×	×	×
Scrum Master	×	✓	✓	✓
Product Backlog	✓	✓	✓	✓
Sprint	×	✓	✓	✓
Sprint Backlog	×	✓	×	✓
Sprint Planning	×	✓	×	✓
Sprint Review	×	✓	×	×
Sprint Demo	✓	×	×	×
Sprint Retrospective	✓	✓	✓	✓
Daily Scrum	×	✓	✓	✓
Weekly Synchronize Meeting	✓	✓	✓	✓
Kanban	✓	✓	✓	×

There are both similarities and differences in the ways of working between the four sections, see table 1. All sections have Product Backlogs and synchronize with the twin office at least once a week. The teams within the same section all share the same ways of working. Moreover, every section agrees that Scrum is better suited for development teams than system test teams.

The interviews revealed a number of common issues all the sections shared. They all believe that most employees lack deeper understanding of Lean and Agile principles. The teams apply it only because the company promotes it and many employees aren't convinced it is the right solution for them. Also, many see Lean and Agile principles as a number of methods and lack the mind-set according to the interviewees. However, MME ST Lindholmen aren't convinced this is a problem since they deliver on time.

Further on, all sections mention that they are too resource optimized and not enough flow oriented. An additional problem, related to the resource optimization, is the difficulty of handling unforeseen urgent tasks. This results in a very uneven workload.

MME ST Lindholmen lacks many ceremonies and roles that the other sections have. Their section is the only one that doesn't have Daily Scrums or Scrum Masters. Instead of an OPO they have a TTC (Technical Test Coordinator) which basically have the same function as the other OPO at other sections. Also, they don't work in Sprints, which all of the other sections do to some extent. Moreover, MME ST Lindholmen employs some elements of Kanban, which most of the other sections do as well. Unlike the other sections, MME ST Lindholmen performs Demos. The remaining three sections believe Demos aren't applicable on system test, which MME ST Lindholmen doesn't agree with. When comparing MME ST Lindholmen to the other sections the conclusion is that the employees operate more freely and aren't as

controlled by ceremonies, roles or other frameworks. This is possible because of the group's many years of experience and maturity, which the other sections lack.

EPG ST Lindholmen has more ceremonies and frameworks than MME ST Lindholmen. They have a Scrum Master in each team, Daily Scrums and work in Sprints regarding competence work, which MME ST Lindholmen lacks. However, EPG ST Lindholmen has less ceremonies and frameworks compared to the Shanghai sections. Both sections in Shanghai employs Sprints not only for competence work, but for test cases as well. EPG ST Lindholmen employs Kanban which MME ST Lindholmen and MME ST Shanghai also do.

MME ST Shanghai is the section which applies the most ceremonies and roles among the four sections. They perform all ceremonies except Sprint Demo, which they believe isn't applicable on system test, just as EPG ST Lindholmen and EPG ST Shanghai also believes. Their Sprints are four weeks which differs from MME ST Shanghai's Sprints with the length of two weeks. MME ST Shanghai utilize Kanban more than MME ST Lindholmen and EPG ST Lindholmen, having both a virtual and a classic Kanban board that are frequently used.

EPG ST Shanghai's ways of working are similar to MME ST Shanghai. However, they do not use Kanban or perform Sprint Review. As mentioned before the length of the Sprint differs as well, EPG ST Shanghai having only two week Sprints. However, the Line Manager mentions he would like the team members to commit daily or every other day instead, in order to become more flexible and handle urgent tasks or other unpredictable needs. Notable is also that EPG ST Shanghai is the only section among the four that doesn't employ Kanban.

The Shanghai sections are more focused on Scrum than the Lindholmen sections. Which test cases should be executed when and in which Sprint is strictly decided in Shanghai. Since Lindholmen doesn't apply Sprints, which test case should be executed when is more flexible.

5.2.2 Comparison between theory and the current state

As mentioned in earlier paragraphs to what scale the sections work with Scrum differs. However, none of the sections fully applies Scrum according to the theoretical framework. MME ST Lindholmen is the section that deviates the most from Scrum. Compared to the theory of Scrum, MME ST Lindholmen lacks almost all ceremonies and roles. They only perform Retrospectives and Demos. However, they do have Technical Test Coordinators which basically have the same function as an OPO. EPG ST Lindholmen also deviates from the theory of Scrum, using Sprints only for competence and improvement tasks and not for testing. Since they don't work in Sprints they haven't implemented any Sprint related ceremonies such as Sprint Planning, Sprint Backlog or Sprint Demo. However, they do follow Scrum by having an OPO, Scrum Masters and performing Retrospectives and Daily Scrums. MME ST Shanghai and EPG ST Shanghai work close to the theory of Scrum. They have all Scrum roles and ceremonies, except for Sprint Demos. The length of the Sprints is two and four weeks respectively, which is recommended in Scrum (Schwaber, 2001).

According to Scrum, once the team has initiated a Sprint they aren't allowed to be interrupted by new tasks they haven't committed to already (Schwaber, 2001). None of the sections obey this rule. When an urgent and unforeseen task appears the tasks that the team has committed to are deprioritized, even though the team is in the middle of a Sprint. In order to be full scale Scrum the team would have to wait with the urgent task until the next Sprint (Olausson et. al., 2013).

All sections except EPG ST Shanghai employs Kanban to some degree. MME ST Lindholmen only employs some small elements of Kanban. However, they don't have a Kanban board, which makes it doubtful if you can really say that they are using Kanban. EPG ST Lindholmen on the other hand do have a Kanban board, however the employees don't utilize it as much as they could. MME ST Shanghai also employs a Kanban board.

In order to manage the flow and visualize bottlenecks, all columns on a Kanban board should have WIP-limits (Anderson, 2010). EPG ST Lindholmen and MME ST Shanghai don't use WIP-limits on their boards. Furthermore, Anderson (2010) promotes a common understanding and opinions of theories of workflow, which most team members have from shared educations. Even though the employees share the basic knowledge, some lack a deeper understanding.

For teams located globally, virtual Kanban boards are essential (Anderson, 2010). EPG ST Lindholmen do have a virtual Kanban board, however it isn't fully utilized by the employees. Moreover, since EPG ST Shanghai doesn't employ Kanban, EPG ST Lindholmen can't synchronize their board with them. Since MME ST Lindholmen doesn't have a Kanban board, MME ST Shanghai can't synchronize their virtual board with them.

Through the interviews it became clear that most employees in all four sections lack deeper understanding and mind-set of Lean and Agile principles. Some apply it only because the company promotes it and don't believe it is adapted to fit their needs and culture. Especially at MME ST Lindholmen they do not think that management has sufficient reasons for why changes should be introduced. Bruzelius and Skärvad (2011) writes that a change should never be perceived as a change for the sake of change, which seem to be the case at MME ST Lindholmen. It is vital that the change is reviewed and implemented thoroughly.

5.2.3 Recommended Ways of Working

Scrum was developed to fit development teams. The system test teams work differs a lot from the developments. The development teams constantly have different, new projects and work with a clear period of time with a start and an end. System test teams on the other hand perform the same tests repeatedly and don't have to update themselves on customer needs as much. Therefore, Scrum isn't fully applicable on system test, which most employees agree with. Moreover, Scrum isn't suited for handling unexpected tasks since the team isn't allowed to be interrupted once a Sprint is initiated. Let's say EPG ST Shanghai, who employs a four

week Sprint, is in their first week of a Sprint and receive an urgent task. According to Scrum the team would have to wait three weeks until they could even start solving the urgent task.

Scrum comes with a set of ceremonies and roles. This can be an advantage since it can contribute with support and increased efficiency if used the right way. Overall, EPG ST Shanghai and MME ST Shanghai have less experienced employees and higher turnover, and therefore need more support through ceremonies and roles. However strict ceremonies and roles could also be a disadvantage if it leads to the teams being too controlled. If the team is used to managing on its own, roles and ceremonies might not be as necessary and therefore meet resistance. Since the team at MME ST Lindholmen has high maturity and great knowledge in their work they manage well despite the lack of ceremonies and roles. However, they might be even more effective if they added some ceremonies or roles. Moreover, if the experienced quit and the section need to hire new system testers, it might be tough for the new team members without the support of roles and ceremonies.

The views on whether Sprint Demo is applicable on system test or not differs between the sections. EPG ST Lindholmen, EPG ST Shanghai and MME ST Shanghai believe Sprint Demo isn't suited for system test. The system test teams perform the same tests over and over again and therefore don't feel like they have anything to demonstrate. However, the Line Manager of EPG ST Shanghai sees the Sprint Demo as one of the most important ceremonies of Scrums, since it makes the team feel like they've accomplished something which leads to increased motivation. He would like to implement Sprint Demo if he thought it was possible. In contrast to the other three sections MME ST Lindholmen performs Demos and sees no problem with applying it on system test. Since Sprint Demos can increase motivation and therefore also efficiency, it could be a good idea for the sections not performing Sprint Demo to discuss with MME ST Lindholmen on how to apply it on system test.

To what extent Kanban is used could improve among MME ST Lindholmen, EPG ST Lindholmen and MME ST Shanghai. They could both benefit from using a board and visualizing the workflow. Visualizing the workflow will reveal bottlenecks and problems which stimulates continuous improvement. Moreover, none of the three sections have set any WIP-limits, which according to Anderson (2010) is a mistake. Setting WIP-limits will reveal bottlenecks additionally and force the team to improve the process. Teams that implement WIP-limits deliver frequent, high quality result and increased efficiency (Anderson, 2010). In opposition, teams with no WIP-limit only achieve limited success and improvement. Therefore, it is recommended for MME ST Lindholmen and EPG ST Lindholmen to utilize the concept of the board more and set WIP-limits.

Since the teams are situated at different geographical locations, virtual Kanban boards could support the synchronization and communication between the twin sections. For this to be possible between the EPG ST sections, EPG ST Shanghai will have to start with implementing Kanban. They previously tried to implement Kanban but had problems with keeping the board updated and with employees not checking the board regularly. However, they believe they could benefit from implementing Kanban. A virtual Kanban board will

solve the problem of keeping the board updated and will make it easier for the employees to check the board, as it is available on their computers. An additional reason to utilize the virtual Kanban boards is that it enables tracking and data gathering. This is crucial for analysing processes and past periods to find possible improvements. Teams aiming for higher levels of organizational maturity are highly recommended to use electronic tracking (Anderson, 2010). Because of the increased communication possibilities and allowing of tracking data it is believed that all sections employing Kanban would profit from utilizing virtual boards.

All sections believe Kanban is better suited for managing urgent tasks than Scrum since Scrum doesn't allow the teams to get interrupted once a Sprint is initiated. Besides Kanban offers a way to deal with unexpected tasks by creating an expedite lane reserved for highly urgent tasks to flow through. This lane has a WIP-limit forcing upstream sections to keep the number of expedite requests at minimum. This will stimulate improvement at upstream sections. Both EPG ST Shanghai and MME ST Lindholmen mentions that they believe they need more cooperation with teams upstream. Therefore, implementing WIP limits will help improve communication between the system test sections and upstream sections and is an option on how to handle expedite tasks.

A disadvantage of Kanban is that it isn't made to meet deadlines, which they currently have at the system test sections. This is one of the main reasons the Shanghai sections employ Sprints. On the other hand, EPG ST Lindholmen mentions that they would like to be more flow efficient and deliver the product when it's ready and not according to a deadline. If this is the case then pure Kanban shouldn't be a problem in the future.

All sections agree that they are too resource efficient and not enough flow efficient. If someone is sick or if an unforeseen, urgent task appears they have trouble handling it because of the lack of resources. Modig and Åhlström (2013) writes that being very resource efficient leads to a low flow efficiency. The throughput time increases and customer focus decreases. This can result in missed opportunities. Furthermore, high resource efficiency tends to have many units in flow, which leads to stress and mistakes among employees due to handling too many tasks at once. Some employees mentioned they would like to have a buffer of resources enabling them to be more flow efficient. Adding resources can be costly, however in the long run they might profit from it. If they meet customer needs rapidly, it can lead to increased market share and income. Therefore, Ericsson should consider looking into if they should invest in more resources or if the flow is efficient enough. In addition to increasing resources, reduced variation also leads to higher flow efficiency. At the system test sections unforeseen, urgent tasks is what causes variation and should therefore be avoided. By decreasing the number of urgent tasks the flow will improve without having to add resources. However, it might be the high resource efficiency that causes upstream employees to request urgent tasks, which will make it difficult to reduce urgent tasks and increase flow without adding any resources

Many employees lack deeper understanding of Lean and Agile principles and some only follow them because it is promoted by the company. Some perceive it as a “change for the sake of change” and don’t believe it is adapted to the organization's needs and situation. This should never be the case according to Bruzelius and Skärvad (2011). Management needs to motivate the change and find a way to adapt it to Ericsson in order to convince employees that it will make a positive contribution. The implementation of Lean and Agile principles must be reviewed and presented thoroughly. Management needs to visibly support the implementation and have more personal and direct communication with employees, even though this can be difficult in a large company as Ericsson. Management can take advantage of the resistance by taking inputs from the employees on what can be improved. Furthermore, it is important to understand that change takes time and effort, especially in the beginning.

5.3 Conclusion

The team set up is over all well connected to theoretical models and doesn’t need to change drastically, however, there are some factors that could increase team efficiency. It is recommended that MME ST Lindholmen carefully considers reorganizing the section into teams. Even if it doesn’t currently seem necessary, it will benefit the section in the long run. To further increase efficiency, motivation seems to be a key factor. Three areas have been identified that can increase motivation; skill variety, feedback and autonomy. It is believed that by investigating those areas, motivation can increase as well as efficiency and quality of work life. It is also of importance to increase team feeling at the sections and shift responsibility from individuals to teams.

Neither Scrum or Kanban match system test perfectly, however together Scrum and Kanban can complement each other. Scrum makes it possible to meet deadlines and can add ceremonies and roles that support the work. Kanban can manage urgent tasks, works well without time boxes and helps visualizing the workflow. Therefore, a combination of the two is recommended. How strictly the sections should follow each approach depends on the maturity and culture of the section. However, since all sections only work with Kanban to some extent, or not at all, it is believed all sections would benefit from following the Kanban approach more than they currently do. Furthermore, the low support among employees for Lean and Agile principles is something Ericsson should work on improving. Moreover, an evaluation to see if the sections are too resource optimized and if the flow efficiency can improve should be considered.

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Appendix 1 - Interview questions

- What is your title?
- What are your daily work tasks?
- What section do you work in?
- How many teams are in your section and how many people are in each team?
- In what way is the team controlled?
- How autonomous is your team?
- How does the work methods differ between teams in your sections?
- How is the team put together?
- Is the team set up permanent or is it temporary?
- What does the competence generally look like in the team?
- Do you feel like you have a good overview of what the rest of your team is working with, and if they have any difficulties?
- What do you think about the work environment?
- How much do you consider to knows about Lean and Agile ways of working?
- What is your opinion on Lean and Agile ways of working?
- How much do you think your team knows about Lean and Agile ways of working?
- Do you think it is possible to become more Lean and Agile in your section?
- Do you think today's arrangements works well?
- Do you have any other comments or additions?

Appendix 2 - Web poll questions

- Name (Optional)
- Title
- Section
- Are you located in Shanghai or Lindholmen?
- Are you a part of a team, and in that case what team?
- What size is your team?
- How does the team set up work at your department and what are your thoughts on it? Name one positive aspect and one negative.
- Do you have a team internal Scrum Master, a team external Scrum Master or no Scrum Master at all?
- How much do you consider yourself to know about Lean and Agile principles?
- Do you think it is possible to apply Lean and Agile principles on your department? Why or why not?
- Do you think today's set up works well? (The current team composition and ways of working)
- Other comments and additions.
- Are you interested in participating in a more detailed in-person interview? If yes, please leave your e-mail below.