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Assessing the use of agile principles in a manufacturing factory

A case study of white-collar departments at ABB

Master's Thesis in the Master's Programme Management and Economics of Innovation

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Preface

This article is a master thesis conducted with support from ABB and Chalmers. ABB has provided us with the necessary support to set up a viable master thesis as well as access to a factory to complete a case study. The research question was defined with support and input from both ABB and Chalmers.

We hope that this study is another step towards understanding how agile concepts successfully can be adopted in non-software environments. Moreover, we propose a categorization of agile principles suited to our case factory as a way to better understand how agile may fit into a manufacturing unit.

We want to thank Giada Baldessarelli at Chalmers division of Entrepreneurship and Strategy for supervising and guiding us from start to finish on our master thesis. We also want to thank everyone at the ABB factory together with Carl-Ove Kolmodin that have made this master thesis possible. Thank you for your openness, positive approach and warm welcome whenever we have visited the factory or reaching out to you.

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Abstract

This thesis investigates to what extent (and how well) a non-software manufacturing factory uses and benefits from software-originated concepts of agile management. Agile management aims to develop and deliver quickly and continuously solutions to customers. The concept of "agile management" (henceforth, agile) was developed at the beginning of the 21st century to tackle the difficulties and uncertainties of developing software in an increasingly uncertain and unstable business environment. Even though agile was originally designed for software development, today a variety of companies operating in other industries is trying to integrate agile.

This thesis uses a case study research design to investigate how (well) a company that is producing tangible goods adopts (or are able to adopt) the software-originated agile principles in order to reach their strategic goals. We researched theory on agile management frameworks, values and case studies, and focused on the 12 agile principles as a baseline to determine to what extent our case company is using agile. Through the analysis of interviews and observations, we found that our case company is implementing some of the agile principles with positive results. Some principles are found not to be applicable and others are identified as areas of improvement that the case company today has the potential to develop. We categorized the 12 principles into 4 categories to fit our case company. These categories are communication, teams, motivation, and processes. Insights from each category as well as overall recommendations are provided regarding possibilities to improve and fulfill the requirements for a successful implementation of the agile principles. By embracing the agile way of working within the four categories, we believe that the case factory easier will be able to reach their strategic goals.

Keywords: agile, agile principles, factory, communication, teams, motivation, processes, key performance indicators (KPIs), strategic goals, qualitative study

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Introduction

In this section, a brief background of agile development and applicability is presented followed by the purpose and aim of the study in the shape of a research question. A brief company- and factory description is presented together with definitions regarding strategy and finally the thesis delimitations.

Background

The agile management style is an emerging alternative to the otherwise traditional management style which originated in the 20th century. Agile management is explained by Denning (2017) as a *"team-based search for opportunities to achieve continuous customer-focused innovation as well as to find solutions through rapid experimentation and decisiveness"*, which is quite different to the traditional style of focusing on efficiency and planning (Denning, 2017). When large companies focused on economies of scale, command-and-control micromanagement with top-down bureaucracy in line with Taylorism and scientific management (Medinilla, 2012), innovation and flexibility were not favored. Grönroos (1994) argues that traditional scientific management principles remain present despite many trends (e.g., information technology, international competition, knowledge worker and new technology), but that it starts to decrease in effectiveness and fit. As the earlier stable and predictable industry environment started to erupt and become unpredictable, there was a need for a new kind of project management style which could cope with changes in the business environment.

For decades, software engineering was failing in their projects of meeting deadlines, budgets and quality codes, which were very apparent in the "Chaos reports" delivered by industry magazines (Medinilla, 2012, p. 30-40). While the majority of the responses were to plan more and estimate better beforehand, others started to successfully experiment in their project management styles. Drawing upon the successful project management as well as other sources such as lean production, the theory of constraints and complexity science, new methods and frameworks started to emerge, which in turn set the foundation for the agile manifesto created in 2001:

> "We are uncovering better ways of developing software by doing it and helping others do it.
> Through this work we have come to value:
>
> –**Individuals and interactions** over processes and tools
> –**Working software** over comprehensive documentation
> –**Customer collaboration** over contract negotiation
> –**Responding to change** over following a plan
>
> That is, while there is value in the items on the right, we value the items on the left more."
> –Manifesto for Agile Software Development (17 signatories)

As the agile manifesto is based on a software development environment, it is not designed for other types of industries. However, an agile working style is today being adopted in many industries as most companies face similar uncertainty with white-collar employees. With prominent frameworks such as SAFe, XP, Scrum, Kanban and Feature-Driven Development

(FDD), non-software companies have successfully implemented an agile way of working in their production (e.g., Volvo trucks, Saab Technologies). As for manufacturing companies, limited research has been made to investigate how and if agile management can be adopted in white-collar processes in a manufacturing company not conducting any software development. Looking at a manufacturing unit within a larger organization and how its white-collar workforce can adopt agile processes could provide insight into understanding how well agile processes may function outside the realm of software development.

Purpose

This report will research the adoption, and potential adoption, of agile concepts in a medium sized (80-150 employees) manufacturing factory. The aim of the report is to understand if and to what extent agile principles (that is derived from agile concepts) may be embraced in order to reach strategic goals.

Problem Analysis and Research Questions

The aim of this master thesis is to see to what extent a medium sized manufacturing company are and can adopt agile concepts in order to reach strategic goals. This will be done by answering the research question below:

To what extent (and how well) does a manufacturing company implement software-originated agile principles?

Case Company Description

ABB is a Swiss-Swedish technology leader focusing on robotics, automation, and electrification towards customers within utility, transport, infrastructure, and industry. ABB is today operating in over 100 countries with 147 000 employees with its main office in Zurich (ABB.com, 2019). ABB is a matrix organization, meaning that there are independent teams operating not just vertically in the organization, but horizontal within functional departments as well.

Today, ABB is working on transforming their large and complex organization to a modern flexible organization that will better handle the quick changes in our fast-paced world. One of the ways of doing so is to change managerial practices. Now ABB wants to know if and how they can reach their strategic goals by implementing a new agile management strategy in their factories.

In 2015, ABB launched the Next Level strategy program, which is a five-year program created to accelerate sustainable value creation for the company (abb.com, 2015a). The program is made up of three focus areas consisting of profitable growth, relentless execution, and business-lead collaboration. In 2016, ABB started stage two of the global transformational program consisting of more change programs instead of cost reductions and supply chain management in stage one. In stage two, the objectives within the relentless execution focus area were to make ABB a simpler, customer-focused and more agile organization (abb.com, 2015b).

As the structural change to an agile organization has been underway in ABB for a couple of years, different sites have made different levels of advancements in terms of completing the

agile change. One of ABB's factories where we had the opportunity to conduct our case study is now in the process of adopting an agile working style on top of their lean operational processes and would therefore like to benefit from an analysis consisting of defining the agile frameworks and how they best can implement agility into the organization.

The case study of which this thesis will be built upon will take place on an ABB manufacturing unit in Sweden. At the factory, there are about 110 people working at the site, whereas 30 are white-collar employees and 80 are blue-collar employees. In the management team, there is a representative from every department. The departments differ in size from one to seven employees. The departments at the factory are R&D, Quality, Supply chain management, Planning, Product development, Finance and HR. The factory is operating autonomously but follows strategic guidelines and code of conducts set by the global organization. They use support functions as well as cross-functional teams spanning over multiple factories, enabling economies of scale but also creates organizational complexity in their white-collar department.

Delimitations

This report will be limited by using the ABB factory as the focus area of the case study, with input from ABB employees outside the case factory to be used as benchmarks. Hence, the outcome of this report will mirror the conditions and characteristics of the case factory in Sweden. The study will also be limited to agile governance implementation on a white-collar level, and upwards. Furthermore, the agile manifesto will be used as the definition of agile.

This report will research how the management team and white-collar workers work internally at the ABB factory. Focus will not be on the interaction with the mother organization ABB, blue-collar workers, or teams and support functions from other parts of ABB. As described in the aim and purpose, the report will examine software-originated concepts of agile.

Theoretical Framework

In this chapter, we present theory to create a foundation to support our thesis with and to use when exploring the research question. In the theoretical framework, different parts of the agile concept are presented together with tools and concepts that are essential for our research and thesis. Initially, a short definition of the concept of agile is presented. Afterward, the theory will primarily be focusing on different levels of the agile concept, consisting of mindset, values, principles, practices and processes and tools. Finally, theoretical risks and advantages around agile are presented.

Agile Definition

To be able to work in a more agile way means that the company will have better dynamic capabilities, which according to Eisenhardt & Martin (2000) helps the company to be able to adapt better to the marketplace.

The agile way of working, and especially producing software, is not new. In fact, agile principles can be traced back to NASA's Mercury project from the 1960s (the project to send man up into space), having "time-boxed" activities similar to the ones used today in the agile framework of Extreme Programming practice (Wasson 2015). At this time, the way of working was simply an effective way of getting things done. Today, many people use the *Agile Manifesto* from 2001 as a pillar for the agile way of working. Moran (2015) argues instead that agile originated in the 1990s as a way to balance planning and control with feedback and execution. Moran continues to explain that a definition of agile is hard to construct but that the definition concerns products, people and processes while at the same time embodies four core elements (Moran, 2015):

- **Adaptive**: reacting to change
- **Value driven**: focusing on what creates value for the customer
- **Collaborative**: tacit knowledge-sharing by consensus-driven multi-disciplinary teams
- **Empowered**: increase self-organizing teams and inspirational servant-minded leaders

Laanti et al. (2013) argue that the definition of agile lies within the agile manifesto and principles (covered below), that gave rise to the non-profit organization Agile Alliance. The Agile Alliance defines agile as *"[…] the ability to create and respond to change. It is a way of dealing with, and ultimately succeeding in, an uncertain and turbulent environment"* (agilealliance.com, 2019). Laanti et el. However, argue the manifesto being "too vague" to be used as a scientific base. Conboy and Fitzgerald (2004) proposed another definition of agile being *"the ability of an entity to proactively, reactively or inherently embrace change in a timely manner, through its internal components and its relationships with its environment".* Although short definitions are easy to understand, Laanti et al. criticize Conboy and Fitzerald by stating that their definition only embraces the part of agile relating to embracing change. As agile is an entire concept with multiple layers, it is hard to capture the entire width and depth within a single definition. Therefore, going forward we will primarily use the values within the manifesto together with the 12 principles presented below and Moran's four core elements above. Next, the agile manifesto and principles are presented as part of understanding the concept of agile.

Agile Manifesto

The agile manifesto is an attempt to gather key values of agile development. The manifesto was co-written and signed by 17 agile developing experts in Utah in 2001 who together created the guidelines of what many people now use as a pillar for an agile way of working (Beck et al. 2001). The experts had prior experience in different types of agile frameworks, so during this meeting, they extracted key values essential for successful software development and created the agile manifesto. Hence, many agile frameworks (e.g., scrum, XP, and Kanban) have influenced the manifesto, which is presented in *figure 1*.

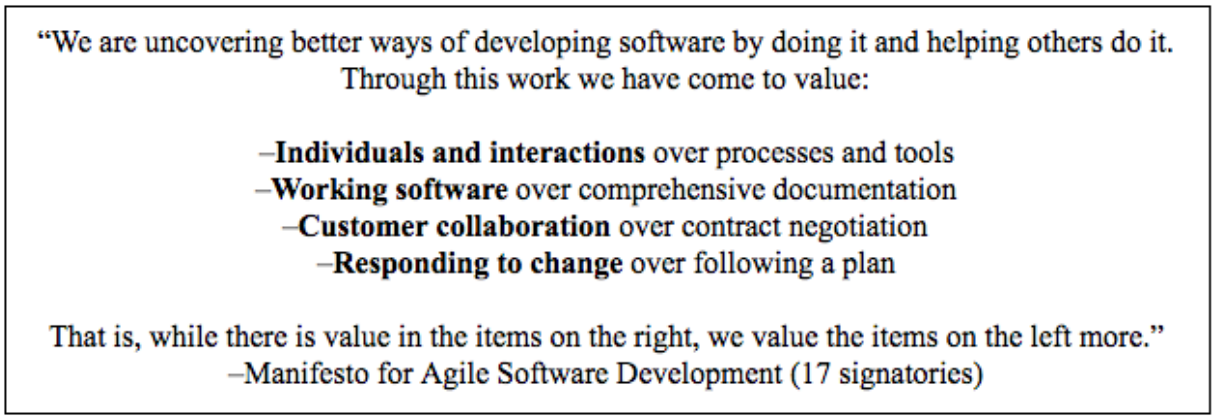

Figure 1 - The agile manifesto, originating 2001 in Utah, USA.

The manifesto was set up to emphasize where to put focus on projects to be able to deliver maximum value to customers. Together with the manifesto, 12 principles were set up. These principles were made as helping guidelines for working effectively and keeping the customer value in focus (Hohl et al. 2018). These 12 principles are the following (Beck et al. 2001):

1. *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*

2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*

3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.*

4. *Business people and developers must work together daily throughout the project.*

5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*

6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*

7. *Working software is the primary measure of progress.*

8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*

9. *Continuous attention to technical excellence and good design enhances agility.*

10. *Simplicity--the art of maximizing the amount of work not done--is essential.*

11. *The best architectures, requirements, and designs emerge from self-organizing teams.*

12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*

Although the manifesto is originally built for software development, it is applied in other fields as well. Bennekum, one of the main authors of the manifesto, admits that he would rather have used the word "solution" instead of "software" in agile value number two (Hohl et al. 2018).

A concern of Ron Jeffries, another main author of the manifesto, is that working agile has become too much of a buzzword which top management sometimes try to implement without understanding the concept. Trying to follow the principles without understanding the underlying meaning could create an agile framework that is no longer agile. A framework that does not deliver the valuable attributes expected, and instead even inhibits productivity (Denning 2011). Bennekum also raises the concern of people implementing agile frameworks because "*it is fashionable to be agile*" and cannot motivate why they want to use such a framework. The same concerns are heard from other authors of the manifesto, and elsewhere in the agile community. The conclusion that can be drawn from these comments is that it is important to know why you want to implement an agile framework, what value you want to gain and if you have enough knowledge to use the framework in an agile way (Denning 2011).

Although no change has been made to the manifesto, with little interest from the majority of the authors, one of the authors suggested a change to the manifesto (Denning 2011). Kent Beck suggested in 2011 changes to the manifesto in order for it to be feasible outside of IT-development. Beck's addition emphasized learning and teamwork while using more general words and avoiding IT jargon, which later was acknowledged by other co-authors of the manifesto. Next, the agile concept will be explained as a layered concept with the mindset being the first layer of agile. This indicates the agile concept to be useful in industries other than software development.

Agile Mindset

Measey (2015) presents agile as made of different layers with the agile mindset as the outermost layer and processes and tools being the innermost layers, as presented in *figure 2*. While the mindset is less visible and tangible than the other layers, it is the most powerful layer of agile as it drives the company towards being a learning organization. Measey (2015) explains that visibility increases going inwards towards processes and tools, while importance and powerfulness increase going outwards towards mindset. Adopting values and principles requires structural and cultural change while being semi-visible and semi-powerful to the company. The inner layer of practices, processes, and tools (e.g., scrum, visual board) is the most visible and tangible part of agile, but it is also the least powerful as these layers can be

implemented with command-and-control methods without significant changes to the layers of culture and mindset.

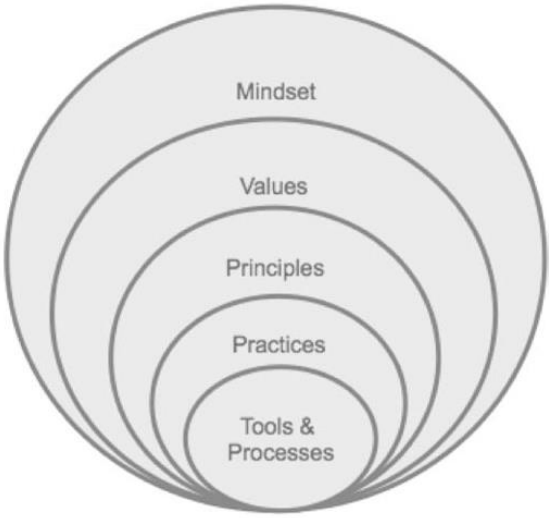

Figure 2 - The many layers of agile by Measey (p. 11, 2015).

Measey explains agile as something a company should become instead of what a company should be doing and that there are significant differences in company results depending on how companies are perceiving and implementing agile (2015, p.11). Measey stresses the importance of adopting the agile mindset and it being a prerequisite for other agile parts to be successful as well as understanding that agile is not a set of tools or techniques that should be repeated, but a mindset opposite of being static in terms of goals, challenges, and abilities. If the mindset is not implemented carefully, the company risks creating a "cargo cult" situation, meaning the employees work with agile methods but do not see the purpose nor advantage of it, making them over time fall back into previous ways of working (Measey, 2015, p.12).

Agile values

According to the agile manifesto, there are four values that organizations should understand and follow in order to work in an agile way and be agile. It is important, however, to not see these values as rules one must unquestionable follow, but they are to be approached in an "agile" way - used in a way that works for the current situation for the specific company. All four values will be presented and explained in order to better understand the agile concept and how it can be used by ABB to better reach their strategic goals.

Value A

A. Individual and interactions over processes and tools

The first principle concerns the value of people and teams, and that it is people rather than processes that gives the project its value (Measey 2015). This value that emphasizes the importance of motivation within agile and self-organizing teams. This in turn provides important qualities for the agile leader such as team building (Measey 2015). This value is primarily embraced in agile principle 5 and 11 that focuses on motivation and self-organizing teams.

Cobb (2015) explains that there are different tools and processes in every project, but these must be viewed in a smart way, which means that they are not always rigid, but designed to the needs of the specific project. Cobb continues to explain the importance of proper leadership, that the agile leader has a softer leadership approach that focuses more on people and helping them to do their jobs, instead of putting a larger focus on processes.

Value B

B. Working Software over comprehensive documentation

Measey (2015) explains that the second value is based on the idea that the sooner a product is delivered, the sooner it will produce value for the business. With product in this case means a functional product, not just documentation on "how it will work". This implies that in order for a project to be as valuable as possible for the customer, agile teams need to deliver working software or products frequently. This value primarily permeates agile principles 1, 3, 7 and 9 that focuses on delivering live software frequently through good design and measurable progress.

Cobb (2015) explains that this value is an answer to the old "gate"-models that often is used. In these "gate"-models there is a lot of documentation required, which leads to resources being allocated to something that is not value-creating. There is certainly a need for documentation, but only to a certain extent. Especially since customers often do not see any documentation and therefore do not know where the resources have been allocated to.

Value C

C. Customer collaboration over contract negotiation

The third value is based on the importance of trust within the relationship between team and customer (Boral 2016). With trust, there is no need for a rigid contract that explains all the parameters of quality, time and cost. Since there always are changing business conditions, such a contract will take time to renegotiate - hence costing both the team and customers time. Value C says that constant collaboration strengthens customers' product offering by creating real value for your customers, avoiding unnecessary bureaucracy (Boral, 2016).

Measey (2015) says that this value primarily permeates agile principle 4 and 12, that focuses on better collaboration between business and development departments, as well as emphasizing the need for reflection.

Cobb (2015) notes that it is important to adjust value C according to the situation. There might be situations where all the parameters are fixed, and there might be no need for closer collaboration.

Value D

D. Responding to change over following a plan

The fourth and final value is about embracing change (Measey 2015). By embracing change, the team will in an easier way find knowledge and requirements that are of value for producing

the product. This value primarily permeates agile principle 2, which focus on supporting change to deliver value to the customer.

Cobb (2015) explains that value D is a response to projects in uncertain environments, where it is hard to establish complete project plans from the start. This value changes focus from controlling costs, which often makes it hard for the customer to change requirements, to focusing on what will bring value to the customer. Next, all agile principles are presented and explained as one additional step into understanding the agile concept and its potential impact the implemented concept may have on ABB.

Agile principles

Agile principles are more tangible guidelines based on the agile values (which in turn are derived from the agile mindset). Just as the values, the principles are not meant to be rigid rules, but used in a way that is suited for external conditions (Boral 2016). The 12 principles below are explained in order to understand the essential underlying idea of each principle.

Agile principle 1

> *1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software*

Cobb (2015) found that the first principle emerges as a counteract from the old way of delivering projects, where customers ordered a system and then received the first view of the complete system at the delivery date. If customers want specifications or functionality changed, it would often take a lot of time and cost a lot of money. This principle tries to counteract this result by continuously delivering functional parts of software. This continuous delivery gives customers a choice to change specifications early in the process - making it easier and cheaper to change and form the system after the needs of customers. Delivering functional software is also a good measurement of how the project is coming along (Cobb, 2015).

Boral (2016) argues that this first principle is the most important one, being at the core of agile development. By continuously delivering working software to customers early on and give them early insight for feedback around products will help the developers build a software that is more valued for customers. By delivering in this manner, there will always be a value in the project, even if it is canceled later on. If companies do not apply continuous delivery and feedback, they risk having the project deliver zero value due to canceled projects that have not delivered anything to customers with only products, code or documentation with no perceived value for customers.

Maesey (2015) explains that the sooner a system, or part of a system, is delivered to customers, the sooner it will start delivering value for customers. By delivering value early, the business is able to respond and give critical feedback on how to develop the rest of the project to deliver maximum value. With early feedback, developers are also able to structure their backlog to prioritize tasks that bring value for customers and reduce time added on low prioritized tasks.

In a case study by Straçusser (2015) conducted in a construction project, he implemented principle 1 to the best of their ability. They tried to isolate different systems, such as the water system and designed, built and tested the individual systems as soon as possible. By doing this,

the systems that were complete and available to operate helped the rest of the project to manage risk by releasing individual parts instead of one big release.

Agile principle 2

> 2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage*

Cobb (2015) explains companies should create a dynamic environment where change is welcomed in order to satisfy the second principle. But it is important to have a mutual understanding about the process of change what will be allowed and in what way change will be handled in terms of setting rules and guidelines that enables and not discourage change.

This principle, like the first, puts customers in focus (Boral 2016). To make sure customers get a product that fits his or her needs. This principle works if the agile idea is embraced and if there are frequent deliveries and less rigid documentation demands and processes.

Agile principle 3

> 3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale*

The third principle is aiming for an iterative way of working to divide and break down projects into smaller pieces (Cobb 2015). Within agile, these small and iterative pieces are typically referred to as *sprints*. Here, teams gain knowledge and are more prepared to make necessary changes to projects earlier on due to the ability to easier change direction after each sprint. Furthermore, people also have a tendency to work harder at the end of projects. Because of the increased ability to change and tendency to work harder, work will be argued to be more effective when divided into smaller pieces with shorter deadlines.

Measey (2015) explains that regular deliveries create opportunity for stakeholders to review work and give feedback. Deliveries of products can also help business people better understand what really is being produced. With tighter feedback loops, more valuable software will be produced since it will be more aligned with the stakeholders' vision and needs. Furthermore, small and frequent changes between updates lower the technical risk of delivering unwanted or obsolete features since fast feedback puts you quickly back on the right track with little time spent on unwanted activities.

Agile principle 4

> 4. *Business people and developers must work together daily throughout the project*

Business people are the personnel working as a buffer between developers and customers. Developers are those who execute the project (Yodiz team, 2016). Who is involved from the business- and development team and to what extent, depends on the nature of the project (Cobb, 2015). Cobb (2015) continues to explain that this principle emphasizes the importance of commitment and collaboration between developers and business people throughout the project, and that both feel a joint responsibility for the outcome.

One of the basic ideas of agile is to produce a product that fits stakeholder needs as well as deliver in time and on budget (Measey, 2015). A frequent feedback loop between the

stakeholder and development team is essential since requirements from stakeholders might change. Through constant communication between departments, business people will more easily be able to address and comment on technical parts of ongoing projects, and make better informed decisions (Measey, 2015).

Boral (2016) explains that principle four could be hard to achieve in practice but it is still recommended to implement. At its core, there should be a natural time and place for business people and developers to interact, especially in a face-to-face setting having maximal information exchange available. The two main obstacles being co-location and customer time-restraint could be mitigated by having physical project meetings together at the start of a project as well as having a product manager or domain expert to represent the customer (Boral, 2016).

Cross-functional teams are a way to try and increase the cooperation between traditional company functions. Galbraith (1994) explains cross-functional teams as being presented in many different forms and shapes. They include people from different traditional company functions, which creates a wide array of competence within a single team.

An example of how this agile principle has been translated can be seen in Straçusser's (2015) case study of a construction project. he translated this principle by creating cross-functional teams that handled design, construction, and testing with the customer embedded in every aspect. These teams met up and discussed work that had to be done, and how the process was going in order to ensure that the result was in line with customer needs.

Tibazarwa and Augustine (2017) identified a knowledge gap when trying to adopt the agile principle in an automation process. As developers and manufacturer representatives have a significant difference in knowledge skills, the empathy gap (a cognitive bias that explains the lack of understanding for different peoples' decision-making process) were identified as to potentially decrease the empathy gap between them when applying the principle. Here they suggested that a program manager could still be beneficial as an intermediator.

Agile principle 5

> *5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done*

Principle five is aimed towards working in projects with people motivated enough to control and lead their own tasks and activities to achieve a clearly defined goal (Cobb, 2015). It is an attempt to stay away from the command and control tactics used by many project managers in order to meet deadlines and budget at the expense of the workforce. Cobb continues to explain that the underlying philosophy of working agile is to let teams be agile by letting themselves be in charge of what tasks are needed to be done at what time. It is argued to be healthy to create a sense of general direction in order to guide the team in a people-driven leadership manner. There is also a high expectation on the manager being able to provide a suitable level of autonomy for the group, depending on factors such as context, complexity and team maturity (Cobb, 2015).

Boral (2016) believes the fifth agile principle is about people over processes, which also is one of the core values of agile management. Boral continues by saying that motivated people are crucial for an agile team's success and managers should steer away from micromanaging and instead foster a collaborating consensus driven team that take pride in reaching their designated target while working in a continuously improving environment. Amabile (1997) states that

while managers have a significant impact on motivation, intrinsic motivation with curiosity and inner drive is much stronger than extrinsic motivation regarding recognition, money, and pressure. Hence, the principle should take into consideration to build projects around people that are more inclined to be motivated intrinsically rather than extrinsically. Measey (2015) continues to link motivation with productivity by arguing that motivated people are going to be more productive.

Medinilla (2012, p.55-60,) defines the agile manager with a laundry list of activities that are specifically designed to move away from any machiavellistic command and control approach. Medinilla further argues that while command and control management could work in a repetitive, manufacturing environment, there are still Japanese examples of factories being much more productive with agile management compared to a machiavellistic management. Command and control management also reduces commitment, engagement, and proactivity within teams, as the manager has created an essential role where the team could not function without the manager. Furthermore, it creates a more need for managers which, according to lean practices of which agile is related to, is waste. This creates teams with low engagement and low independence, which will ultimately decrease their ability to be agile in its working process. The role of the agile leader is also to know when to gently say no to input and instead follow a strict backlog prioritization. In order to control the workload on an acceptable level that does not decrease motivation, limiting work in progress and improve bottlenecks are important practices for the agile manager (Medinilla, 2012, p.130-154).

Medinilla argues that every great product with large impact has been made with a highly motivated team (2012, p.69-80). If a company is producing a low-quality commodity, they should not bother going through the hard process of implementing agile. But if that is not the case, they should start to create a highly motivated workforce. Medinilla argues that the main areas for motivating a workforce are: security, self-organization, networking, vision, and learning. Security is hygiene factors such as job stability, housing, and food. Self-organization is about autonomy and independence. Learning is about fulfilling your need for progress. Vision is contributing to a higher purpose. Finally, networking is to feel connected and related to other humans. In the Agile Motivation 3.0, money is not the main motivator but more of a hygiene factor where workers instead want to be able to take pride in their work as well as being able to fulfill the five main areas of motivation (Medinilla, p.69-80, 2012).

Self-organization is defined by Medinilla as “having some autonomy and decision power on how to perform your job or how to organize yourself, [which] is a key motivation factor for knowledge workers” (2012, p.81). Knowledge workers are easily de-motivated by failure and blame, and also by not developing any new skill or knowledge and get the feeling of being stuck. This can be overcome by having “lab times” (i.e. personal time to focus on a work-related topic of their choosing) to develop skills and favoring on long term goals over short term losses (Medinilla, 2012, p.82-90). As self-organization is a precondition for agile success according to Medinilla, management should delegate appropriate and manageable amount to the teams and let them make decisions as they have more information and insight around activities than management. Medinilla (2012, p.82-100) compares this to a traffic roundabout with the principle that management defines clear rules and only intervenes when something goes wrong but the daily operation is carried out individually by each team working in the system.

Agile principle 6

> 6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation*

Cobb (2015) explains that if possible, it is desirable to have face to face communication because of the information-sharing effectiveness. He continues to clarify that the essence of the principle does not convey only face-to-face communication but should be on the level the project requires the right mix to enable the best efficiency. The way of communicating may vary with the scope and complexity of the project, and the physical location of the team members.

Measey (2015) states that with face-to-face communication, you will receive more non-verbal information that will help enrich the given message (e.g. body language). You will also get another type of emotional bond amongst employees, that may help to increase trust and teamwork. To use face-to-face conversations in a better way, agile teams tend to be small to reduce the number of communication channels, making it easier to use face-to-face conversation and reduce complexity. Measey continues to state that if you want an even more efficient way of communicating, you may also use visual tools such as a whiteboard (as seen in *figure 3*). The whiteboard will enrich the communication and helps the communicator to better clarify his message as well as helping the receiver to better remember what has been said.

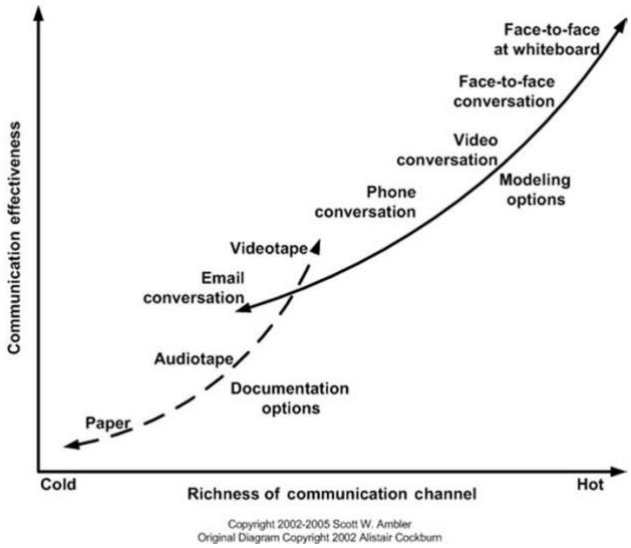

Figure 3 - The communication richness and effectiveness in different mediums (Measey, 2015).

Boral (2016) explains that additional factors arrive when working closely together using primarily face-to-face conversations, such as tacit knowledge and osmotic communication. Tacit knowledge is such knowledge that is hard to translate into words, such as feelings. Osmotic communication refers to a sort of interference of communication, for example, if one person overhears others discussing a problem and might be able to help them, even if he was not directly contacted.

In Straçusser's (2015) case study, a construction project uses this principle by introducing meetings where people from different departments are present with physical distance between teams. They transferred additional employees from different departments to be able to be present and participate in activities at different locations. That way, all key departments would have at least one member present, thus capturing richer information and mitigating the risk of not having inter-departmental communication.

Kupritz and Cowell's (2011) study enforces the theory that more information from communication may be received from face-to-face, as well as helping to build relationships, mutual respect, and trust. They also found that face-to-face is the most efficient channel for more sensitive information between a manager and employee and that face-to-face is preferred when speaking about important topics such as performance.

Agile principle 7

7. *Working software is the primary measure of progress*

In agile frameworks, live software is the main measure of progress, which is, when the value-added product is delivered (Measey 2015). When the incremental product is delivered into a live environment, the customer business will at the same time directly gain value. Having this main goal of progress forces the agile team to work in a more integrated way together with stakeholders.

Cobb (2015) explains that to be able to work efficiently, a definition of done needs to be clear. To know when you have reached a goal and to know what type of functionality and tests that are good enough. By working in such a way with adding live software with a clear definition of done, the team will minimize risks of a non-compatible system later on in the development process.

Boral (2016) continues to emphasize the importance of this principle, and adds that only working software is worth the money. Until the software is running, it does not add any real value.

Agile principle 8

8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely*

Cobb (2015) explains the importance of a sustainable environment as an environment where creativity and motivation of the team are high, which is not supported by long hours in poor conditions.

If teams are not motivated, it may result in poor result even though many hours are put in (Boral 2016). However, there will be times of stress in projects. It is only important to see that the stressful part of projects is only during shorter time slots and that employees do not take any long-lasting damage from it. Transparency in the workplace is important where everyone is able to share their view of the work conditions. One tool that is frequently used in agile teams is retrospect. Here, team members will not only share technical details, but also what they thought about workload, autonomy, work processes and more.

When people are working under pressure, it may result in people cutting corners which sometimes lead to technical debt (i.e. a system that is poorly designed) to the company (Measey 2015). Because of bad design, a system can become unnecessarily complex and inefficient. Such a system will have more defects and become increasingly harder to support and maintain. In the agile team, there is often a position called "agile leader". It is the agile leader that is responsible to ensure that people are working in a sustainable pace so technical debt is avoided.

In Straçusser's (2015) case study, they embraced principle 8 by scheduling and reallocate resources on a need-basis in order to hold a steady phase. This did not work very well, since tight deadlines and team dependencies did not give room for a constant phase.

Agile principle 9

9. *Continuous attention to technical excellence and good design enhances agility*

Boral (2016) explains that by having a well thought out and simple design, the project will be more easily maneuvered. It is important to have a smart, flexible design because of all requirements not being known from the start. By having a clever and simple design, there is less problem with integrating new functionalities later on without the project becoming too complex.

According to Cobb (2015), the design of projects or processes should be put on an appropriate level. This means that one shall not put unnecessary work into designing a process beforehand. It shall be done sufficiently and only fulfill the defined purpose of the project or process. Everything above that is considered unnecessary as it may create barriers towards unforeseen areas as well as the design not being a good fit for the evolving project.

In Straçusser's (2015) case study, they translated principle 9 to state that better the designs, drawings, etc., the less delay there will be in the field work. They produced as good designs as possible, and were out in the field and helped to clarify the designs and ask questions.

Agile principle 10

10. *Simplicity - the art of maximizing the amount of work not done - is essential*

Cobb (2015) argues that this agile principle is related to the "good enough" concept where it is often advantageous to start with an incremental product. Minimum viable product (MVP) is a concept where you keep the product as simple as possible in the beginning to later add features only if they are perceived as value adding for the customers. That way, you reduce the risk of overdesigning a product while keeping down the product complexity and costs (Cobb, 2015). Measey (2015) agrees with Cobb about producing a simple solution that meets the minimum requirements from customers. Measey argues that it is important to focus on delivering value the most effective way possible, which in turn means to reduce production waste in every form.

Measey (2015) continues with principle 10 being linked to prioritization and time management when creating the simplest product possible. That is why there needs to be a focus on using business cases for all projects and keeping a backlog that clearly prioritizes what needs to be delivered. The idea of keeping things simple is much drawn from the 2002 "chaos report" (consisting of analysis around IT projects within the IT-industry) showing that the majority of features not being part of the core offering is not being used (Measey, 2015). Therefore, close customer collaboration and product alignment is recommended together with a fit-for-purpose delivery concept, consisting of eliminating waste, build in quality, create knowledge and optimize the whole (Measey, 2015, p. 119-122)

Measey argues that sometimes the organizational structure with separated functions increases waste produced and reduces effective communication and deliveries (2015, p.119-122). The potential risks of silos are that customers are opted to change with more time, the product may be tested in a late stage unable to correct errors, hard to implement end-to-end learning in a silo-

environment, decrease commitment with handoffs, increase delivery time with unnecessary communication waste and silo sub-optimization (Measey, 2015, p.119-122).

Tibazarwa and Augustine (2017) translate the agile principle into process automation by focusing on good architecture instead of work done. Tibazarwa and Augustine suggest trying and focus not on the product simplicity but on architectural simplicity, reducing complex collaboration, resolving ambiguity and improve creativity. For the construction market, Straçusser (2015) translates the principle in a more practical way, putting a focus on simplifying the system design, upfront costs, and lifetime costs. All scope items added are also challenged by management, with formal change processes, before being included in the project.

Agile principle 11

> 11. *The best architectures, requirements, and designs emerge from self-organizing teams*

Measly (2015) argues that self-organizing teams could be hard to succeed with, as a supporting culture and environment is needed. In complex organizations, Measey (2015) suggests that there could be advantageous with high-level architectural design principles meaning the team decides the details and controls the timeline and tasks for each specific project but are given a design framework to operate within. However, that could be difficult as the team must buy in and accept the initial design, or else they risk losing the sense of autonomy and motivation (Measey, 2015).

Boral (2016) found little value in deciding on an architectural design early in projects where changes were hard to anticipate and features added late hard to integrate. Boral argues that it is the team themselves who should define and create the architectural design because they have the most insight and best information regarding the project. It is encouraged to start off with an easy design that is reiterated if needed and let the design grow as you progress forward. The advantages to that are, according to Boral, that teams take ownership and get increased motivation to see the project through. However, leaving the architectural design to the self-organizing team puts pressure on the team to foresee activities beforehand and create a design that can easily be changed, scaled and understood (Boral, 2016).

When adapting principle 11 into manufacturing automation, Tibazarwa and Augustine explain the architectural design to be more complicated and repetitive compared to software development (2017). They argue that the design and layout are best made in collaboration with stakeholders, customers and area experts. The manufacturing automation industry is also more limited in its ability to architectural change because of value chain limits in terms of industry expectations of what they receive from suppliers and delivers to customers.

Vertical teams are core to agile concepts where a vertical team is an agile team within a traditional organization with traditionally divided company functions (Measey, p.122-123, 2015). Focus on this feature or component-based team is to as continuously as possible deliver value through the organization by using so-called user stories (i.e. short description to define why, how and for whom the feature is for) to define why the product needs to be prioritized and what is required to produce the product. The positive impact on the fit-for-purpose delivery concept is that shorter timespan creates no extra story requirements from customers, tests are integrated into the process and not at the end, knowledge is shared in teams from each stage of the process and teams take ownership of projects and deliver increment progress with short time frames.

Agile principle 12

> 12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly*

Boral (2016) believes the 12th principle is fundamental for agile teams. However, Boral also questions the idea of having well-documented lessons learned, as that document risks not being used due to not having identical projects in the future with similar challenges with little to no time to go through old documents to read up on past lessons learned. Instead of extensive documentation, Boral argues that if retrospective reflections are carried out, and teams immediately implement the suggested changes, the advantages are huge. Especially if the team itself comes up with new ideas to test and what to stop doing. they become more motivated to apply the changes and to do another reflective retrospective (Boral, 2016).

Measey (2015) states that agile deliveries follow three steps: transparency, inspection, and adaptation were the last two are strictly related to the 12th principle of short feedback loops. All agile teams should use some kind of retrospect in order to continuously become better and develop in their work.

Practices

Measey (2015) explains a set of practices used in agile concepts. Practices include different kinds of activities that link to certain agile principles. Below are several agile practices mentioned and briefly explained to easier enable tangible ways and activities on how to adopt the concept of agile into a company (2015).

Feedback loops

To the agile delivery, feedback loops are a critical tool to empirically reflect how and what the team has done and then take action on the results to improve their work processes and products (Measey, 2015). Examples of feedback loops are face to face communication, daily stand-up meetings with visual boards and show and tells. While face to face communication has been covered in principle 6, daily stand up meetings are short, simple meetings (preferably in the morning) to synchronize and plan today's work within a team. It is common to use a visual board to gather around for the daily stand-ups for easier representation of tasks being carried out to complete the team's goal. A visual board is usually a physical whiteboard but can also be burndown charts, RAID (risks, assumptions, issues, and decisions) charts, virtual tools, or project task timeline. The goal of visual boards is to somehow radiate instant information to the entire team. Show and tells are slightly different meetings than daily stand ups. They are held at the end of a working cycle (i.e. sprint) in order to gather instant feedback and get recognition for the tasks carried out from the stakeholders and customers. At show and tells, product prototypes should be presented together with a discussion of which tasks and activities have been made and which ones to go forward with – which will ultimately be put in the team's backlog and prioritized for next working cycle.

Retrospective

The retrospective is the agile tool that is used for constant improvement, similar to the lean idea of Kaizen which in Japanese means improvement. Retrospectives are closely related to the 12th agile principle of reflecting over work done and is usually done at the end of a working cycle (i.e. sprint). Measey (2015) explains that there are different ways of conducting a retrospective

but a common way is to set aside a few hours to discuss and reflect about what went well, what went poorly and what should be done differently next time around. Retrospectives are, by Measey perceived as improving the following team aspects: collaboration, productivity, team dynamics, capability, capacity, and quality. Retrospective activities are primarily designed to understand the underlying root cause of the problem. Hence activities like Five whys, Fishbone diagram, and Plus/delta are suitable when conducting a retrospective.

Emergent documentation

Within agile practices, documentation is considered hard to keep updated as it most often is not the most stimulating part of the process (Measey, 2015). In order to keep documentation on a minimum but accepted level, it is suggested that documentation is a clear part of the definition of done for the product or process. That implies documentation is carried out before teams are being able to check an activity or task as done, which should prevent them from starting on the next task of the backlog before the entire current task is complete.

Sustainable pace

Measey (2015) argues that pushing teams extra hard is not beneficial in the long term as increasing productivity today is decreasing productivity tomorrow. He also claims teams to lose productivity after a certain time, where there is decreasing output per every additional hour spent. Moreover, motivation, spirit, and morale of the team can be badly hurt if not a sustainable pace is applied. One dominant agile framework, Extreme programming, has adopted sustainable pace into their framework as one of the core values of working agile. This acknowledged agile framework provides an argument for the importance of sustainable pace in everyday work and that overtime should be reduced to a minimum.

Focus on quality

Agile concepts look at quality from a software developer's point of view as functional and technical quality. Functional quality focuses on delivering what customers want without any add-ons from developers or alternations from stakeholders. Customer collaboration is the main tool to continually keep high functional quality. The technical quality refers to the product, or code, itself and its ability to be changed, welcome new integrations and develops using test-driven development (Measey, 2015).

Tools and processes

A part of working agile often means that work is conducted in an iterative and incremental way with tasks broken down into small pieces and executed in portions commonly called sprints. In this subchapter, agile processes and tools are presented through different operational and scalable agile frameworks that work differently from each other but are all based on the same idea of iterative, incremental tasks with projects including planning, developing, testing and retrospective.

Kanban

According to Turner et al. (2012), Kanban is a framework and visual tool used in manufacturing as a mean to manage the flow of processes. Kanban signal cards (i.e. physical cards carrying information about the product being linked to the card) are made for each kind of product or process which could be any kind of task. The underlying idea of using Kanban is explained by

Turner et al. (2012) to synchronize workload with capacity, reduce waste, minimize inventory, track work in progress and avoid poor quality. The Kanban system has also been applied to knowledge workers where it is primarily used as a capacity synchronizer. Kanban also prevents knowledge-workers from accepting too many tasks at once, creating a pull-system (Turner et al., 2012). Limiting the number of parallel tasks bring many advantages such as minimizing context-switching, favoring higher value tasks over lower value tasks as well as maintaining a reasonable workload over time (Turner et al., 2012).

Scrum

Scrum is an agile framework originating from software development where companies can address complex problems in uncertain environments while delivering customer value in the context of delivering products in the best way possible (Scrum.org, 2019). The Scrum framework is considered to be relatively easy to understand but harder to master. The framework is designed as an iterative process with small (5-9 people) self-organizing teams moving through sprints. Takeuchi and Nonaka (1986) described the sprints as a rugby team moving in sprint-like stages with predefined results to each sprint. The iterative method enables short and fast changes in customer demand, improving companies' ability to respond to change and reducing work not valued by customers (Scrum.org, 2019).

Scrum is built on values, team roles, events, and artifacts. These will briefly be presented below as a way to further understand what Scrum is and what role it can play in an organization (Scrum.org, 2019):

Values

- *Courage*: Team members have the courage to work on tough problems and do what is rights
- *Focus*: Everyone is focused on what is to be done during the current sprint and its goals
- *Commitment*: Personal commitment to achieving goals set by the team
- *Respect*: Team members respect every individual in the team
- *Openness*: Team and stakeholders agree to the transparency of all work, risks, and challenges

Self-organizing and cross-functional teams

- *Scrum master*: This role is responsible for promoting and supporting scrum in the organization by helping people understand scrum through theory, practice, rules, and values
- *Product owner*: A product owner is responsible for maximizing the value output from the delivery team, which can be done in many different ways
- *Development team* - A team designed to optimize productivity, creativity, and flexibility, delivering value incrementally in every sprint

Scrum events

- *Sprint*: A consistent time period of less than a month where value is delivered at the end of the sprint in some sort of incremental and defined finish.
- *Sprint planning*: Planning of the work for the next sprint, made by the entire scrum team
- *Daily scrum*: A daily 15-minute event for the development team to decide activities and plan for the next 24 hours.

- *Sprint review*: A review held at the end of a sprint to inspect the progress and update the backlog
- *Sprint retrospective*: A development team period to reflect on continuous improvements

Scrum artifacts

- *Product backlog*: An ordered list of tasks waiting to be performed by the development team
- *Sprint backlog*: A set of product backlog problems together with a plan to deliver the product to the extent stated in the goal of that backlog
- *Increment*: The sum of all product backlog activities that have been completed during one sprint

SAFe

SAFe (Scaled Agile Framework) is a result of trying to address problems when scaling agile beyond single teams. The main SAFe framework consists of three levels (as seen in *figure 4*): Team, Program, and Portfolio, with a lot of additional features and intermediate stages in some of the levels. The main functions of the SAFe framework are presented below (A Scaled agile Inc., 2018).

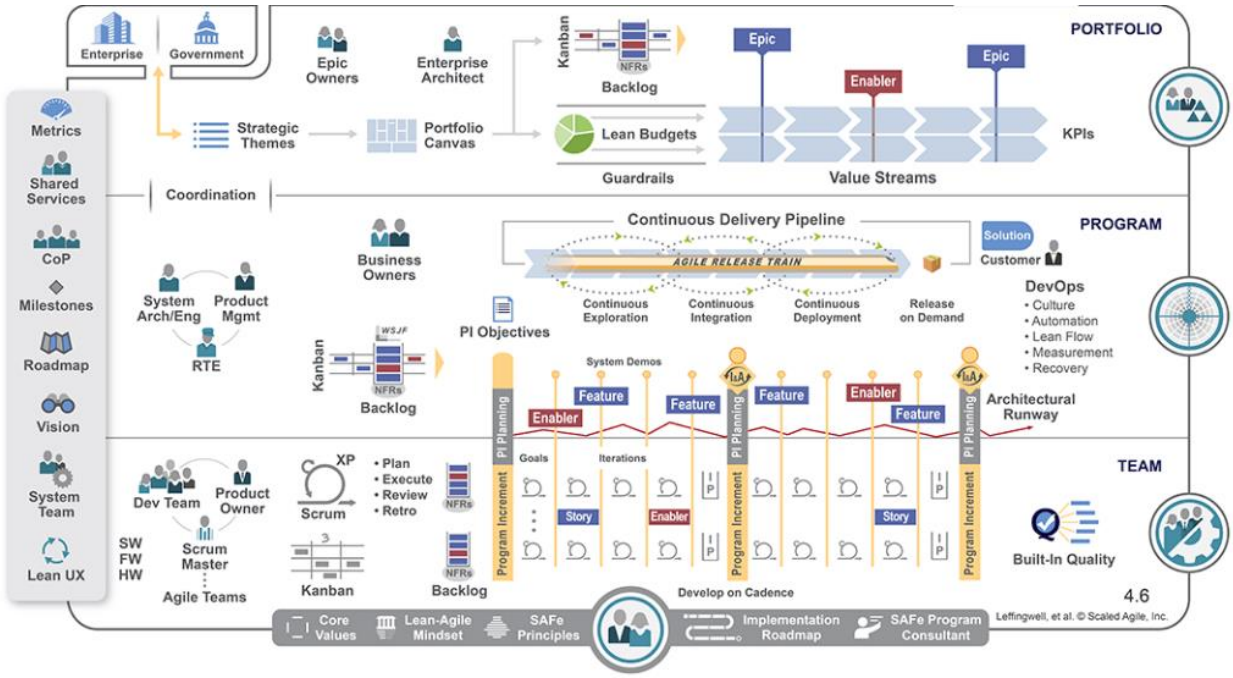

Figure 4 - Main SAFe framework (www.scaledagileframework.com).

The *Teams* level may be any agile team that can work in different single-team-framework, most commonly used are Scrum or Kanban. The team has a scrum master that is responsible for the team processes to run smoothly, and there are iterations of 1-4 weeks. At the next level, there is *Program***,** which is groups of teams working together under the program management team. This level works similar to a large scrum, where you replace the individuals with teams. The level consists of somewhere between 50-125 people and releases an agile release train (ART) every 5th iterations. The last iteration is meant for double checking that everything in the current train works, come up with creative ideas, having retrospective and planning for the next sprint (A Scaled agile inc, 2018). *Portfolio* level is at the top of the framework above teams and program. It is from here that budgets are allocated, and where the organization is keeping track

of where value is added for the customer. Portfolio level also manages the project backlog, which they will communicate down to the program managers at the different agile release trains.

Successfully adopting agile

Van Kelle et al. (2015) found three success factors for whether agile projects succeed or fail. The factors are *transformational leadership, value congruence and degree of agility.* The study also concluded that project size did not determine agile project success. The first factor refers to a leadership style that focuses on motivating, inspiring and emotionally engaging followers while focusing on the long-term team commitment (van Kelle et al., 2015). Furthermore, transformational leaders must encourage effective communication through informal communication as misunderstandings and lack of communication are the main reasons for agile project failure. Value congruence is explained by van Kelle et al. as the main factor due to the risk of conflict and decreased satisfaction as value congruence had a very high correlation with agile project success. Degree of agility is defined as the perceived level of which the team is using agile practices in an agile way.

Serrador and Pinto (2015) conducted a quantitative analysis of how project efficiency and stakeholder satisfaction is affected by agile project management. They found the agile use to have an increasing effect on efficiency and stakeholder satisfaction as well as a moderately improved perceived quality, implying that the use of agile could lead to improving the effects explained above.

Risks of Agile

As presented, there can be advantages for a company going agile. However, Norberg (2016) discusses examples of risks and costs of trying to implement agile. The risks mentioned are:

- If the customer is not able to participate or work in proximity to the company, it is hard to uphold frequent meetings and check-ups with sufficient information needed to avoid waste and deliver customer value
- If teams are unable to work face to face, problems regarding the speed of knowledge sharing and transparency are affected
- It is hard to control and measure several teams simultaneously
- It is difficult to have offshore teams
- Hard to pass on knowledge as there is less focus in documentation
- Demands education which may be costly
- Requires a lot of testing which can be expensive in the long run

Furthermore, Medinilla (2012) stresses that an agile leader should always do what is most efficient in the long term over the short term. This is in regard to an initial understanding of agile, working in an agile way and solving problems on the cause-level and not on the effect-level.

Methodology

In this chapter, the methodology of this paper will be presented. This paper is based on a qualitative case study using the abductive approach. To answer the research questions, we gathered information about the white-collar department of the ABB factory. We also gathered information regarding communication channels, motivation, working processes and how each attribute works and where there might be room for improvement by embracing agile. We obtained primary data through semi-structured interviews and complimented them with observations, informal interviews and company documents. We collected additional information and input from other sources within ABB (i.e. other factories and organizational functions like HR) in an attempt to strengthen the conclusions drawn from data collected at the ABB factory.

Research design and approach

This report is of qualitative nature, meaning the data gathered is of higher quality compared to quantitative data, as every piece of data typically has greater weight. When the research field is relatively new, like agile practices for non-software white-collar, Edmondson and McManus (2007) argues that qualitative type of data is preferred. Edmondson and McManus (2007) continue to argue that qualitative research is well suited for research questions using "how" to explain the question. The nature of the research is what Bryman and Bell (2015, p. 67-70) refer to as a typical case study of a single location, since the empirical research will mainly be conducted on a single factory with findings that potentially can be useful outside the factory. The case study was conducted during a four-month period with multiple visits to the factory while spending the most time at Chalmers processing material and meeting with the supervisor.

The data collection will mainly be qualitative because of us having the data collection mainly through interviews. Bryman and Bell (2015) explain that qualitative research is more about the words rather than the numbers when analyzing the data. Moreover, the primary research method will rely on qualitative semi-structured interviewing, implying some variance in the questions and order as well as follow up questions to significant answers (Bryman and Bell, 2015). As we are unsure about what we will find and where the majority of the solutions will lay, we have a more flexible way of interviewing. Semi-structured interviews will enable employees to help and guide us beyond the original questions in order to get a better understanding of the white-collar departments at the ABB factory.

The abductive approach is suitable for this report since there is such a large amount of literature, theories, and frameworks regarding agile strategies. The approach enables the authors to gather initial data from the factory to guide us towards appropriate theories that will help us answer the research question. We will draw conclusions based on logical assumptions based on literature studies and data from the ABB factory. Hence, the abductive approach will suit this study well (Bryman and Bell, 2015). The process of data gathering and literature review will be used iteratively for the study to reach a more credible outcome.

Data gathering

During the research, empirical data is gathered mainly in two ways - through interviews and through observations. Company documents are also contributing to our understanding of the ABB factory's organizational structure and operational processes.

Below in *figure 5* is an aggregated figure of the empirical data collection in chronological order. First, a field visit with the factory manager was held as an introduction followed by two weeks of round one interviews. Observations of meetings were conducted and round two interviews followed by validating interviews at a sister factory.

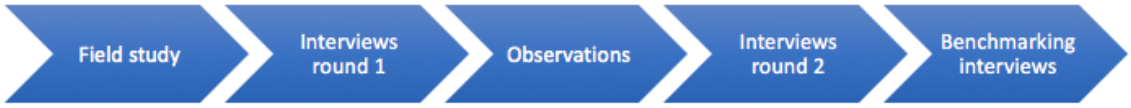

Figure 5 - A visual representation of the empirical data collection, sorted in chronological order from left to right.

In order to verify findings from management interviews, observations and additional interviews with non-management employees were made. This to make sure that the findings from interviews provide a sufficient representation of the factory and its employees. By observing employees in the factory regarding the data collected from interviews as well as additional intervews with other employees, we tried to verify our findings by triangulation of data, as supported by Björklund and Paulsson (2012).

Interviews

In this thesis, semi-structured interviews were held. Semi-structured interviews mean that the interviewer follows a template or guide that is crafted before the interview but also leaves space for discussion and follow-up questions (Bryman and Bell, 2015, p.480-485). This way of conducting interviews provides a broader picture of the organization and the role and thoughts of the people interviewed. As our thesis attempts to cover many aspects of agile concepts, interviews are a recommended research method according to Blomkvist and Hallin (2015), because it provides a chance to develop a deeper understanding of non-verbal data (i.e. data concerning different mediums such as tone of voice, language, facial expression, body language etcetera).

The decision to first interview the majority of the white-collar employees was made in order for us to get a good general idea of how ABB is working, what they are doing and what knowledge they have regarding agile management. Interviewing several people is supported by Bryman and Bell (2015, p. 479) as they argue that it takes many interviews for the qualitative content to carry any scientific weight. Since we ask the same questions to all interviewed, it is easier to see when thoughts and views vary between people and how it is working in the factory.

We designed an interview guide to base the semi-structured interviews on and took notes in an excel file consisting of all questions from the guide. The execution of the interviews tried to have a natural order of topics (going from top to bottom in the interview guide for all interviews) with relevant and easily understandable questions that do not lead the interviewee to a conclusion, as suggested by Bryman and Bell (2015, p.488). As we followed the guide, both interviewers were trying to identify non-leading follow-up questions to the interviewee's answers. These follow-up questions were asked to enrich the data collection and to avoid the interview becoming more quantitative than qualitative (Bryman and Bell, 2015, p.479).

As seen in *table 1*, 19 interviews have been conducted with employees at ABB with 16 of them associated with the ABB factory of the case study. 14 of them were formal semi-structured

interviews with an average length of about 1 hour and 20 minutes. The informal interviews were about 30 minutes long with a more conversational tone with a defined goal of what data to retrieve from the interview. Most interviews were held face-to-face in the ABB factory in order to get as rich data as possible for each interview. 3 interviews were conducted over Skype to gather additional data outside of the selected ABB case factory.

Table 1 - Representation of interviews.

Type of employee:	**Type of interview**	**Number of interviews**	**Interview medium**	**Main purpose of interview**
Management Team	Semi-structured	7	Face-to-face	Mapping the ABB case factory white-collar landscape
Department manager	Semi-structured	4	Face-to-face	Mapping the ABB case factory white-collar landscape
Department manager	Informal	1	Face-to-face	Inter-departmental process mapping
White-collar worker	Informal	4	Face-to-face	Complementary data gathering
Interviews with another ABB factory	Semi-structured	3	Skype	Complementary data gathering

During the interviews, there were three people present; one person leading the interview, one person taking notes and one person being interviewed. This way of conducting interviews with two interviewers is encouraged by Bryman and Bell (2015). To ensure no information is lost from the interview, they were also recorded - to be able to double check facts or if the person taking notes was not able to catch everything. By recording the interviews, the opportunity to interpret how the interviewee expressed herself and not only what she said but how she said it, is available, which is helpful when drawing conclusions (Bryman and Bell, 2015 p.494).

All first-round interviews were held in the office at the ABB factory in private office areas. All were face to face with two interviewers and one interviewee attending in a confined space with no one else to listen in. The interviewers tried to keep it casual by engaging in small talk before and after the interview as well as to ask for examples to increase the amount of storytelling in the answers. The interviewee was told to what purpose the interview is for and that answers are anonymized. Afterward, one interviewer asked the pre-defined questions while the other focused on writing down the answers. Both were in charge of follow up questions to the interviewee. In some instances, the interviewee required examples of answers to clarify the question, which could have contributed to leading examples, given a somewhat skewed result. The duration of the interviews varied in time with an optional coffee break in the middle, that was used four times. After asking all questions from the guide, the interviewers stopped the recording device, stopped taking notes and put down their laptops. As a closing discussion, the interviewers asked the interviewee for anything she can think of that might have been overlooked during the interview. The idea of closing the formal interview but continue to ask questions where to get a more sincere and honest answer, as Bryman and Bell (2015, p.497) suggest that the interviewee may be more relaxed and might share additional valuable insight.

The interviewees also asked for feedback regarding the interview setup as well as informing the interviewee how she could stay in touch.

The second round of interviews was sampled on an ad-hoc basis, as they were conducted late in the process where time and availability were limited. These were all held face-to-face. The third round of interviews was held over skype with another factory within the ABB sphere in order to understand, validate and compare our findings from our case factory to how the other factory works today.

The third round of interviews were conducted over skype with top-level management at another ABB factory similar to our case company. We were able to only get three interviews with three top-level employees Through those three, we managed to get an overview of the sister company, its functions and how they conducted their work compared to our case company. Since these interviews were held late in the process, we could ask data regarding the four categories and other data obtained from the case factory.

Designing the interview guide

For all interviews, a guide to base the interview on was constructed and is presented in appendix A. Blomkvist and Hallin (2015, p.481) suggest that a guide to a semi-structured interview is favorable but that there can be follow up questions and deviations from the guide. The first guide was constructed partly by finding inspiration from questions from similar master theses in similar industries. The main source of the questions was derived from the master thesis research question and the agile manifesto and its 12 principles. While the first guide was aimed at the first round of interviews, which contain the majority of data, a second and third guide was designed for a second and third round of interviews. The second guide was aimed to better understand certain areas and blind spots that needed more attention as they grew to be a significant part of our analysis and discussion. Hence, the questions were designed with an initial analysis in mind in order to be able to verify and maintain a data-driven approach to support our analysis going forward The second round of interviews contained 4 informal interviews at the ABB factory with white-collar employees. The third and last round of interviews were conducted over Skype with another factory within ABB that have many similarities with the ABB case factory. Round three contained three semi-structured interviews, each with a duration of about 50 minutes. As proposed by Spradley (1979), the guides were designed to stimulate stories and bring up emotions as to get a deeper understanding of the answers provided while at the same time keeping a red thread throughout the interview.

Observations

Another common method in qualitative data-gathering is observations (Bryman & Bell, 2015, p.504). This type of study complements the interviews by generating another view. The observations will likely give a more “real” representation of activities and events. Information the interviewee might have taken for granted during the interview may be revealed, underlying cultural patterns may be observed which the interviewee might not think about. During the case study at the factory, observations of the way of working within the white-collar department were held. Observations were done in the hope that different data will be received that is not able to be gathered from interviews. During these observations, the authors will only observe and take extensive notes of what is being observed.

The observations consisted of one field trip to the factory in the early stages of the study where we met with the factory manager. During about 45 minutes, we received a short presentation

about the factory with internal documents regarding the employees, working processes and goals of the factory. After the meeting, we got the opportunity to observe the entire factory, including white-collar and blue-collar where we got an initial insight into the landscape of the two different groups and how they work. The field trip ended in a lunch with the factory manager, discussing history, culture and the master thesis scope.

Observations were also made on structured management meetings. During a three-hour meeting, we observed the team management meeting in the ABB factory on a separate table next to the larger conference table in order to avoid influencing the meeting. Notes were continuously taken from both observers and aggregated after the meeting in a separate document to remember what exactly happened.

During the period of the research, a lot of work were done sitting in the open landscape at the ABB factory. This helped us to observe day-to-day work, meetings and other interactions in order to gather data as well as strengthen or reject data gathered from interviews.

Data analysis

We are conducting this research using an abductive approach, meaning that we are iterating between theoretical research and empirical findings to come up with relevant recommendations and conclusions.

We begin with a literature review on the subject of agile and agile frameworks. We are especially looking for cases where the agile frameworks, that were mainly meant for software development, had been implemented in a white-collar environment. We found a few cases with companies where values and principles of the agile manifesto were used. From our first field trip and initial interview with the factory manager, we believe that many of the frameworks for software development are challenging to adapt in a non-software factory environment such as the ABB factory's. This is because production, development, and delivery are very different in a tangible, mass-produced product compared to software. And because of the differences just mentioned, large portions of software frameworks are not as applicable to the ABB factory as they are for software developers. Instead of using and trying to adopt agile frameworks to the ABB factory, we try to comprehend the underlying values of working agile. Therefore, we start researching around values and principles of the agile manifesto.

The agile principles are a more concrete approach of the agile values (Measey, 2015) and therefore, we investigate whether ABB is following the agile principles or if they might be able to improve their strategic goals by following them. After the initial round of interviews and observations, we analyzed all of the agile principles separately against findings gathered from ABB and connected findings with appropriate principles. When connecting findings with principles, we identified different similarities and differences. The principles were then categorized based on their similarities into four groups which in our case is communication, processes, motivation, and teams. When analyzing qualitative data, it is common with thematic analysis, meaning that the collected data, for example comments during the interviews, are categorized according to patterns emerged during data collection and then further analyzed (Aronson, 1995). When categorizing the principles, we discovered that some principles were not applicable, whereon we decided to not continue our research about applying those specific principles to the ABB factory.

We analyze the four categories separately. We first examine if the principles in the category already are implemented. If they are implemented, we are analyzing if the effects proposed by the agile principles are there. If it is not implemented, we investigate how it might work if implemented at the ABB factory. We research how the implementation will affect the strategic goals while we at the same time are looking at literature that might strengthen or reject the proposed implementation. We also conduct a second round of interviews and a few more observations at the factory, to be able to answer questions that arose during the analysis. After a thorough analysis of the four categories, we have shaped a couple of recommendations with a primary goal of improving the factory's strategic goals.

In a final step to strengthen the result of our study, we are conducting additional interviews. We interview employees at another factory in the ABB company that are similar to the ABB case factory, to see how they are working and if they have tried anything similar. These new findings are compared with previous findings and literature studies to theoretically ground them and build a theoretical understanding of what goes on at ABB.

After validating the recommendations, we present the recommendations for the ABB factory and a case of how agile principles might be introduced into manufacturing environments to strengthen strategic goals, and what principles that are not applicable to be translated into this environment.

Below is a visualization of the steps in the data analysis that have been made, see *figure 6*. Starting with the big concept of agile, we have funneled our way to a few recommendations gathered from the categories that we believe can improve ABB's strategic goals.

Figure 6 - Research process.

Findings

In this report, we want to see if it is advantageous to implement agile concepts into a manufacturing factory for the purpose of reaching strategic goals. In this chapter, findings collected from interviews and observations at the ABB factory are presented. The findings are structured and clustered to appropriate agile principles concerning the data found, with an initial discussion about the ABB factory's strategic goals.

Strategic Goals

When we asked the management team about what the strategic goals were for the factory, they told us:

> *"The strategic goals for this factory are our KPIs [Key performance indicators]. It is the goals we get sent from the mother company, and the goals we are using to guide our activity."*

KPIs according to Parmenter (2007), are created to measure the progress of the company and lead it in a desirable direction, now and in the future.

The KPIs the ABB factory is using are divided into different categories. The first handles safety regarding accidents and preventions of accidents. The second KPI category handles customers, measuring lead time, delivery and defect products. The third is focused on cost. The controller at the factory work a lot with this KPI, and it is also one of the main KPIs of the procurement team, having a goal to lower the cost of the material purchased. The fourth category handles cash flow, measuring metrics such as working capital and inventory turnover. The production planning team mainly handles inventory turnover. The fifth category is profitability and is mainly handling operational gross margin and EBITA. (Observation KPI, 2019-04-01)

We will with this report examine if there is potential to improve these KPIs by introducing concepts from the agile manifesto. Because ABB thinks about strategic goals in terms of KPIs, the success or otherwise of the implementation of agile principles at ABB is compared against the achievement of KPIs.

Agile Principles

In this chapter, data from interviews and observations are presented. We connect each finding to one or several agile principles, where the finding explains how the ABB factory is dealing with that or those particular principles. During our data analysis, we find four different areas that can be used to cluster our findings. These four areas are communication, team, motivation, and processes. These areas are later used for categorizing the findings and principles in the discussion.

In what follows, we describe if and how the ABB factory adopts each one of the 12 agile principles. In some cases, two principles are grouped as they are understood as one at the factory.

Agile principles 1 & 2

We have chosen to group principles one and two together. We do this because of the principles both regard customer collaboration. Since the ABB factory is operating in another environment than software-development, those two principles are somewhat merged with similar findings.

"Our highest priority is to satisfy the customer through early and continuous delivery of valuable software." and "Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage."

The two first principles emphasize the value of delivering products frequently to the customer in order to create short feedback loops, while allowing the customer to make changes continuously throughout the project. The information from these feedback loops helps developers to create a product that better fits the need of the customer and continually creates value. After interviewing members of the white-collar management team, we noted that the two first principles might be difficult for the factory to directly use and adopt into their everyday practice. This because of the unit being a factory that are producing tangible products with little room to change once being produced. One person explained:

> *"In the factory, we have tried to implement lean-processes to have as efficient production as possible. Right now, it takes about two to three days from ordering a batch until its ready for shipment" (1a).*

Since ABB have tried to implement lean practices and maximize the current production process efficiency, it will be hard to make changes late in production. Since all slack and wasted are removed from the product line, there is reduced possibility and time to change a product once entered into production. There will also be a modest need for partial delivery of the batches ordered since they have a short production time. By providing early delivery, together with short production time, the ABB factory gets close in achieving the first principle by striving for continuous delivery.

After interviewing the heads of the white-collar departments, we found that there was one area where project work is applicable to frequent delivery of projects. This is supported by these two comments stating:

> *"R&D divide their projects into a number of gates until every gate a specific number of tasks shall be finished."* (1b) *"Since we are not working with for example software, it is hard to have a working product in the first gates."* (1c).

We found that the ABB factory tries to satisfy their customers through, for example, a very generous return policy where customers can return large portions of ordered products after receiving them.

> "*To satisfy our customers, we are often letting them return large portions of the products they have purchased. Even after a long period of time. This since they often don't know exactly the amount that is needed for a project*" (1f).

We also observed that this return policy is a part of their premium product offer, as seen by the following quote:

> "*The return policy is a part of our premium offering, and we have included the cost in the product to be able to handle it."* (1d).

We also observed that the ABB factory tries to get feedback loops through a constant dialogue with their customers and other relevant stakeholders, to produce products that fit the market needs in the best way possible. Therefore, we observe that the ABB factory embrace some of the core messages in the two first principles.

A majority of the products that are produced are sold to a few large customers, as seen from the following quote:

> "*We mainly work with large companies and whole-sellers, these stand for the majority of our revenue"* (1d).

The factory is keen on having a good relationship with its customers and has frequent communication with them. We observed (observation 1, 2019-04-03) that customers are welcomed to the factory for a tour and discussion on however products will be better fitted for the need of their company. The R&D team also has a close relationship with the customers, in order to deliver a product that fits the market (observation 2, 2019-04-03). A member of the management team told us that tight customer relationship is one of the reasons for their strong market position,

> "*By having a good relationship with our largest customers, we have been able to produce a product that fits well into the industry – and have through that gotten a really strong position in the Nordic market."* (1e).

We have also observed that the ABB factory is operating in a market with a relatively high level of certainty, that there is a possibility to project sales and shifts in the market (observation 11, 2019-04-01).

Since communication and collaboration with the customer constitute the core of the first principles, we will discuss these principles further in subchapter communication in the discussion.

Agile principle 3

"Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale."

The third agile principle is about continuous delivery during a project. Because the ABB factory produces products through a line that has a short lead time, this principle is hard to apply. Neither is it easily applicable internally in the white-collar departments since there are not many projects that are of the nature of being divided into smaller functional pieces that can be continuously delivered. We will therefore not discuss this principle any further.

Agile principle 4

"Business people and developers must work together daily throughout the project."

The fourth agile principle can be translated to other practices than software, since the meaning of the principles is that there must be recurrent information flow between people in contact with the stakeholders that ordered the project/product, and people working on producing said project/product. For the white-collar part of the ABB factory, we interpret this principle as continuous interdepartmental communication between customer-focused roles and production focused roles.

We found from interviews that there is a variable level of interdepartmental communication depending on physical factors (i.e. where people have their offices), personal network factors and department dependencies. One person suggested that:

> *"We must integrate other departments closer to production in order to avoid isolated departments"* (4a)

and another interviewee thought that:

"*Communication works well within the two physical working areas but not as well between them*" (4b).

Two comments specify governance as an obstacle for interdepartmental communication:

> *"There are different demands coming from several directions which creates a focus on departmental performance indicators before factory performance indicators. This strengthens the barriers and de-incentives to collaborate with other departments"* (4d)

and:

> *"Right now sales and production departments have goals that are not very aligned, even though we work for the same company. This creates some tension, and I think this is based on a lack of knowledge and communication."* (4e).

The fact that goals are not aligned, together with limited communication, seems to create a gap between different departments.

While there seems to be an identified gap between departments, they are also working together a lot with projects and processes not seldom needing competence from different departments. This is supported by quote 4f stating:

> *"Every single larger project I do, I do together with other departments".*(4f)

Regarding tension,

> *"I am depending on working together with other departments on trying to achieve my goals and responsibilities, but it is sometimes hard to deliver results when my department is the only one having those goals while the others [departments] have their own goals to fulfill"* (4g)

explains the co-dependency and tension between departments.

We also found from interviews that there is one forum where interdependent communication seems to be used in a proper way:

> *"The Integrated Business Planning (IBP) meetings are the only structured recurrent process between departments"* (4c).

The IBP process at the ABB factory is three closely coinciding meetings that are conducted on a monthly basis where members from several departments meet to discuss the operation and planning of the factory (Observation 22, 2019-04-03). The first meeting handles sales projections, what products to focus on and what projects that are currently in the pipelines. The second handles how to plan production in order to meet up with the projections. The third meeting is a summary of the previous two, as well as a meeting to discuss KPIs.

Since we will discuss the setup and communication within teams and departments in this principle, it will be further discussed and analyzed in the subchapter teams.

Agile principle 5

"Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done"

Principle five emphasizes motivation and self-organization within a company that wants to become more agile. These traits are not exclusively advantageous in software development but also applicable in other fields.

At the ABB factory, there are different opinions about how the employees perceive motivational culture (Observation 23, 2019-04-01). Some managers find motivation different in different parts of the factory, while others believe there is generally a high level of motivation. Others

believe that motivation is entertained by management through the communication of financial results, quality improvements and factory KPI's. They also believe that motivation is created by engaging and helping co-workers through e.g. positive feedback as well as working in a stimulating, complex and analytical environment (Observation 36, 2019-04-06).

While some white-collar workers feel that motivation is not being actively dealt with, others point out heavy workload as a cause for reduced motivation, as seen in the following quote:

> *"In certain areas, resources are very limited, thus decreasing our motivation. Especially when we see little acknowledgment or change from management."* (5a).

We do however see that employees are being motivated by the autonomy of their work:

> *"To receive responsibilities and freedom and to do so many things is very motivational even if people might get tired once in a while."* (5b).

One person in the management team said that:

> *"There is never a lack of resources but only a lack of setting the proper prioritization on what to spend time on. If a project is about to fail, no decisions are made to mitigate, which forces us to keep working the same way which results in overtime etc."* (5c).

We see that proper decision making is not always in place, which may lead to decisions not being taken.

One way the factory tries to create a more united vision is by having a monthly staff meeting, as described by a management member:

> "*We have introduced a monthly meeting with staff from the whole factory. In this meeting, we are displaying the performance of the factory as well as future goals and current projects. We do this to try to get better transparency through the factory.*" (5d).

People at ABB were, in general, satisfied with the networking opportunities the company provided (Observation 20, 2019-04-01). They explained that the size of the ABB organization enabled knowledge sharing through several factories, and that there were good networking opportunities if you are interested.

We have observed that some employees feel that there is sometimes a lack of ownership, support and project/department coordination of goals and activities. This may create a level of irritation and frustration (Observation 37, 2019-04-01)

Overall, a majority of the employees are satisfied with their motivation (Observation 17, 2019-04-01).

Since this principle concerns both the motivation of individuals and teams as well as the way of self-organization within teams, this principle will be further discussed and analyzed in subchapter motivation.

Agile principle 6

"The most efficient and effective method of conveying information to and within a development team is face-to-face conversation."

Within the white-collar community at ABB, there is a variety of ways communication is conducted. One employee said that:

"The majority of my communication is done through e-mails" (6a)
while another one said that:
"About 70-80 percent of my communication is done face to face." (6b).
Even though there is a different need of communication methods for different departments, we observed that most departments preferred face-to-face communication (observation 3, 2019-03-20) and that the departments with the most face-to-face communication tended to be more satisfied with the communication (observation 4, 2019-03-20).

Overall, we have observed that there are mainly three ways of communication within the white-collar department at the ABB factory. Between departments and teams as well as other non-repetitive communication (smaller questions asked between people of different departments that are not directly linked to a project) (observation 5, 2019-03-20). Within departments, there is a lot of face-to-face communication. Working within the same physical area helps this process (observation 6, 2019-03-20). Within interdepartmental-teams, there is a larger variety of communication methods, since members do not always sit close to each other (observation 7, 2019-03-20).

Several employees think that e-mails are used in a poor manner, for example:
"There is often to many people cc:ed in e-mails. I often feel that a lot that is cc:ed to me is quite irrelevant for me." (6c).
Some of the white-collar departments have started to have short stand up meetings in the morning to brief everyone on the progress and priorities, similar to Scrum meetings (Observation 24, 2019-04-01). These meetings are very much appreciated and the teams think that the meetings have helped them to increase teamwork and productivity.

The white-collar employees of the ABB factory sit in two different office spaces that are separated by a 2-3-minute walk inside the factory. In one office space sits the departments that are directly involved in the production; quality, planning, procurement and R&D (observation 9, 2019-02-19). In the other, there are controlling functions and sales. Observation 10 (2019-03-20) show that there is more frequents communication between departments more directly involved in the production, then in others. Employees do not seem to think that this barrier affects their work, but one person said that:
"If there is someone I need to talk to in my office space, I often go directly and talk to them. If the person is in the other office space, I often call them - if it's not something major." (6d).
Which suggests that the physical location of the two office spaces have a direct effect on the choice of communication method. The barrier does also affect the general knowledge of what is going on in the different white-collar departments, as seen from another quote:
"I rarely know what people in the other office space is up to right now "(6e).
The factory has tried to counter this effect by building a common lunchroom for all the factory, which seems to have positively affected the general spirit and culture:
"I think that the communication amongst all the factory has improved since we build the new lunchroom" (6f).
This has given more people a forum to have conversations with other departments, since some positions work independently and thus do not always need the same level of frequent communication than others (observation 8, 2019-03-08).

The office space where the production units sit has lately been renovated. During this process, a lot of open office landscapes has been created. Everyone still has offices from where they can work, but now there is an area where teams easily can sit together and have shared work boards

and meetings. This layout was explained as helpful when implementing the new stand up meetings, quote:

> "*The open office space is nice to have when conducting morning and team meeting*" (6g).

We have seen that these open landscapes are often used for different kinds of meetings, and not while working independently (observation 26, 2019-04-01). While working independently, they are sitting in assigned office rooms.

This principle will be further discussed and analyzed in subchapter communication in the discussion.

Agile principle 7

"Working software is the primary measure of progress."

The seventh principle emphasizes the importance of delivering live software continuously to the customer, and that it is first when the software is implemented and running that it adds value to the customer.

The ABB factory produces standard catalog products as well as made to order products. Both of these types of products are produced in a lean process in the factory (Observation 27, 2019-02-19). Lean processes are defined by the Lean Enterprise Institute (2019) as a process for increasing customer value by minimizing waste. In the white-collar department, several projects are running alongside daily production work. The projects may vary from a few days with a team of one or two people, to larger projects with a lifetime of up to two years and with a team of up to eight people (Observation 28, 2019-04-01). There is no continuously agile release process in these projects and that is because it is difficult to divide the projects into smaller functional parts being carried out individually by different people. One person explains that the R&D projects are developed with the help of a gate model:

> *"In R&D projects, there are typically 5 or 7 stage gates that a project needs to complete. We have work in a type of mix between an iterative framework and waterfall model."* (7a).

These gates do not always require functional products to be displayed, but rather different parts of a project such as product sketches or research. These stage gates are however not the same as frequent continuous delivery. This because the agile principles emphasize the importance of functional products being delivered that may directly create value for the customer (Boral, 2016). To the extent of our observations, the stage gates at ABB are not designed to deliver products to the customer at each stage gate, since the product is not ready to be used.

As seen from observations (0, 2019-04-01) the factory's progress is measured mainly through the KPIs. Some of these KPIs are directly linked to a specific department, such as quality, and some are not, like EBITA. Even in cases where a KPI is directly linked to a specific department, it is not always broken down into smaller and more tangible parts nor is it assigned to specific people having ownership of the partial KPI.

We see that in the white-collar department at the ABB factory, this principle is not very relevant as they are not able to deliver partially functional products. Most of the work is not project-based and is often more of an operational nature. We will therefore not elaborate on this principle any further.

Agile principle 8

"Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely."

The core of this principle is to have a sustainable working environment to encourage creativity and motivation.

We see from the quote of one employee that there is a difference in the workload between departments:

> *"Some departments have very much to do, and does often seem stressed"* (8a).

We do however observe (Observation 15, 2019-04-01) that the majority of departments are working at a sustainable pace. In departments with too much workload, people tend to be less motivated than in departments with a more sustainable workload (Observation 21, 2019-04-01). We also heard from one person that:

> *"I would like to reflect more about my working methods, but I simply don't have time"* (8b)

Which means that a result of having too much to do is that employees rarely have time to reflect on their work.

We are noticing that quick fixes and working ad-hoc have been in the culture in the factory for a long time (Observation 29, 2019-04-01). The management team is, however, saying that they are trying to change this culture to a more proactive way of working, making the "fire-extinguishing" culture less dominant (Observation 30, 2019-04-01). We see that ABB has implemented some practices to try and work more proactive, such as the IBP process and management meetings (Observation 16, 2019-04-01). But several departments still have the old ad-hoc way of working, which in some cases are found to be a result of a heavy workload, as supported by the comment:

> *"I want to work more proactively, but I usually don't have time – since there is so much crucial work to be done"* (8c).

We have observed (Observation 39, 2019-04-01) that the ABB factory is constantly rightsizing their organization to make it more cost effective. This means that current roles get more responsibilities as well as some responsibilities are outsourced.

Since this principle is about working environments and processes, which are directly affecting the motivation of individuals and teams, this principle will be discussed further in the subchapter motivation.

Agile principle 9

"Continuous attention to technical excellence and good design enhances agility."

The ninth principle is about doing things the right way and doing the right things from the start, to avoid waste in projects. For the ABB factory, we believe that it means that they shall focus on clean and simple processes. This in turn will make it easier to work in a more agile way and be able to respond better to change. Therefore, this principle partially merges with the next principle that handles simplicity.

From interviews, we got an understanding of the problem-solving culture at the ABB factory. The factory has a history of ad-hoc problem solving, but are now trying to now work more in a proactive manner, as stated from one of the employees:

> *"This factory has a history of doing things ad-hoc, to "extinguish fires" have long been the way we work here" ..." but we are trying to change this culture, and work more proactive."* (9a).

This problem-solving style has resulted in a general lack of work descriptions and operations, where one person stated worries that:

> *"Since we have had a fire-extinguishing [ad hoc] problem-solving style, much information is in people's heads instead of on paper. Therefore, it is hard for us when we need to replace employees"* (9b).

There are worries about how to keep competencies within the company since few positions have proper documentation on the day-to-day work.

At the ABB factory, we found through interviews that the transparency regarding insight into different peoples' work is limited. We found examples of lack of transparency in one role prohibited others to complete their own tasks:

> *"When [the absent employee] was away from work over a longer period of time, I had no chance of continuing my project as [the absent employee] is the only one doing this specific task with no one else knowing exactly how [the absent employee] does it. It is very frustrating for me as my project that was supposed to take two weeks ended up taking two months" (9c)*.

We also received data from interviews stating that they try to enhance transparency through cheat sheets:

> *"I have made cheat sheets for a couple of processes I have been involved in. I try to create some kind of work rotation and documentation which I have done for a couple of work tasks"* (9d).

Since this principle handles processes and frameworks, we will discuss it further in subchapter processes.

Agile principle 10

"Simplicity - the art of maximizing the amount of work not done- is essential."

The tenth agile principle is about simplicity and is focused on keeping the software as simple as possible and develop features on a need-basis (Cobb, 2015). Tibazarwa and Augustine (2017) suggested adapting the agile principle to more architectural simplicity rather than product simplicity. For the ABB factory, we believe that the principle is applicable in two ways; simplifying the current processes as well as keeping projects as simple as possible, focusing on the core of the projects.

The white-collar organization at the ABB factory is divided into different functional departments. We observed that the departments have individual ways of working, as no department operates the same way (Observation 31, 2019-03-20). For the cooperation between departments, there are defined processes where the different departments have regular meetings and information exchange. These reoccurring interdepartmental processes concern introducing or improving products, factory development, capacity planning, and quality improvement. These processes have a need to engage several departments for every project being carried out (Observation 32, 2019-03-20).

One person in the management team explains that:

> *"We have a clear communication channel with the R&D team where we apply roadmap and backlog for all projects, but it is still very new to us. [...] Other than R&D and sales, we do not have any structured channels to other departments other than the setup processes like the IBP-process"* (10a).

We observe that there is an occurrence of backlogs being used in the factory on a daily basis, but that these practices are limited to certain departments (Observation 33, 2019-03-20). Furthermore, we see that more than one department find it hard to choose what to work with, as activities and projects are coming from many different directions without a clear order of prioritization, as seen from the following quote:

> *"I get things from both the Hub and BU, which one should go first? It [the prioritization] has to be done before I receive it. The prioritization is not very well organized so it makes it hard for me to know what I should do first"* (10b).

Even though business cases are used as a mean of accepting a new project, it is only used partially in some departments. Business cases are used mainly in larger projects as a mean to make sure that the project is beneficial to implement and to motivate its required investments. (Observation 41).

We see that there is a varying degree of formality in their many projects. The degree of formality often correlates with how large the project is in terms of investments and man-hours. For less formal projects, there is not always a project leader. If there is not a project leader, individual departments decide when and how a project should move forward. There is also a handoff procedure that, according to one employee, might not be working:

> *"Sometimes I get information that a project is complete and then later I hear it is not complete from someone else. The handoff and communication between departments on what is done and not, do not work very well, which makes things unnecessarily confusing."* (10c).

One employee stated that there are processes they are supposed to do that are more complex then they need to be. The person continued to explain that if the process would be simpler, it would be used more often (Observation 38, 2019-04-01).

Once again, this principle handles processes and are therefore further discussed and analyzed in subchapter processes.

Agile principle 11

"The best architectures, requirements, and designs emerge from self-organizing teams"

We see that departments at the ABB factory have a high level of autonomy when it comes to how they work within each department, as seen from the following comment:

> *"We decide together within the department how we should work, who does what and what we are going to do today*" (11a).

In each department, there is a department manager who decides how to structure the way of working. While some departments use daily whiteboard meetings, others have an active backlog system connected to projects or scrum boards. Overall, there is a high level of autonomy within the departments (Observation 14, 2019-04-01). To the extent of our observations, we see no indication of ABB having problems with micromanagement (Observation 25, 2019-05-06).

During interviews, we recognized that employees in different departments in the ABB factory work on separate tasks with unique skills needed for each role (Observation 13, 2019-02-19).

It is hard for people outside the departments to quickly understand the different tools and procedures needed for handling the work.

Besides the structured processes, many department managers feel they do not know what other departments do or how they work. We see that some managers have a good insight into other departments, but little insight into how other departments structure their work, as seen from the following quote:

> *"I know the overall function of the other departments, but I don't know what their everyday tasks are*." (11b).

Many structures within departments are often informal, which would explain the lack of insight from other managers.

Observation 34 (2019-04-01) shows that the ABB factory's white-collar setup is functional departments where every department works independently in its own way. At the ABB factory, they tend to use vertical team practices in the sense that different department managers can allocate resources of her choosing, but the resource would still stay in the department working with other tasks simultaneously.

This principle will be discussed further in the subchapter teams since it involves setups and effect teams.

Agile principle 12

"At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly"

As the twelfth and last principle are focused on continuous improvement and short feedback loops, there are no apparent barriers in applying the same kind of principle in a manufacturing environment.

At ABB factory, there are routines regarding follow up and feedback called lessons learned. We see from the following comments that there probably is room for improvement:

> *"We do not work enough with lessons learned. We have them connected to projects but do not really follow up which makes [lessons learned] pretty outdated"* (12a),
>
> *"We do not do lessons learned in all projects but only in some when something has gone wrong"* (12b),
>
> *"We have routines for lessons learned but there are potential for improvement there. Does not work well in process or project work"* (12c).

We notice that this tool is forwarded from the central ABB organization and are not always favored locally in the factory. The tool is used in a moderate way and is considered by some as not working very well. Our impression is that this is a central ABB-tool which was not favored or praised by anyone in the local organization. Hence, there is no one making sure to follow up and go through with feedback loops. This made the process optional in the sense where it was only used in larger projects where lessons learned were a clear part of the overall project structure.

In the operational day to day work, employees rarely reflect on their work. When this question was brought up in an interview, one person gave the following answer:

> *"I actually haven't thought of that, I bet that there are many of my daily processes that could be much more effective. I only do as I always have done, without reflecting about it"* (12d).

This comment suggests that there might be room for improvement in the day to day activities. Several other interviewees had the same opinion, that there probably is room for improvement and that they seldom reflect around their work (Observation 35, 2019-04-01). Besides the absence of a given reflection process, one additional reason for this lack of reflection is, as earlier mentioned, a heavy workload for some of the employees.

Since short feedback loops and continuous improvement are dependent on which processes that are used and embraced, the discussion will be handled in the subchapter processes.

Discussion

The purpose of this report is to understand to what extent agile principles can be applied in a manufacturing company, i.e. ABB. We found that ABB is extensively implementing some agile principles, while it is partially fulfilling several other agile principles. Finally, some principles are not applicable without extensive modification due to the differences in nature between ABB's production and software development. Since the agile principles were originally created solely for software development, some principles are not applicable in a non-software environment. While some principles do not apply directly from the manifesto definition, ABB has embraced, modified and adopted most of the core values from the 12 principles. As explained by Straçusser (2015), other non-software companies have successfully adopted, modified and implemented agile principles. These companies have not tried to adopt the principle word for word but instead tried to modify the principle to fit their specific needs whilst keeping the core message of each principle intact. Building on our case, we adopted the principles to fit how the ABB factory understand and embrace them, whilst keeping the core message of each principle intact.

We found that the principles suitable for the ABB factory all have attributes that could be connected to certain categories. By analyzing data together with theory around the agile principles, we found that there are similarities in the way that the ABB factory is applying certain principles. When we analyzed how each agile principle acquires meanings into a manufacturing environment, we observed that some principles merge together in their practical translation, meaning that similar activities at the ABB factory can satisfy more than one agile principle. We grouped the principles into four categories because of how the principles are translated into the ABB factory operations. To group, we identified dependencies between principles both in the way they affect each other and how they are understood and enacted in the ABB factory's daily operations. Hence, we clustered the principles into four meaningful categories, i.e., communication, teams, processes, and motivation. Grouping like this is common within thematic analysis as described in the Method chapter and promoted by Aronson (1995). We choose to use categories after careful consideration about which principles overlap and are strongly connected in ABB. However, we did not achieve mutual exclusivity as categories in some instances overlap.

In category communication, we will discuss customer collaboration in the form of advantages with customer communication and its frequency; we will also discuss face-to-face communication and its applicability to the ABB factory (principles 1, 2 and 6). We found that communication could be a well-fitted category as customer collaboration at the ABB factory is based on tight communication with customers. In agile principles, there are two characteristics of teamwork mentioned when working agile. These are cross-functional teams and self-organizing teams (principles 4 and 11). These will be discussed in the category teams and compared with how ABB is currently working in teams. Another category is motivation, where workplace motivation and autonomy in ABB are discussed, reflected and compared to agile theory around motivation. Because we found strong theoretical connections between motivation and autonomy (Sharp & Ryan, 2011), we have chosen to group together principles regarding these two topics (principles 5 and 8). The last category is processes. In an agile way of working, simplicity and clarity in processes are central, whereby we analyze the ABB factory's processes to see if they are or can embrace an agile way of working. In this category, we are also discussing the value of reflecting upon one's work, and how the ABB factory currently is doing just that. Common for the principles discussed in this category is that they are affecting work processes and procedures in different ways (principles 9, 10 and 12). The categorization of each

principle can be seen in *table 2*. After discussing the categories, we present and discuss results from round three interviews with management team members at a sister factory to the ABB factory together with a summary of insights from all sections of the discussion.

Table 2 - Agile principles divided into categories.

Agile Principle	Category
1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Communication
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Communication
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.	Not Applicable
4. *Business people and developers must work together daily throughout the project.*	Teams
5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*	Motivation
6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*	Communication
7. *Working software is the primary measure of progress.*	Not Applicable
8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*	Motivation
9. *Continuous attention to technical excellence and good design enhances agility.*	Processes
10. *Simplicity - the art of maximizing the amount of work not done- is essential.*	Processes
11. *The best architectures, requirements, and designs emerge from self-organizing teams*	Teams
12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly*	Processes

Communication

With communication, we refer to sending and receiving information, as stated by the Oxford dictionary "*The imparting or exchanging of information by speaking, writing, or using some other medium.*" (Oxford University Press, 2019a).

In this category, we have gathered three principles that deal with communication which are principle 1 ("*Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*"), principle 2 ("*Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*") and principle 6 ("*The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*") (see *table 3*). These principles regard communication in the way that they either directly or indirectly, through customer collaboration, affect the view of how communication is used within the company. In the case of the ABB factory, they use a continuous dialogue with their customers to achieve customer collaboration.

From the literature, there are two central ways of communication promoted by the agile principles. These are customer collaboration and face-to-face communication (Agile Manifesto, 2001). We find that the ABB factory is satisfying these traits to a large extent, as will be shown in the following subchapters.

Table 3 - Agile principles related to communication.

Agile Principle	Category
1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Communication
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Communication
6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*	Communication

Customer collaboration

The reason why customer collaboration is included in the category "communication" is because we found that at ABB, collaboration with customers translates mainly into ongoing communication.

The ABB factory has a few large customers that purchase the majority of their products. A close relationship and frequent communication with customers helps gain benefits from continuous feedback, as described in principle one and two by Boral (2016) and Measey (2015). Benefits from continuous feedback are for example that the ABB factory has a continuous dialogue with their customers regarding product development and production planning. Because of their close collaboration with customers, they have a strong product portfolio on the Nordic market. This type of relationship is called by Barringer and Harrison (2000) as an alliance relationship. It is

often used to increase knowledge between the corporations and in that way, increase their strategic advantage.

According to Lei and Slocum (2005), one of the risks of producing physical, high-volume products such as the ABB factory while having a large market share is that companies focus too much on standardizing the product. That the product stops improving since energy is focused on cost reduction in production instead of fine-tuning the product, which might open up for competition. Continuous feedback loops are essential for the product development, to make sure that a company has a product that fit the market in the best way possible (Akbar et al., 2018) and thus helps retain a strong market position. De Wit (2017) also emphasize the importance of having a good fit with the market environment. He continues to explain that without a good fit, the demand of the market environment will not be met, and thus the company will underperform. We observed that the ABB factory is trying continuously trying to update its product portfolio, through R&D processes that are highly connected with customers.

Agile principles explain the importance of accepting change in production. For the ABB factory it is hard to change a product after production is started. They do however offer a very liberal product return policy to their customers. This policy has a similar function, to allow customers to change quantity even late in production. The ABB factory states that this policy is a part of their premium product offer.

Face-to-face communication

Face-to-face communication is included in the category "communication" because it is a central way of communicating within agile practices as well as within the ABB factory. According to the sixth agile principle, face-to-face is the preferred way of communicating within teams. This is strengthened by research conducted by Kupritz and Cowell (2011) that states that additional benefits may arise from face-to-face communication, such as building relationships and trust. Overall, we observed by comparing interview results that face-to-face communication seems to be the preferred way of communicating at the ABB factory.

On a day to day basis, we discovered three areas of communication used in the ABB factory; within departments, within teams and other non-repetitive and informal talks. With non-repetitive communication, we refer to smaller questions asked between people of different departments that are not directly linked to a project or process. Within departments, we observed a high level of face-to-face communication since the departments are small and usually work from the same office space. Within the different inter-departmental teams, on the other hand, we observed that there is less face-to-face communication and the team members sit more segregated from each other. One of the main obstacles with communication within an agile context is co-location, as described by Boral (2016). Important to note is that in The ABB factory case, the co-location is only in the case of a few minute walk between office spaces in the same building, and not in two widely separated geographical areas. Boral further explains that this constraint could be mitigated by having physical meetings, which at the ABB factory often is doing since the distance of separation is not very far. We observed physical barriers between the two office spaces at the ABB factory as an obstacle for face-to-face communication. Even if employees prefer to speak face-to-face, they sometimes e-mail or call instead, when contacting someone in the other office space. Even if the answer might be satisfiable this way, other benefits of face-to-face communication - such as building relationships (Kupritz et al., 2011) - is not accessed. In the ABB factory, we have observed that some positions work independently and thus may not benefit in the same extent from face-to-face communication. We also observed that there is a lot of virtual teams at the ABB factory,

since they are working in a matrix-organization with collages at other factories. We are however not investigating this part, since it is outside the delimitation of this report.

Several departments at the ABB factory have recently started implementing morning stand up meetings at an action board, where they can discuss the work and problems that they may face. According to Measey (2015), this way of communicating face-to-face with visual aids are very effective. We have observed from several interviews that this new way of starting the day has had several benefits, such as improving the overview of what everyone in the department is working on and created an area to structure and tackle work and problems. This is a method that is very common in agile frameworks, such as Safe, and are often one of the key-stones to good teamwork.

To be able to use face-to-face communication easier and utilize all the benefits from this way of communicating, the white-collar departments would sit together in one office space. This is supported by Cobb (2015) who states that if possible it is desirable to have face-to-face communication because of the information-sharing effectiveness. We observed that this is not possible right now, but the ABB factory seem to have made a good prioritization on who should work in which office space. From the interviews, we observed that departments working closer to the actual production have more frequent communication amongst each other, and therefore benefit more from shared office spaces. However, since these are not used often, the ABB factory does not get all the benefits from osmotic communication (i.e. overhearing others), which may help with problem-solving (Boral 2016).

Face-to-face communication is the richest way of communicating (Measey 2015), but it is not always the most efficient – since this richness is not always necessary. Face-to-face is often used in areas where there is a high level of uncertainty (Kupritz et al., 2011), and that is not the case at the ABB factory. The ABB factory is observed to be working in a moderate or low change environment regarding how things are done and what is being produced. Face-to-face communication is not the general solution, but should be implemented in the cases where it may be advantageous (Cobb, 2016).

Insights

Main takeaways from communication within agile principles at ABB are that customer collaboration is important to strengthen market position, as well as having a good level of face-to-face communication for having an effective way of communicating within the factory. The ABB factory is observed to have strong customer collaboration as well as a high level of face-to-face communication. The KPI's associated with communication are mainly regarding customer satisfaction and ensuring future revenue streams as customer collaboration improves the products' fit to market. Effective communication will also improve the overall efficiency in the factory, indirectly affecting most KPI's.

Teams

In this chapter, we discuss agile principles that cover ways of assigning people to work in teams. In the agile principles, we found that two principles focus on teamwork. In particular, two team characteristics are mentioned: cross-functional teams mentioned by principle 4 ("*Business people and developers must work together daily throughout the project*"), and self-organizing teams mentioned in principle 11 ("*The best architectures, requirements, and designs emerge from self-organizing teams*") (see *table 4*). Our data analysis revealed that there are to some

extent cross-functional teams at the ABB factory. We also see that self-organizing teams are developed at the ABB factory, and that they have captured most benefits provided by this kind of team, as explained by Boral (2016).

Table 4 - Agile principles related to teams.

Agile Principle	Category
4. *Business people and developers must work together daily throughout the project.*	Team
11. *The best architectures, requirements, and designs emerge from self-organizing teams.*	Team

Cross-functional teams

Cross-functional teams include employees from different company functions and are used to increase cooperation between corporate functions to create a wide arrange of competencies within a single team (Galbraith, 1994). When assessing the applicability of principle four to the ABB factory, we observe, to some extent, existing communication barriers between company departments.

As findings suggest, there are limited structured communication channels between departments. A way to enhance communication between different departments that are typically used within agile is cross-functional teams and cross-functional forums (Beck et. Al., 2001). At the ABB factory, there are some cross-functional teams already operating within a department. However, we observe that there seems to be a potential need for increasing cross-functional activities as a way to further improve communication between departments.

In the software environment, there is often a focus on having several competencies within each team to be able to carry out tasks independently (Scrum.org, 2019). At the ABB factory, we did not observe a direct need for competency sharing between departments, but rather an understanding of each other's roles and working processes. This understanding could lessen empathy-gap as supported by Tibazarwa and Augustine's case study (2017) as well as less sub-optimization between departments.

One of the outcomes of cross-functional teams and forums is a better understanding of each other's work and needs. We observe that there are several situations where different departments struggle because of counterproductive KPIs, such as production departments ITOs and cost-saving order quantity KPIs from the procurement department. By working closer together, departments may be better aware of each other's work and goals, and thus be able to work better together to benefit the factory, avoiding sub-optimization (Measey, p119-122, 2015). As we have observed that sub-optimization exists within the factory we believe that the ABB factory is not completely fulfilling principles regarding cross-functional teams.

One example of an area where we observe a potential for better cross-functional communication is between product planning and sales. This because of the two departments being dependent on each-others work and information whilst being directly affected by each-others work. More frequent communication between those departments may result in more precise planning after customer needs. This, in turn, could positively affect KPI's like inventory turnover (ITO) and the number of finished goods. Storbacka et. Al. (2009) describes that the role of sales departments is changing to a more integrated part of the business, that cooperates more with

other departments to benefit the company in other ways than just plain sales. We observe that the ABB factory do this to some extent, by inviting the sales department to internal factory processes (e.g. IBP meetings). The sales department are also located close to other factory functions, being exposed to osmotic communication, as described by Boral (2016). What is essential when creating cross-functional teams is always to have a clear purpose of why they are implemented and follow up and analyze the effect of the teams (McDonough, 2003). Else, the teams may become a waste of time and instead become a liability for the factory. Just as the example above with planning and sales, other departments at the ABB factory can benefit from increased integration. As we found from interviews, many departments work on a daily basis with other departments in order to achieve their goals and activities. However, we also found tension in-between departments as goals and prioritization are not aligned. As all departments can benefit from a continuum of increasing integration with other departments, the concept of cross-functional teams is supported by Measey to be able to contribute to increased inter-departmental integration.

Self-organizing teams

Self-organizing teams internally decide how to best reach project goals. This is in contrast to ordinary teams where a project manager often decides when and how things are done in order to reach a goal (Hoda et al., 2010). In these teams, employees themselves decide how to structure their work and distribute tasks. Measey (2015) argues for the importance of having basic guidelines and goals for teams to adjust around while deciding the details and tasks themselves. Boral (2016) suggests that teams should decide their own design and completely operate as they like, creating ownership and motivation for employees. However, Boral (2016) notes that this might put pressure on the teams being able to design a sufficient framework that does not restrict them in their work going forward. Kirkman and Shapiro (1997) describes self-organizing teams, or self-managing work teams as they refer to it, with the following quote: "*Much of the research describing SMWTs* [Self-Managing Work Teams] *includes the following attributes: the team controls individual member task assignments; the team has an identifiable or "whole" piece of work; the team has responsibility for its own quality control, purchasing, absenteeism, and training; and the team receives group compensation and performance feedback.*".

We observed that departments and teams at the ABB factory set their own framework and decide for themselves when and how to carry out the activities - enabling high autonomy. Because of the ABB factory's small size and many departments, white-collar employees have a lot of autonomy in deciding how they should go on about their work. There are processes in place to support (not control), but most activities carried out are made on an individual level where the execution is decided by the employee. Consequently, we conclude that the ABB factory is already working with self-organizing teams.

Self-organizing teams enable autonomy that helps motivate staff and make departments more efficient - which in turn will affect the overall performance of the factory. We observed that there is a high level of autonomy and self-organizing team practices within the ABB factory.

Insights

Main takeaways from teams within agile principles at a manufacturing factory are that cross-functional teams provide a better understanding of others work and needs. As the ABB factory is discovered to have counterproductive targets between departments, there is a potential use of cross-functional teams to stop sub-optimizing in each department. Self-organizing teams are

argued to provide autonomy and motivation, which is found to be used in the ABB factory to a large extent due to departments working autonomously. In order to mitigate the counterproductiveness of KPI's currently existing, multiple KPI's will increase. By having KPI's that are better aligned with factory needs, profitability KPI's will be positively affected as supported by Grant (2017) explaining the link between aligned KPI's to help achieve strategic business goals. De Wit (2017) strengthen this statement and explains that without proper alignment, the organization will suffer from inefficiency, conflict and poor external performance.

Motivation

With motivation, we refer to the way of getting people enthusiastic of work, stated by the Oxford dictionary as *"Desire or willingness to do something; enthusiasm."* (Oxford University Press, 2019b).

The principles grouped in this chapter all have a clear link to motivation. In this category, we grouped two agile principles: The fifth agile principle that addresses the importance of building an environment that support motivated individuals and autonomy ("*Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*"), and the eighth principle that addresses the need for a sustainable workspace ("*Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*") (see *table 5*). According to Cobb (2015), sustainable work pace is a prerequisite for motivation. Therefore, although principle eight regards sustainable development, it is still strongly connected to motivation, and thus is handled in this chapter.

Motivation is a very large subject, and in this research, we have tried to examine which parameters the employees at the ABB factory sees as essential for keeping a high motivational level. In this chapter, these parameters together with parameters we have observed are discussed and analyzed, but we have limited the chapter to mainly focus on motivation connected to the agile principles and the case factory.

Table 5 - Agile principles related to motivation.

Agile Principle	Category
5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*	Motivation
8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*	Motivation

Factors affecting motivation

Principle number five is aimed towards working in projects with people motivated enough to control and lead their own tasks and activities to achieve a clearly defined goal (Cobb, 2015). From Medinilla (2012) we saw that team autonomy is important when tasks are complex, non-repetitive and analytical. According to the findings, most people expressed activities that were non-repetitive, complex and analytical. Literature also suggests (e.g. Medinilla, 2012; Measey,

2015; and Cobb, 2015) that there is an incentive to increase autonomy in order to increase the motivation in the workforce. From observations, we find that there is generally a high level of autonomy in the different departments.

Overall, we observe from interviews that a majority of the employees are satisfied with their motivation in their workplace. From interviews, the main identified areas affecting motivation were training, autonomy, responsibility and being recognized. These areas are somewhat in line with Medinilla's (2012) five areas for a motivated workforce (learning, self-organization, security, networking, and vision). The areas identified from the ABB factory can be connected to Medinilla's areas in the following way: training – learning, autonomy/responsibility – self-organization, being recognized – security. The interviews gave an indication of having a lack of vision by some workers not being aware of certain feedback processes or motivation mitigation (i.e. how management work to improve motivation) that were more visible to others. We found that the ABB factory has started monthly meetings in order to share the factories performance and goal with all staff. The networking opportunities at the ABB factory were perceived as satisfied because of the opportunities provided by the small size of the factory and the large size of the company. The small factory enabled personal networking while the large company enabled networking towards other employees within the same function and interests. Thus, we see that of Medinilla's (2012) five areas, there is only vision that is not satisfied. Hence, it is not surprising that we found the majority of employees having high motivation.

According to Sharp and Ryan's statement (2011), in order to be motivated, team members should work in projects that are meaningful, offer assessments and permit autonomous work. The ABB factory is observed to have meaningful tasks and autonomy. They are however not always assessing work done with any tools of reflection. Which also prevents personal growth and development. Reflection will be further discussed in the subchapter processes.

We also find activities in the factory that reduces motivation. Observations suggest that the increasing workload reduces workforce motivation. This issue will be addressed in the next subchapter named sustainable workload. From interviews, we have also noted that there sometimes is a lack of ownership, support and project/department coordination of goals and activities that creates a level of irritation and frustration, which in turn decrease motivation.

Overall, we see that the motivation in the ABB factory is high. However, it is important to constantly monitor the motivational level – in order to maintain the motivation and thus maintain the productivity of the factory, as Measey suggests a strong link between productivity and motivation (2015). From interviews, there is an ambiguity of how motivation is dealt with as some believe they are working on it while others think that nothing is being done.

Sustainable workload

Cobb (2015) interprets the eighth principle as by having a sustainable working environment, which will encourage creativity and motivation. Measey (2015) explains having a sustainable working environment will help prevent technical debt that may arise as a result of cutting corners while being stressed.

A downside of having an unhealthy work pace is that employees rarely have time to reflect on work conducted. This reflection is strongly related to agile principle 12 regarding retrospectives and is essential for development and performance (Di Stefano et. al., 2014). We will discuss reflection further in the chapter processes.

The factory has a long history of ad-hoc problem-solving (i.e. fire-extinguishing), causing difficulties in having a sustainable work pace. But recently, the ABB factory is changing its problem-solving method to a more proactive method. However, this old culture is still observed in the factory today. If the ABB factory does not have a sustainable pace of working, they will have less time to work proactively and will continue to extinguish fires. Quotes explain that certain employees are still using ad-hoc problem-solving as a result of a heavy workload. According to Wang & Wang (2017), ad-hoc problem-solving can be advantageous in some environments, but not in the slow-change environment that the ABB factory is operating. In the environment of the ABB factory, there is instead an advantage of having a structured and proactive way of working, which will be more advantageous in the long run. In contrary to companies in a fast-changing environment where more structured and proactive processes instead will be a waste of time, as they will not always be applicable when the environment is changing.

Although costs may increase when creating a more sustainable environment regarding work pace, Medinilla (2012) explains that agile leaders are always supposed to favor benefits in the long term before the short term. The ABB factory is constantly rightsizing their organization to make it more cost effective. It is important for the ABB factory to constantly monitor the changes in employee responsibilities in order to maintain a sustainable work environment. By constantly monitoring, the ABB factory will make the organization more sustainable in the long run.

Overall, we observed that there seems to be a sustainable workload in white-collar departments. We also observed by comparing interview results that most employees have rather high motivation. There are however some departments that are understaffed, resulting in an increased workload for them. In some departments, the motivation is lower than in other departments. If this issue is not addressed, the quality of the work done might decrease - resulting in lower quality and technical debt in processes and products as explained by Measey (2015).

Insights

From agile theory, autonomy and workload are main factors influencing the level of motivation, which in turn affects productivity. Overall, the motivation at the ABB factory is observed as high with some deviation regarding sustainable workload and a clear vision of how motivation is mitigated. The sustainable workload is observed as hurting when the ABB factory applies the ad-hoc "fire extinguishing" style, but they are trying to change to a proactive way of working. By having a sustainable workload, KPIs regarding safety and sick-leave will be positively affected as supported by a study conducted by House (2017) showing a strong correlation between an unsustainable workload and negative personal well being and effectiveness. A positive motivation also affects overall performance of factories (Bhatti, Awan, Razaq, 2014) , and thus are indirectly affecting several of the factory's KPIs.

Processes

We are using the Oxford definition of processes as "A series of actions or steps taken in order to achieve a particular end." (Oxford University Press, 2019c).

In this category, the principles regarding processes are analyzed and discussed. The agile principles in this section are those affecting different parts of processes within a company. These are principle number nine ("*Continuous attention to technical excellence and good*

design enhances agility."), principle number ten ("*Simplicity - the art of maximizing the amount of work not done- is essential.*") and principle number twelve ("*At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*") (as seen in *table 6*). Traits such as clear and simple processes, feedback loops and retrospect, are promoted by the agile principles (Measey, 2015; Medinilla, 2012). As suggested by Atkin, Borgbrant and Josephson (2003), processes that are transparent increase efficiency (which is doing things right) and effectiveness (which is doing the right things). This will ultimately increase the possibility of reaching the strategic goals of the ABB factory. We find that the ABB factory has many different processes in each department, but also common processes that are used by all departments. Processes used by all departments are for example information systems provided by the ABB organization as well as a system for generating feedback. We found that the process for generating feedback in ABB was not being used properly or actively by the ABB factory today. We also found from interviews that there is potential to improve and develop the existing tool.

Table 6 - Agile principles related to processes.

Agile Principle	Category
9. *Continuous attention to technical excellence and good design enhances agility.*	Processes
10. *Simplicity - the art of maximizing the amount of work not done- is essential.*	Processes
12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*	Processes

The ninth principle emphasizes that a good design will help companies respond to change more easily. We find this principle challenging to directly translate to the environment of the ABB factory since they work in a very product-driven environment with more non-dynamic tasks than in software development. While software developers create products that can change from day to day, the ABB factory produces standardized products like cable cabinets and electric switches that do not change in the short term. To capture the value of this principle, we believe that it can be translated into transparent and simple processes that are easy to understand. Furthermore, transparent and simple processes will be more easily maneuvered (Boral 2016) and more cost-effective (Measey, 2015).

The tenth agile principle about simplicity is originally focused on keeping the software as simple as possible and develop features on a need-basis (Cobb, 2015). Tibazarwa and Augustine (2017) suggested, in their case study of non-software process automation, to modify the agile principle to a more process simplicity (e.g. making working processes as simple as possible) rather than only product simplicity. For the ABB factory, we believe that the tenth principle is applicable in a two-fold way of simplifying the current processes of how they work as well as keeping the projects as simple as possible, only focusing on the core value-added parts of the project.

The twelfth principle is focusing on continuous improvement and short feedback loops (Measey, 2015). Today, we observe that the ABB factory is lacking proper processes for conducting reflection. Reflection is a vital part of gaining continuous improvement, as described by Measey (2015).

Transparency

Changes in transparency may lead to projects being more easily maneuvered (Boral, 2016) and more cost-effective (Measey, 2015). The changed processes will help employees to understand each other's tasks and situations better, which will improve transparency between departments and thus improve the foundation for working together. Changes in transparency will also help employees to understand why an activity is carried out, and in what ways it is helping the factory. At ABB, we observed employees having limited transparency between different departments. With increased transparency, departments will work better together which ultimately will increase the overall effectiveness at the factory.

With more transparency in roles and processes, it will be easier for employees to understand new roles and processes. We observed that the ABB factory generally does not have documentation for processes and tools, with a lot of information about how things are run bound to key people. This is a risk since ABB will lose valuable information and potentially harm its production if key employees leave the organization without sharing their intellectual knowledge. It may also delay and uphold operations since sometimes only a few people know how certain processes are done, as supported by interviews.

We see from the findings that the ABB factory has a history of working with extinguishing fires, instead of working proactively. If there were to be a transparent framework for different types of tasks, employees would save time and be able to work more proactively. In this way, the employee will be better prepared for a more shifting environment. Since the factory is working in a low-dynamic environment with slow shifts in the market and known information needed to run the business, according to Wang & Wang (2017) the ad-hoc problem-solving technique that has been used is not preferred.

By making roles, activities, and processes more transparent through definitions and documentation, the ABB factory can make knowledge sharing easier and create a better environment for working together (Smith, 2015). It is however essential that roles and processes have a definition and a link to how they will help the factory in order to avoid unnecessary work, as explained by Cobb (2016). We have noticed from observations that it is not always clear who have responsibility for certain goals or projects. We also noted that departments seldom synchronize work, projects, and goals which cause ineffectiveness and sometimes organizational inertia. As all departments have their own agenda but are often co-dependent on multiple departments to get things done, there is no mutual prioritizing on where to put resources. This leads to sub-optimization as each department is focusing on completing their own projects and processes.

From observations, we have found that there is an opinion that the ABB factory might increase transparency, efficiency, and motivation by having a common way of prioritizing and have someone that is responsible for setting up clearly defined goals that are mutual for the entire factory. Latham (2004) supports this claim by stating that clear and specific goals improves performance and has a positive impact on motivation.

Another way of increasing efficiency, effectiveness and reducing risks of losing valuable information is by having a process of knowledge sharing. By having for example cheat sheets, information will be stored within the company – and processes will be more effective since time wasted on trying to understand new procedures will be reduced. We observed the ABB factory to some extent use cheat sheets but only in a few departments and processes.

We discovered that the ABB factory is using business cases when assessing and prioritizing new ideas against the factory's KPIs. We observed that business cases are used in large projects but sometimes neglected in other, smaller, projects. They are also used more or less in different departments where some departments use business case for the majority of projects while others use it seldom. Measey (2015) states that business cases shall be used in all projects and new ideas, in order to prioritize correctly. Measey (2015) also suggests that there should be a clear use of business cases in order to prioritize a backlog which should be relatively similar across departments. By properly using business cases, the new initiatives will also fit with the company's business model and thus be a part of the ABB factory business model innovation that will help them gain competitive advantage (Massa & Tucci, 2013). If clear use of business case is used together with a similar prioritizing backlog, fewer projects will be active at the same time and less waste is generated in documentation, forgetfulness and focus on many projects. This is important since it is more effective to focus on a few projects than several, as supported by Adler and Benbunan-Fich's (2012) study showing an inverted U-shaped relationship between multitasking and performance efficiency (i.e. productivity). For large projects, we observed that business cases are used with a defined purpose. The business cases are mainly used to determine whether to pursue a project or not.

Simplicity

As Cobb (2015) points out "simplicity is essential", by starting simple and expanding later is key to maintain simplicity. Lei and Slocum (2005) explain that simplicity is important in the slow-changing environment that the ABB factory is operating in (to him called "Steady Evolution"). Since the environment and products are changing at a slow pace, companies shall focus on simplifying and making processes more cost-efficient. Lei and Slocum (2005) do however warn that there is important to not over-standardize products and stop listen to customers, which sometimes is the case when the focus is put on simplifying and cutting costs.

We have observed that simplicity is connected to the level of formal authority of processes at the ABB factory. Hence, those processes that have an assigned project manager work smoothly, because of clear ownership. On the contrary, we identified problems when projects did not have proper ownership or a formal handover to other departments. In the latter case, projects got stuck or deprioritized which ultimately led to a high number of open projects at once. Although Medinilla (2012) emphasizes the importance of having an appointed leader for the success of agile projects, we have found that within the ABB factory, some projects do not have a project owner, which sometimes create unnecessary friction and confusion. Note that having an appointed leader is not the same as having a manager. In this aspect, the appointed leader supports the team in the journey forward with shared authority in contrary to a manager using command- and control management style. As supported by Medinilla (2012) the right kind of leader is an enabler of self-organizing teams instead of a disabler.

Simpler processes mean fewer co-dependencies between employees which make work more efficient and in turn increase performance (Lumpkin & Dess, 2006). There will also be a more significant understanding and transparency within the organization that will help co-workers to work together and make the right priorities that in turn will benefit the strategic goal. As identified in interviews, a couple of processes of the ABB factory is not being used as much as hoped by management. If the ABB factory would analyze and simplify the process it might be used more often, as supported by interviews. By using simple processes, you are actively avoiding waste and unnecessary work by focusing on the core parts of the project (Measey 2015).

Even though we have found that some processes may be better used if simplified, we find it hard to determine if the processes at the ABB factory is at the right level of simplicity. This because there is difficulty to see if there is the complexity or the lack of insight/transparency that make some processes hard to execute.

Reflection

As discovered, the ABB factory has an existing routine that enables feedback and work improvement, called Lessons Learned. The tool is used for mainly larger projects in order to reflect on what has happened and why, but are considered to not always be used very well. Lessons Learned are often used when something went wrong. From interviews, we see that the ABB factory does not follow up on Lessons Learned to compare if there has been any improvement or successful change that has come from using Lessons Learned. Since reflection is an essential part of learning and developing work performance, having a functional reflection tool or process is very important. This is supported by Di Stefano, Gino, Pisano and Staats (2014), explaining in their article how learning can be more effective when coupled with reflection and more productive by reflecting on what one has learned from its experiences.

Even if agile principles praise the idea of having reflection-tools in order to develop, the ABB factory does in some cases face difficulty because of their organizational structure. While retrospectives (i.e., a tool to reflect upon one's work) are designed for teams that endure for multiple projects (Scrum.org, 2019), the ABB factory designs new teams for new projects, choosing from resources that are currently available from different departments. That structure complicates continuous growth for project teams as they are often dissolved after each project is finished. At the ABB factory, project teams are usually dissolved, but there are also permanent teams present (e.g., management team and functional/departmental teams).

We see from interviews that time is also a factor why reflection is not done since some employees believe they have a heavy workload and that reflection then is not prioritized. We also see that conducting a Lessons Learned is not viewed as a necessary part of projects, as multiple interviewees say that they skip this part.

According to Measey (2015), continuous reflection about work done is an essential part of agile and an essential part of personal continuous improvement. There should be room for reflection not just in projects, but in daily work and processes as well (Garud et. Al., 2011). The ABB factory has today no tool for reflection around processes, individual way of working or smaller projects, and may thus not be continuously improving in a pace that would be possible if continuous reflection were applied and promoted by the organization. According to Dittrich et Al (2016), having different types of reflection opportunities, and especially opportunity for employees to have reflective talks together, can increase routines (including processes).

Insights

Main takeaways from processes within agile principles at a manufacturing factory are that processes shall be simple and transparent to give an effective result. Transparency can lead to the factory working better together through increased knowledge sharing and joint synchronization of work tasks between departments with visible backlogs and use of business cases. The ABB factory is observed to often have complex processes, and that insight and knowledge to several processes and tasks are limited. While theory praises the presence of a project leader to claim process/product ownership, ABB does not always have an appointed project leader for all projects, which sometimes creates confusion. From theory, it is crucial to

have a working way of reflecting upon ones work to be able to constantly improve and develop. The ABB factory has one tool for reflection on large projects, but do not use it very often as it is sometimes only used in projects gone wrong. Furthermore, there is a lack of tools and processes in smaller projects and in their day to day work. Since having proper processes helps improve effective and efficient work, most of the factory's KPIs will be positively affected by embracing the traits regarding processes from agile.

Comparison to a sister factory

Overall, the sister factory to the ABB case factory where we conducted three interviews is functioning in quite a similar way to the ABB case factory. The sister factory has come a longer way in using agile and lean tools in their everyday work compared to the ABB case factory. This is noticeable as most of our findings regarding the sister factory display a higher level of maturity around agile practices than the ABB case factory. Below we are briefly discussing how the sister factory is working with the four categories, and are especially focusing on ways that The ABB factory can mimic in order to easier reach their strategic goals.

The sister factory also understands the value of customer collaboration. Although the factory does not have a local sales team, they instead have monthly talks with a customer care organization to make sure that their products are in line of what is needed on the market. Opinions from management are that this has been very effective, and management believes this is one of the reasons that they are amongst the largest actors in the global market.

Their way of communicating internally is also similar to the ABB case factory. However, it seems like they are benefitting more from everyday morning meetings using specially designed whiteboards. Reasons for this could be that they are further ahead in implementing a lean transformation with a strong focus on changing the entire factory one step at a time. These morning meetings are perceived by management as a way to significantly increase work transparency and communication between employees and what they are currently working on.

The factory also assembles teams the same way, which is not surprising since they are working in the same company. They do on the other hand always have a project manager for all projects that are in charge of coordinating and making sure that the project is running forward.

The motivation at the factory seems to be high, just as in the ABB factory. The management team explains the reason for the high motivation with autonomy, salary and especially clarity and understanding of how they contribute and add value. The manager of each department has a high level of autonomy.

The sister factory is working a lot with instructions for all roles, to always have detailed instructions and keeping instructions up to date. They are also working a lot with transparency and standardization, which helps to reduce waste and makes it easier to work together and understand each other's roles and tasks. Overall, they have a lot of focus on reducing waste. By breaking down KPIs and having someone responsible for every KPI makes it easier to have an overview and makes sure that every part of the factory's goals is constantly monitored and worked with. One part we have noticed that is of importance to motivation amongst the employees is the prioritization of the KPIs. As we mentioned earlier, some KPIs are contradicting each other – meaning that by increasing one, another might decrease. The factory has solved this by having a joint dialogue at management meetings where they discuss what level is most strategic to aim for. And that after deciding these levels, the person or department

responsible for a KPI will not be punished for not reaching a goal, if they have decided not to pursue that specific KPI. Similar to the ABB case factory, the sister factory is not working actively with reflection. This is one area where they thought that there were potential for improvement.

Summary of the insights

Today, the ABB factory is partially implementing several of the agile principles. Based on the ways the ABB factory implements these principles, we have found that they could be categorized into four high-level categories (communication, teams, motivation, and processes). These categories are defined based on both links and overlaps between principles, and how the ABB factory understands and translates the principles into practice. From a communication point of view, we find that customer collaboration and face-to-face communication are supported by the agile principles and implemented by the ABB factory. This is helping the ABB factory to gain a stronger market position and improve communicating efficiency, as stated by team management members. We also noticed that these traits of communicating are also implemented at a sister factory to the ABB factory with similar effects. Looking at teams, we see that there are two important team-attributes that are supported by the agile theory: being cross-functional and self-organizing. We see that the ABB factory is partially using these attributes to guide the team composition and organization. If used in the right way, these attributes of teams will affect autonomy, motivation, sub-optimization, and information sharing within the company. In the category of motivation, we find that autonomy and sustainable workload are two important factors for achieving high motivation. The ABB factory is to a large extent implementing these factors. High employee motivation positively affects productivity at the factory. From a processes perspective, we have found that it is important to have simple and transparent processes to be effective and efficient. It is also important to have tools and processes for reflection in order to have a high level of continuous improvement. The ABB factory often has too complex and non-transparent processes, and vague routines for reflection. At the sister factory, they have successfully implemented a transparent working landscape with help from agile tools, but have also failed to implement a tool for continuous reflection for the majority of the departments. From each category, we saw that agile pratices can improve many of the factory's KPIs.

Recommendations

Based on the four categories of communication, teams, motivation, and processes, some recommendations to ABB emerged that we discuss below. Overall, these recommendations revolve around the improvement of communication, the maintenance of high motivation among employees, the extensive use of cross-functional teams, and the improvement of processes. Recommendations for each category are not mutually exclusive, as the recommendations may affect several categories. We believe that by implementing these recommendations, KPIs at the ABB factory will improve, thus helping the factory to reach its strategic goals. To further facilitate the changes suggested within the recommendations, an agile mindset can help employees to understand why changes are made and what the desired outcome is. Based on insights from the categories, we are suggesting the ABB factory to consider the following recommendations:

Communication:

- The ABB factory is recommended to maintain, and continuously improve, a strong collaboration with customers and sales team.
- The ABB factory is recommended to expand and use brief, small meetings to improve work transparency, workload and insight of which tasks are being done

Teams:

- The ABB factory is recommended to oversee where it might be advantageous with more cross-functional teams, in order to improve information sharing between departments.

Motivation:

- The ABB factory is recommended to maintain a high level of motivation and productivity by moving away from ad-hoc problem solving while maintaining high autonomy.
- The ABB factory is recommended to oversee the workload of the white-collar employees to make sure that they are all working at a sustainable pace. By working at a sustainable pace, the employees will be able to work in a more proactive way as well as be able to reflect more around tasks and processes.
- The ABB factory is recommended to increase the visibility of motivation processes to maintain high motivation.

Processes:

- The ABB factory is recommended to reduce the ad-hoc problem-solving technique in order to maintain a sustainable workload and thus high motivation.
- The ABB factory is recommended to examine in what way they can simplify internal processes.
- The ABB factory is recommended to examine in what way they can make internal processes more transparent and visible to all.
- The ABB factory is recommended to make time for reflection in both project and processes, and create a structured way of dealing with feedback.
- The ABB factory is recommended to have a clear ownership structure of all tasks and projects.
- The ABB factory is recommended to have a more synchronized prioritization between departments in order to avoid sub-optimization with counterproductive goals.

Conclusion

We began our study with the goal to understand to what extent and how well a manufacturing company can implement software-originated agile concepts. Through a qualitative study of the case company ABB, we have found that some of the agile principles from software development are applicable to a non-software manufacturing factory. We have found that for the principles applied and applicable for the ABB factory, there are several benefits by embracing the agile principles. In the cases where the principles are followed, we discovered a positive impact in both results and employee opinions of how well their everyday-work is working out. Where principles were not followed, we detected a larger need for change and improvement from employees. We believe that embracing the agile principles in the four categories may help strengthening the ABB factory's KPIs and thus its strategic goals.

The principles that are applicable to the ABB factory can be categorized into four categories that explain how the ABB factory, and potentially other similar companies, can behave in order to gain benefits from the agile principles. These categories are communication, teams, motivation, and processes. In communication, customer collaboration and face-to-face communication are means to strengthen market position and improve communication efficiency. Teams that are promoted within agile are self-organizing and cross-functional, which will raise autonomy, motivation, sub-optimization, and information sharing within the company. Motivation will positively affect productivity; important contributing factors are autonomy and sustainable workpace. Processes shall be simple and have transparency to be as effective and efficient as possible. It is also important to have a mean to reflect upon ones work in order to continuously improve at a higher pace. In the case factory the ABB factory, we saw that some of these categories were satisfied, giving the effect described, and that some of these categories were not satisfied, and that there was room for improvement.

From this study, we find that it is strategically viable to implement and embrace a large part of agile concepts in a manufacturing factory.

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Appendix A

Interview guide

Round one

Introduction

a. In short, can you describe your role and your responsibilities in ABB?
b. What are your largest work tasks?
c. Could you please explain how you plan your work (long term and short term)?
    i. Who do you plan together with?
d. Are there any specific KPI's or goals that you are responsible for?
e. What are your everyday goals? Do you have stage gates or equivalent?

Self-organizing teams

a. How do you assemble white-collar teams at ABB?
b. How do you organize competencies within different teams?
c. What is the ordinary size of your teams? Largest and smallest teams?

Agile Knowledge

a. What do you think is meant by working agile?
    i. Is there already any agile way of working in the factory today? And that case, what are they?
b. What kind of experience do you have within agile management?
c. What do you think could be the main benefits for your factory to work more agile at management level?
d. What would you say are the biggest obstacles for moving to a more agile way of working?

Internal Communication

a. How does the communication work at the factory between your boss, your team and upper management?
b. How does the communication between the different departments work at the factory?
    i. How often do projects require help from departments other than your own?
c. How do you know what others in the upper management are working on?
d. Are there any aspects of the communication that you think work particularly well?
e. Are there any aspects that you think should be improved?
f. How much of your communication with your colleagues would you say is face to face?
h. How do you work with the internal knowledge that exists in the company?
i. What kind of daily visualization tools do you use?

External communication

a. Do you regularly meet your customers or do you usually only have contact through the sales department?

Agile leader qualities

a. Have you had any training on leadership?
    i. If you got the possibility, would you like to attend a class or seminar?
b. Do you work in any type of iterative or incremental way?

c. Do you have any routine for reflecting on working methods and results? How does ABB meet failures? (how is it handled?)
d. How do you feel that you work with motivation in the organization?
e. How does the decision making work in the organization? (Most senior or most knowledge)?

Culture
a. What would you say is the main goal of the factory?
b. How do you describe the organizational culture in the workplace?
c. How are new ideas received? (generated?)
d. How does ABB meet failures? (how is it handled?)

Closure
a. Are there tasks or activities in your work domain where you see high potential for improvement and would like to work in another way?
b. Do you see any potential for improvement outside of your work domain? Do you have any ideas on how to improve these work-operations?
c. If you were to start implementing a more agile way of working at the factory, where would you like to start and what expectations would you have?
    i. Where do you think the biggest changes would be?

Round two

1. How do customers handle the liberal return policy you are using regarding cabinets?
2. How often are the open office landscapes used and for what? Please use an example.
3. What are the existing channels used to connect to (internal and external) customers?
4. How much influence do you have over your own work tasks in terms of timing, execution, and prioritization?
5. Are Quality Wins [i.e. a process about quality] only focused on product processes or does it also focus on the white-collar processes?
6. How exactly does your reflective tool work and when do you use it?
7. Are there processes that are complex and hard to understand?
8. Are there any complex processes you would use more if they were simpler?
9. How are business cases used in the factory?
10. How do you work to create transparency around work tasks?
11. Are you actively working to simplify your current processes?
12. How do you try and create a sustainable working environment?
    i. How is unsustainable work mitigated from the management team?
13. How do you break down and allocate ownership to KPIs?

Round three

1. Which channels do you have with customers? How do you cooperate with customers?
2. Internally - which is your main use of communication channel? Why?
3. How do you set up teams?
4. How are your teams managed and where lies the decision making?
5. How do employees and management try to maintain a sustainable workload?
6. What are the important factors in your factory to improve motivation?
7. What level of autonomy do you have in departments?
8. How are KPIs handled and by whom?
11. How do you prevent in-factory sub-optimization (for counterproductive KPIs)?
12. Do you work with process improvement within white-collar? If so, in what way?

13. Do you have a mean for reflection around processes and procedures?
14. How do you work with transparency?
15. Are tasks and roles properly documented?
16. Please tell me about your ongoing project of implementing lean practices?
17. What was successful and what was not successful?