



CHALMERS
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Implementing a Digital Mobile Device to Improve Quality in a Construction Company

Key factors and implications with an implementation

Master's thesis in the Master's Programme Design and Construction Project Management

ANTON LILIENBERG

Department of Architecture and Civil Engineering
Division of Construction Management
CHALMERS UNIVERSITY OF TECHNOLOGY
Master's Thesis ACEX30-18-61
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ABSTRACT

In order to increase the quality standard and improve work methods in construction companies a digital mobile device have been developed, called *The Tool*. The implementation of the device have the main purpose of quality documentation and tracking quality issues on a working site. Since some parts of the construction sector have shown tendencies of being a conservative sector, restrictive to change, the implementation of *The Tool* have had some implications.

This master thesis aims to investigate how *The Tool* can help assist in the development of the quality work in the Case Company and what key factors that needs to be considered in the implementation of The Tool to address the implications. Moreover, the current quality situation and quality culture within the Case Company will be studied to see if the prerequisites for a digital mobile device are met. The benefits and opportunities, as well as shortcomings, for *The Tool* to work as a quality improvement device will be investigated.

In order to answer the problem statement and research questions a qualitative and abductive study have been conducted. The case studies with interviews have been the foundation of the empirical study while the theoretical study focused primarily on what factor affect the quality work of an organization and how an implementation affect the current work situation.

The study shows that the current level of quality awareness in the Case Company are not sufficient enough to start using *The Tool* daily. The ongoing process with inspection work in *The Tool* and quality work in the end phase of a project are satisfactory and developing. The personal benefits and the long term benefits with *The Tool* needs to be addressed and communicated more clearly during implementation and resources needs to be allocated to push the usage and development forward. The Case Company have implemented *The Tool* as a device, and not as a support to a value creating quality work.

Key words: *Improvement work, implementation, quality work, digital devices*

Implementation av ett digitalt verktyg för att förbättra kvalitén i ett byggföretag

Nyckelfaktorer och konsekvenser med en implementation

Examensarbete inom mastersprogrammet Design and Construction Project Management

ANTON LILIENBERG

Institutionen för Arkitektur och Samhällsbyggnadsteknik

Avdelningen för Construction Management

Chalmers Tekniska Högskola

SAMMANFATTNING

För att höja kvalitetsstandarden och förbättra arbetsmetoderna i byggbranschen har ett digitalt mobilt verktyg utvecklats, kallat *Verktyget*. Implementeringen av *Verktyget* har ett huvudsakligt syfte att genomföra kvalitetsdokumentation och spårning av kvalitetsavvikelser. Eftersom vissa delar av byggsektorn har visat tendenser till att vara en konservativ sektor, restriktiv för förändring, har implementeringen av verktyget fått en del konsekvenser.

Denna mastersuppsatts syftar till att undersöka hur verktyget kan hjälpa till med utvecklingen av kvalitetsarbetet i Fall Företaget och vilka viktiga faktorer som måste beaktas vid implementeringen av verktyget på varje byggarbetsplats. Nuvarande kvalitetssituation och kvalitetskultur inom Fall Företaget kommer att studeras för att se om förutsättningarna för en implementation av en digital mobilenhet är uppfyllda. Fördelarna och möjligheterna, såväl som brister, för att verktyget ska fungera som ett kvalitetsförbättringsverktyg kommer att undersökas.

För att kunna svara på problemformuleringen och forskningsfrågorna har en kvalitativ och abduktiv studie genomförts. Fallstudierna med intervjuer har legat till grund för den empiriska studien medan den teoretiska studien främst fokuserat på vilka faktorer som påverkar kvalitetsarbetet i en organisation, och hur en implementering påverkar den aktuella arbetssituationen.

Studien visar att den nuvarande nivån på kvalitetsmedvetenheten i Fall Företaget inte är tillräcklig för att *Verktyget* skall börja användas dagligen. Den pågående processen med besiktningensarbete i verktyget är tillfredsställande och på god nivå. De personbaserade fördelarna och de långsiktiga fördelarna med verktyget behöver hanteras och kommuniceras tydligare vid implementering, och resurser måste allokeras för att driva användningen och utvecklingen framåt. Fall Företaget har implementerat verktyget som ett digitalt verktyg, och inte som ett stöd för ett värdeskapande arbetssätt.

Nyckelord: *Förbättringsarbete, implementeringsarbete, kvalitetsarbete, digitala hjälpmedel*

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PREFACE

This master thesis has been conducted at the Department of Architecture and Civil Engineering at Chalmers University of Technology, Sweden, during the spring of 2018. It has additionally been performed at a Swedish construction company with case studies on their projects in the area of Gothenburg.

First of all I would like to thank my supervisor, Göran Lindahl, researcher at the Division for construction Management at Chalmers for his support and input during the process. I would also like to thank my supervisor at the Case Company, Peter Samuelsson, for his continues support and feedback which has helped me in developing during the process.

Furthermore, I would like to thank all the people who have contributed to the interviews and engaged in the questions I have had. The competence and experience among the interviewees have providing me with necessary and valuable knowledge for the future. I would also like to thank the rest of the employees at the Case Company for making the time at the office an interesting and exciting period.

Göteborg, June 2018

Anton Lilienberg

1 INTRODUCTION

The following chapter aims to provide basic knowledge of the subject of the master thesis as well as an introduction to the scope of the thesis. Moreover, this chapter will present the purpose and aim of the thesis as well as a problem statement, delimitations and method outline.

1.1 Background

The rising competitiveness in the construction sector in Sweden, and other parts of the world, has in recent years started to depend more and more on quality and improvement work (Bergman & Klefsjö, 2007). The importance of quality- and improvement work in production has come to light since the cost of poor quality are found to be from 3,5-6,5% of a construction company's project costs (Josephsson & Saukkoriipi, 2005). Josephsson and Saukkoriipi (2005) further states that the cost of errors in production is not just correlated to direct costs of poor work, but lack of experience transfer, re-work and the risk of losing a high quality reputation also contributes to high costs. As the satisfaction of the customers and end customers are essential for the future growth of every company, quality issues and continues improvement work should needs to be of high priority (Feo, 2017).

To improve the quality work in production the Case Company has in recent years started to implement a number of digital tools, both in production and in planning phases of housing and commercial building projects (CaseCompany, 2016). Quality work on productions sites has traditionally been documented analogously, which requires a lot of administrative work, takes a lot of time and have generally resulted in poor traceability (Bergman & Klefsjö, 2007).

In 2016 the Case Company decided to try a production based mobile tool, which in this report will be named *The Tool*, which has been developed to simplify the process of documenting quality issues, checklists and material flow on site. *The Tool* has the potential of reducing the paperwork on sites by moving all the steps of inspection, checklist, time scheduling and material logistics into an application used on an iPad. The purpose and reason that *The Tool* was implemented in The Case Company was mainly because insufficient external quality delivered to the customers (CaseCompany, 2016). A few pilot projects was initiated where the traditional method of inspection work, with paper and dictaphone, was exchanged to an inspection where *The Tool* was used, as shown in figure 1.

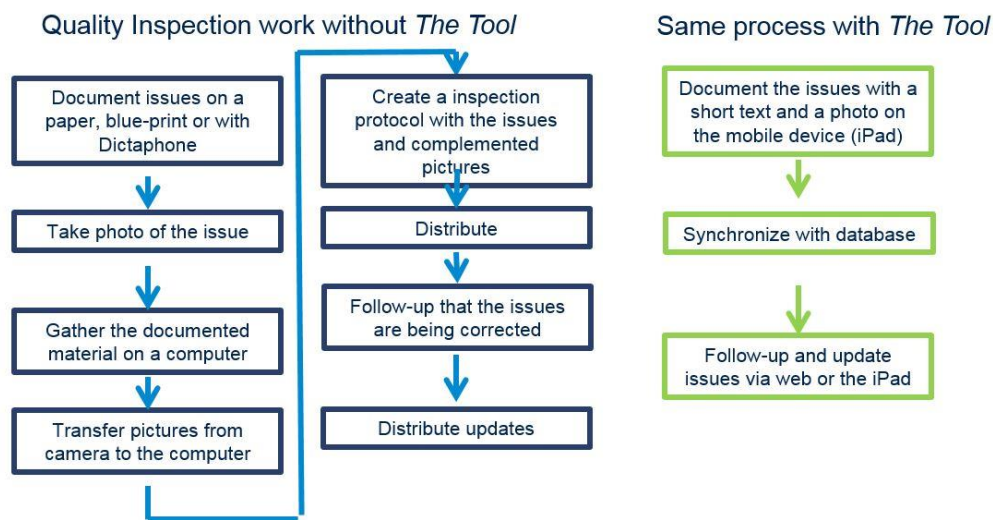


Figure 1, previous analogue quality work versus the quality documentation with *The Tool*, (CaseCompany, 2016)

Internal sources shows that the result and findings from those projects were that hours spend on correcting and re-writing protocols, manually handing out protocol to subcontractors and controlling the status of the issues were reduced. The way *The Tool* are supposed to work is hence to reduce those unnecessary work habits and simplify the communication between the person who document a quality issue and the person who are supposed to correct it. Josephsson and Saukkoriipi (2005) state that, through empirical studies on construction projects, that only 79% of the documented quality issues where corrected before handing over the property to the customer, and by using *The Tool* the monitoring and follow-up of documented issues becomes easier while the traceability makes the risk of missing to correct a quality issue decrease (CaseCompany, 2016).

Using a tool that makes the employees of a project have more control over their quality issues, deliver higher quality to their customers and reducing administrative work can seem like a well-motivated and easy implementation. The reality seems to be not that simple. Löwstedt and Räisinen (2012) have found that the collective norm of the construction sector often glorifies craftsmanship and hard, traditional work. The introduction of a digital tool to an industry that are very tradition oriented demands a significant change in behaviour of the employees (Löwstedt & Räisinen, 2012). In order to increase the level of quality and reduce the cost of poor quality the behaviour and way of work on construction sites needs to be improved and changed. One of the current challenges with *The Tool* is that the usage level varies significantly between projects, which makes it difficult for the Case

Company to enhance a general level of quality. The users personal opinion and perceived benefit of usage of *The Tool* have varied a lot which also is a challenge for the Case Company.

1.2 Purpose and project aim

The purpose of this master thesis is to investigate how the quality work in a Swedish project based construction company can be improved with the assistance of *The Tool*.

The long term goal for the study is to find a way to make quality culture a high prioritized aspect in The Case Company.

1.3 Problem statement

In order to clarify the aim of the study some research questions have been compiled:

- What are the main challenges according to quality- and improvement work in a construction company?
- How can a mobile digital tool assist in addressing the quality challenges?
- What are the implications for the:
 - 1) Project organization
 - 2) *The Tool*
 - 3) The implementation organizationIn order to improve the quality work in projects?
- What actions should The Case Company take in order to improve its quality work and quality culture?

1.4 Delimitations

Since the Case Company have decided that *The Tool* is the mobile and digital device to use, further investigation about possibly better tools will be disregarded. Possibly software improvements and changed features in *The Tool* will not be investigated or studied. The study will focus mainly on the quality work on site and only cover housing project in the region of Gothenburg. The studied projects will be both multi-family housing and commercial buildings and hence have a slightly different quality control process but will be considered as similar.

1.5 Method Outline

This thesis is based on several case studies carried out with interviews on different housing projects in the Gothenburg area by the Case Company. The case studies aimed at understanding the employee's general opinion and thoughts of quality- and improvement work. The case studies further worked as a status check of how well established the quality work were in different projects, and to see if there were any major differences between projects. The case studies, interviews and problem statements were identified together with the supervisor at the Case Company as well as the supervisor at Chalmers.

The research- and interview questions along with the case studies was based on literature studies and complemented during the process with input from the empirical studies. To understand the quality process and level of quality work in the Case Company an analysis and study have been conducted on the current documented quality issue data, through the case company's internal data base.

The empirical information from interviews and data analysis, combined with the litterateur studies made it possible to answer the problem statement and research questions. The problem statement and the research questions are further analyzed and together with the empirical studies presented in the conclusion.

2 THEORETICAL FRAMEWORK

The theoretical framework has the purpose of investigating the subjects stated in the problem statement, regarding quality work, improvement work and implementation work. The theoretical framework will work as a base for further comparison with the empirical studies.

2.1 Quality Work

This chapter aims to provide knowledge about the concepts affecting the quality work within an organization.

2.1.1 The Financial Effect of Quality

To be able to work with quality management and quality innovation it's essential to understand what quality actually is. Bergman & Klefsjö (2007) defines quality as "A service or products ability to satisfy the needs and expectations of the customer". The global market development in many sectors today experiences fast growing information technology, which have had the effect of fast distribution of information, services and products and general increased global competitiveness (Sandholm, 2005). The globalization and IT-development with the increased

competitiveness have affected the construction sector in the way that the demands from customers are higher, the required profitability are higher and in many cases the complexity of projects also have increased (Sandholm, 2005).

As the demands from customers increases and the required profit margins rises the importance of high quality also increases (Josephsson & Saukkoriipi, 2005). A study performed by Chalmers University of Technology indicated that the average cost for a construction company, regarding quality issues, was as high as 4,3% (Ericsson, o.a., 2002). The study showed that the cost of visible quality issues spanned from 2,3%-9,4% but that there most probable was a significantly larger percentage according to a lot of unnoticed issues that later could result in costs (Ericsson, o.a., 2002).

The deficit in quality and production errors results in two different cost for the company: *direct costs* and *indirect costs* (Feo, 2017). The *direct cost* for a company are linked to the expense for the correction of the error while the *indirect cost* for a company are the costs that cannot directly be linked to a specific object. *Indirect cost* can be such as bad reputation due to poor quality delivered to customers which can be shared with other potential customers resulting in lost prospects (Bergman & Klefsjö, 2007).

Inspection cost are also an *indirect cost* that cannot be linked to a specific error or problem, but rather the fact that the company knows that there probably will be a set of errors that needs to be detected (Feo, 2017). The inspection cost is therefore nothing that adds value or increase quality to the project or company but rather a fixed charge that's needs to exist because of the company's inability to find and adjust the errors at first place (except that it is a legal requirement that needs to be done in order to have an approved building) (Ericsson, o.a., 2002) .

Sandholm (2005) states that *indirect costs* and errors are much harder to immediately fix or adjust than *direct costs*. De Feo (2017) argues that it is much harder to fix the lost reputation than to fix a broken window for example. The *direct* and *indirect* quality in a construction company is both a procedure towards external customers, but also the internal customers. For a company to be able to deliver quality to its external customers it also needs to accomplish high levels of internal quality (Bergman & Klefsjö, 2007). Bergman et al. (2007) further explains that internal quality is the ability of a company's work procedures, systems and tools to meet the necessary needs for the employees, which hence are the internal customers. To be able to deliver high external quality, the internal quality needs to be high (Atkin, Borgbrant, & Josephson, 2008). Internal quality can be that the invoice system used by a company is user-friendly, that the planning tool are

sufficient and the support functions such as HR and IT are delivering good services. These internal quality factors, among others, have an important role in order to deliver a product or services that meets the demand of the external customers. The financial effect on a company which prioritizes quality is both beneficial for the internal economy but also for the external reputation as a quality aware company (Feo, 2017).

The cost of quality issues in a construction company are crucial for the specific company's competitiveness (Feo, 2017). De Feo (2017) states that if a company have a cost of errors that in the long run exceeds the profit margin, it will eventually have to increase their selling price and gradually loose market shares. The positive effects of good quality, regarding profit and revenue, are met when the delivery of goods or services respond to the customers' needs. The effect on the sale price of a delivered product or service, that meet or exceeds the requirements, are that the revenue increases and the sale prices can be increased (Orsini, 2013). The effect on revenue is reversible if the quality happens to be poor instead. Deming (1986) states that if customers perceive the quality insufficient, the likeliness of those customers buying the services or product again decreases, and the risk of the customers sharing the poor perception of quality increases.

Sandholm (2005) argues that there are clear connections between financial success in a company and good quality management. There are some approaches in the process within a company that have been shown to have a strong correlation between quality and profitability, and those are:

- ***A clear focus on customers*** – The Company have its main goal of achieving a high customer satisfaction, where the customers wants and needs are of highest priority.
- ***Awareness of the competition*** – To be the best alternative on the market, from the external customers view.
- ***Measures based on facts*** – If the decisions made in the organizations are based on statistical facts it's more likely to be financial beneficial in the long run, than if the decisions are made on personal opinions.
- ***Focus on results*** – The results are what fundamentally matters in business; the company with best profit margin, least defaults and most satisfied customers will have an edge over the rest of the market.

- ***Re-occurring problems solved systematically*** – even the smallest and most subtle errors in the daily work add up to large economic losses in the long run. If the company are able find a way to systematically prevent those errors and find the root causes the company can financially benefit from it.
- ***New procedures are considered from customers perspective*** – If new methods or work procedures are implemented or launched, it's done with the purpose of reaching higher customer satisfaction and better quality.
- ***The work environment characterized by action*** – less bureaucracy and more action, getting started and doing something rather than just discussing about new implementations.
- ***Systematic and persistent work*** – The importance of seeing an implementation or new procedure as long term is important, there will be no long term financial benefit of quick fixes.
- ***Everyone involved*** – If business excellence is to be achieved, the company needs get the employees to be committed to the tasks and goals.
- ***Training is necessary*** – If the organization shall be able to perform their business with excellence and high quality, the employees needs to be trained in those areas. As new procedures and task will be implemented, new skills will be needed.

The principles described above is according to Sandholm (2005) significant for companies which have been successful in their business, regarding quality, profitability and innovation. Figure 2 describes a flowchart of how increased quality work eventually results in higher profitability (Bergman & Klefsjö, 2007):

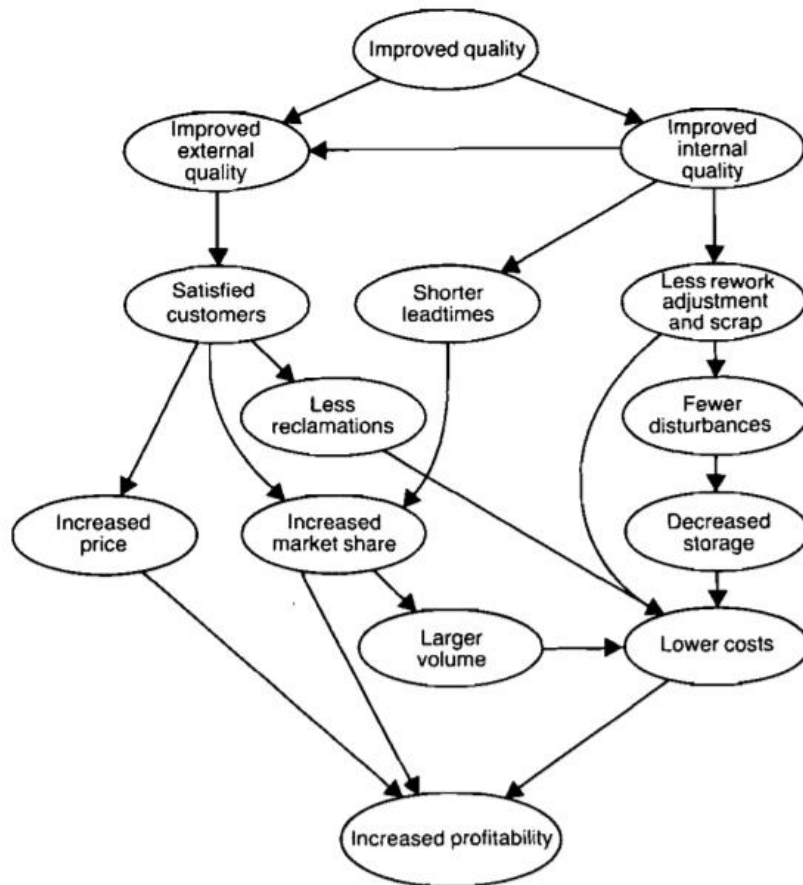


Figure 2, how improved quality effect the profitability (Bergman & Klefsjö, 2007)

2.1.2 Quality culture

The ability of a company to continuously improve their quality work depends a lot on the culture of that company (Deming, 1986). In order to continuously increase productivity, innovation and quality new skills will be needed (Argyris, 1992). The employees will have to learn new methods, new procedures and new techniques (Josephsson & Saukkoriipi, 2005). The importance of a supporting culture towards quality development is essential for the quality level to actually increase (Feo, 2017).

Juran (1986) argues that having suppliers and side contractors that are leading in quality management is a very important factor as well. In a construction company housing project often have around 75-85% of the project price split up on different external sub-contractors (Josephsson & Saukkoriipi, 2005). Getting the sub-contractors to accept and adapt to the required quality culture shall therefore be of high priority, and how to accomplish that.

Some of the defaults of acquiring a culture that thrives for continuously improvement in quality management comes from flaws in management regarding quality issues (Sandholm, 2005). If the top management and leaders of a company doesn't see the benefits of a certain quality work, it will be a hard for the rest of the organization to strive for more quality awareness (Vakola, 2014). Deming (1986) argues that there are some general culture deficits in those organizations which fails to reach good quality standards. One of those general problems are that the executives are personally skeptical to quality work, due to previous experience with quality tools that hasn't worked in specific situations (Sandholm, 2005). The arguments that "our business is different" and "I've tried that tool before, it doesn't work" is a reason to why some leaders creates a culture that inhibits quality development. Juran (1986) argues that the aim of all leaders and executives should be to help their employees to develop and initiate change for the better, in order for the company to grow. If there are methods or tools that can be used in order to increase the level of quality, it's the leader's duty to support and assist their employees to use it (Deming, 1986). The importance of qualitative support and continuous supervision from management is also an important factor that effects the culture (Sandholm, 2005). If a reoccurring-error are discovered it's important to find the root cause to the problem and provide solutions that, instead of just doing a quick fix (Josephsson & Saukkoriipi, 2005). If it happens to be a system error that are the source to the problem it will make no difference if supervisors tells the employee to work different, harder or faster, the problem will still be in the process until the system is changed (Juran, 1986). To blame employees for errors that are completely out of their hand is, according to, Sandholm (2005) a common problem to unbalance in corporate culture.

Companies will have different quality cultures and the quality culture within a company may as well change during time (Feo, 2017). There are different stages in organizations that affect how problems are treated (Sandholm, 2005)

- ***Dormant stage*** – This stage represents a phase where the organization is relatively satisfied with the current situation. The quality work is at an acceptable level and there are no needs to do anything different. The company's profitability is just fine and there are no needs for change.
- ***Awakening stage*** – This stage represents the awareness of quality issues and its effects. Management and executives might realize that competitors are handling quality issues more effectively and the company might start to loose market shares.

- ***Groping stage*** – This stage is where the company starts to feel that a crisis arises. Something has to be done if the company wants to keep their market shares and competitiveness. This stage is usually when companies starts to implement quality tools of all kinds, usually the most recent one. The common problem in this phase is that the organization just implement the most “successful” quality tool on the market, which necessarily doesn’t fit the company’s purpose.
- ***Action stage*** – Gradually the organization realizes that temporarily solutions and tools that were picked quickly only made marginal improvements. The problem need to be thought through more carefully. The management needs, at this stage, to make a more long term strategy with a more sustainable solution to the root cause of the problem.
- ***Maturity stage*** – In this stage the organizations has a mature attitude towards quality. Quality is at this stage as natural as profit and finance in the company. The general culture in the company are that improvements and innovations are encouraged and rewarded.

The overall organization culture within a company plays a decisive role regarding the ability to improve the quality culture (Juran, 1986). The culture that is needed for a continuously improvement of quality is to support innovation in design of product, services and processes (Deming, 1986). The improvement of quality within a company doesn’t solely come from hard work, new tools or technology but rather a systematic approach to the integrate them all (Feo, 2017). The most important factor to increase the level of quality is to applicate profound and adequate knowledge about the root causes to the lack of quality, and that is partially done by having a supportive culture (Deming, 1986).

2.2 Improvement Work

The construction sector has for a long time been self-associated with a mind-set of hard craftsmanship and tough tasks (Löwstedt & Räisänen, 2014). Löwstedt and Räisänen (2014) further argues that the mind-set of many companies in the construction sector can be correlated to a kind of self-reinforcing mechanism. This self-reinforcing mechanism can be described as a force that, rather than strive for change and innovation, strives to remain processes and principles the same. This mechanism can be an inhibitive factor for a company that possibly can hinder innovation and learning and hence to become better (Atkin, Borgbrant, &

Josephson, 2008). Atkins et al. (2008) further states that in order to be able to increase the level of competence in a certain area, one needs to be able to acquire new information and competences. The ability for an individual to acquire new information and hence learn depends a lot on factors such as competence, communication and knowledge (Wasif, Josephson, & Styhre, 2008). The ability for a company, as an entity, to learn and innovate hence depends on the individuals within the company's: knowledge, competence, communication skill and the will to learn (Lövstedt & Räisänen, 2012).

Improvement work are a way for a company to adapt its resources to changed requirement in competence, knowledge or processes, in order to stay or increase the competitiveness (Wasif, Josephson, & Styhre, 2008). The way an organization or individual learns can be described by different levels; single-loop learning, double-loop learning and triple-loop learning (in some cases even more) (Argyris, 1992). Argyris (1992) describes single loop learning as a process where one learns how to solve an existing problem, but without further thought about why the problem exists. Double loop learning, on the other hand, is when ones faces a problem, solves it, and then figures out why the problem even exists. The difference is consequently that single loop learning will result in a solution that continuously will solve a certain problem, but the reoccurrence of that certain problem might not change, while double loop learning will result in removal of a certain problem due to knowledge about the root cause (Argyris, 1992).

Single loop learning becomes a problem when the concern of solving the actual root cause is omitted (Deming, 1986). This results in a defensive approach to quality issues with defensive routines (Argyris, 1992). Argyris (1992) further argues that defensive routines occurs to cover up for problems that no one wants to deal with. These routines 'protects' the organization from dealing with complex problems and other threats for the moment, but in the long term it in fact becomes anti-learning (Argyris, 1992). The problem with defensive routines are further that the organization often rejects that they exists or don not see it, which paradoxical, strengthen the further existence of the certain defensive routines. Since the defensive power in the individuals mind affects the organization to become an active defensive towards complex problems (Deming, 1986).

Wasif et al. (2008) argues that there exists a need for change in the learning process in a lot of construction companies and that there should be an aim of learning and improving for future benefits and not as a reaction to an existing problem. If the learning process only exists as a consequence of problems it will be hard to prevent issues and problems to re-occur, as the solution comes after the occurrence (Argyris, 1992). Wasif et al. (2008) further argues that it is important to understand

that companies and organizations as an entity aren't able to learn how to handle such problems, but it's rather the individuals within the organization that has to learn, and then spread the knowledge to the rest of the organization.

2.3 Requirements for implementing quality culture

Change in organizations is a continuous mechanism that happens in organizations all the time with both controlled and un-controlled change (Wasif, Josephson, & Styhre, 2008). Change behavior can be related to individuals as well as organizations and can be a result of decided action but also emerging, un-controlled, change (Vakola, 2014). If organizations plan to implement changes in their business there are several factors that needs to be taken into consideration, in order for the specific change to be successful such as different personalities, benefits versus drawbacks, clear expressed strategy and purpose (Wetzel & Van Gorp, 2014).

Employees within organizations will have different readiness to change dependent on personal traits, motivational needs, ambition and demography (Vakola, 2014). Employees who are supportive to change often have a high level of self-efficacy which can be described as the confidence in one's ability to manage and cope with new challenges (Jacobs, Van Witteloostuijn, & Christe-Zeyse, 2013). Employees and organizations who are supporting organizational change often argues that the perceived benefits outweigh the possible risk of failure (Vakola, 2014). Vakola (2014) further argues that the degree change affects the employee's daily work, negative or positive, are also a factor deciding whether the change are perceived as positive or negative. Some employees embrace change as something that can enable them to improve and develop their status and role in the company, while others experience change as something that disturbs their continuity in daily work, and hence result in a worse working situation (Wetzel & Van Gorp, 2014).

Organizational change can be very risky, if it stretches the boundaries of an already traditional corporate culture too much (Jacobs, Van Witteloostuijn, & Christe-Zeyse, 2013). It's important for a company to fit the change within the values, core-activities and culture and not apply some universal solution that has work elsewhere, with totally different corporate conditions (Jacobs, Van Witteloostuijn, & Christe-Zeyse, 2013). If change within a company is fitted in with the common values and culture the employees often are more adaptable to the change and the sense of continuity and trust remains (Vakola, 2014). Vakola (2014) further explains that a key factor for leaders and managers of change is to bring a change that take advantage of routines, principles and procedures that already are rooted

among the employees, so that there is a synergy between the new and the old habits.

Sharing experience and knowledge between projects, within the company, are essential for a company to grow but also to change destructive and counterproductive habits (Wetzel & Van Gorp, 2014). Wetzel and Van Gorp (2014) further explain that organizational learning is based on that the company continuously learn what works and what does not work, so that unnecessary work can be avoided.

Examples and studies on previous organizational changes have shown clear indications that it is extremely hard, if not impossible, to get an effective and long lasting change if the employees within the organization are not willing to support and put effort in (Vakola, 2014). Wetzel and Van Gorp (2014) complement this statement by saying that in order to get the employees committed to the change the management must be clear with purpose, extent, expectations and other necessary information. It's equally important to have a culture and climate where open thoughts, feedback and discussions are encouraged in order to deliver a change that everybody feels committed to (Orsini, 2013).

3 METHODOLOGY

The following chapter of the thesis will present the methodology used in the study and a justification of the selected method approaches. The purpose of this chapter is for the reader to understand why the selected approaches have been made and how the study have been carried out.

3.1 Research Approach and Design

This thesis has the aim of investigating how *The Tool* can help The Case Company to improve its daily quality work and improvement work, and what organizational key factors needs to be considered. Research and studies made on organizational quality- and improvement work have been done for a long time, and with quality- and improvement models and methods emerging from it, which will be a basis in the theoretical framework (Sandholm, 2005).

While improvement work and quality work have been widely studied, studies and research on usage and benefits with digital mobile tools regarding quality- and

improvement work have been harder to find. Since the digitalization phenomena is relatively recent there are a reasonable explanation to why there are such a small sample on those studies. The data and theory about the mobile tool will therefore be based on the internal information from the Case Company.

As Mason (2002) states it can be beneficial to use a research approach that interact both theory and empirical data throughout the study, if the studied problem is quite unexplored. In such cases an *abductive* approach can be reasonable, which is a combination between *deductive* and *inductive*. *Deductive* approach focus on finding a research methodology where the hypothesis can be tested, while an *inductive* approach starts with observations from empirical studies and thereafter the theories are proposed (Bryman & Bell, 2003).

Since the research questions and problem statement have been defined during the process, according to what have shown to be relevant from interviews and initial studies, that motivated for an abductive approach (Dubois & Gadde, 2017). The reason why a *deductive* approach was neglected was that it, according to Bryman and Bell (2003) mainly focus on creating a hypothesis from existing theory and then test it with empirical studies, which will be insufficient in this study as part of the problems is unknown. An *inductive* approach will also be unsuitable since the approach starts with empirical studies and from there try to find trends and patterns. This study will require a combination of mixing hypothesis and questions both from theory and empirical studies, and compare them along the process.

As the level of usage of *The Tool* in some degree depends on the users' preferences and ability to see the benefit of it, it is important to combine the theory of quality, improvement work and implementation work with the empirical findings throughout the study. The principle of adjusting the perspective and focus of the research, depending on findings along the way, argues for an *abductive* approach.

A decision between a *quantitative* and a *qualitative* also needs to be made for the study. Bryman and Bell (2003) states that a qualitative approach focuses on gathering general approaches, not definite and fixed, which can be conceptualized with interpretation of the social and empirical context. This makes it possible for the study to adapt and change throughout the study, if the concepts or findings points at other directions. The study will have a lot of its focus on the subjective and interpretive benefits and possibilities of *The Tool*.

Bryman and Bell (2003) further argues that a qualitative approach often focuses on the importance of the contextual social behavior, and why people act in a certain way, to find the link between what they say and what they do. This is one of the

main focuses of the study, to understand how to take advantage of the general behavior of employees, in order to reach the long term purpose of increased and improved quality work with the help of *The Tool*.

The thesis are based on different project based case studies within the Case Company, with qualitative semi-structured interviews. The multiple case studies will have the purpose of understanding differences in projects within the Case Company and investigating how the social context of different projects affect their work. Together with litterateur research the empirical case studies will be the base of the thesis. A continuously conducted comparison between empirical studies and theory are beneficial method in the qualitative research approach (Bryman & Bell, 2003).

3.2 Literature

The thesis is based on a theoretical framework with the purpose of creating a base for the further analysis and conclusions of the empirical findings (O’Gorman & Macintosh, 2015). The initial focus of the theoretical framework was to acquire a broad knowledge about quality work in the construction sector as well as implementation work and improvement work. The research questions was developed from the literature studies along with help from the supervisor on the Case Company. Most of the studied literature in the theoretical framework are on topics covering; quality work, improvement work, change management and implementation work. As the thesis applies a qualitative approach it’s important to reevaluate the relevance of the chosen literature during the process, so that the literature stays relevant if there are new findings from the empirical case (Bryman & Bell, 2003).

The relevance and reliability of the chosen articles and other literature have been critically reviewed, with continues tunings with the super visor on the Case Company, to fit the problem statements and research questions. According to Bryman et al. (2003) articles, books and journals that are well cited should be prioritized. The theoretical part about how *The Tool* works are done in the chapter about the case company, and as Löwstedt (2017) states the technological conditions worldwide changes rapidly and the supply of different digital mobile tools increases fast, the only focus regarding digital tools will be the chapter about *The Tool*. The used literature comes mainly from Summon Chalmers Library, Google Scholar and the case Company’s internal data. The literature has consisted of books, journal articles, publicized case studies and reports. Used key terms; *Quality work, improvement work, change management, implementation work, digital tools in construction, BIM, organizational work*.

3.3 Case study

To be able to find the crucial obstacles and difficulties of quality work in a construction company a case study on different projects within the same Case Company was conducted. The purpose of the case studies was to be able to get a deeper knowledge of the work situation on the Case Company and how the projects differed from each other regarding the research questions. The case study also aims at investigating if there are any differences in how the quality work are perceived on site, and how it is expressed from the central organization.

Since *The Tool* is a new digital mobile device to the Case Company, introduced 2016, the usage level on project sites will be at different stages. Some projects haven't started using it yet, while some project teams are on their second project with *The Tool*. The aim of the case studies is hence to get a deeper knowledge about why some projects adapted *The Tool* as soon as it was introduced and some projects yet haven't started, and why some of the individuals within the projects are more active than others. The studied projects will be representing different stages of the usage of *The Tool*.

3.4 Interviews

As the study have a qualitative approach the most suitable way of doing interviews is to use a semi-structured process (Mason, 2002). Semi-structured interviews are the most commonly used approach in qualitative studies since it opens up for an open and flexible interview situation where improvised supplementary questions can be beneficial (Bryman & Bell, 2003). Bryman et al. (2003) further explains that a semi-structured interview means that the questions are open but with a clear purpose. The reason why semi-structured interviews suits better to a qualitative study than clear structured interviews is because structured interviews tend to result in more quantitative information and data, which is not the purpose of this thesis.

The main purpose of the interviews have been to collect the interviews personal opinion on how the quality work in the Case Company:

- 1) Works today
- 2) Could be improved
- 3) How can digital tools help to provide solutions?

The interview questions might be slightly modified for each interviewees to fit their role in the organization, and to cover their daily production habits, and also

catch their specific interest more deeply (Mason, 2002) . Before the interviews was conducted, the interviewees had been given the topic and main questions, in order to be able to prepare and reflect prior to the actual interview.

The interviewees was chosen dependent on which phase their projects was in regarding quality work and mainly the usage of *The Tool*. Five different projects have been studied with mixed levels of usage of *The Tool*, and complementary interviews with the *Quality Manager* and *Regional Development Manager* in the Case Company. In those five projects, as well as with the managers, the aim was to get the opinion from employees in different positions; site managers, super visors and craftsmen. It was also of interest to get interviews from employees that both promote and disregard the usage of digital tools in the construction industry, and why that is.

3.5 Analysis of data

The findings and data analysis is preferably a simultaneous activity to the actual study (Dubois & Gadde, 2017). This is due to the fact that results and analysis of qualitative research approach when interviewing depends on more than just hard facts, such as reactions, body language, silence and other situation based insights (Mason, 2002). As Dubois an Gadde (2017) further states it's shown that going back and forth between different research methods can strengthen the understanding of the topic. The analysis and findings of the interviews will therefore serve as a continuously input to improvement in the theoretical framework.

3.6 Ethical aspects

The interviewees was prior to the interviews provided with the questions and structure of the interview, so that necessary preparation could be made. In order for the interviews to be effective and for the interviewees to feel as respected as possible, the interviews had a clear focus on keeping the integrity (Kvale, 2006). Bryman et al. (2003) argues that a common factor for an ineffective and poorly performed interview is when the interviewer doesn't consider or respect the privacy of the interviewees.

The interviews was recorded on a mobile device, in order to be able to fully focus on the interview when it was performed, but with the interviewees fully acceptance and awareness. The interviewees also got the information that the answers would be presented anonymously. If a free flow of speech can be achieved and the

interviewee can feel trusted, the chance of accurate and reliable answer increases (Dubois & Gadde, 2017).

4 EMPIRICAL CASE

The Following chapter are based on information and data from internal sources provided by the Case Company.

4.1 Background to *The Tool*

The primary reason why *The Tool* was introduced and implemented in the Case Company was that there was a steady decrease in delivered units with zero deficits, and that the root cause to the lacking quality needed to be found. According to the Case Company's internal sources a unit in the housing sector is the same as one apartment or one house, while in commercial building one unit counts as the whole building as one. The measurement on number of deficit units is a way for the Case Company to measure the level of delivered external quality, where more units delivered with zero deficits equals higher quality standards. The number of units with zero deficits on the Case Company had been a decreasing trend for about 4 years prior to the introduction of *The Tool*, according to internal sources.

When an apartment or commercial building is completed and delivered there are a survey that the end customer can fill in to grade the perceived satisfaction level (Cassel & Strand, 1999). The survey is called CSI which means Customer Satisfaction Index and has a satisfaction grade scale from 0-100. The CSI survey is based on three main questions that are the foundation for the index number, with several sub questions that serves as indicators (Cassel & Strand, 1999). The main questions is the same for each company in the same sector, which makes the grade of a company comparable to other competitors. The CSI is presented as a percentage where higher percentage equals higher customer satisfaction. The survey are delivered to all end customers after the project is completed and the customers have moved in. Participation in the CSI survey is optional for the customers (Cassel & Strand, 1999) .

The issues and situation with decreasing zero deficit delivery and not high enough CSI resulted in that the Case Company decided to implement a digital mobile tool that could keep track and document quality issues during the production phase, according to internal sources. The chosen device to help solving the problem was *The Tool*.

Several different digital tools was evaluated according to the ability to easily and accurately document and analyze quality issues, and at the same time be user friendly. The Case Company came to the conclusion, after some successful test

projects in Norway, that *The Tool* fulfilled the requirements of being a sufficient device for quality work. The launch of *The Tool* in the Case Company's Swedish division came in spring 2016 where three different projects across the country was chosen to be test projects. The purpose of the test projects was to investigate if the benefits with *The Tool* was high enough to implement it in every new housing and commercial building project. The conclusion was that the time saving of administrative work, ease to document quality issues and traceability of quality issues was high enough for the Case Company to decide to start use it in other projects as well.

4.2 *The Tool*

The Tool is an application developed by an IT-solutions company and bought by customers as a yearly license. This means that when the license is purchased the Case Company have full access to the applications features. When the license is bought the Case Company have full permission to use it in all projects, and for all employees including subcontractors. *The Tool* is one application among several other tools developed by the certain IT-company and therefore have compatible applications that provide solutions for planning, documentation management, 3D-usage among others. The ability to link different production steps through an integrated application device is hence an advantage with *The Tool*.

The Tool is composed of different features supporting quality documentation such as checklists, issues documentation and equipment handling. *The Tool* is mainly used as an app on an iPad, where the actual documentation is made but there's also a web portal where the data can be analyzed and processed, to easier get a view of the gathered data. The first feature that the Case Company decided to use was "issues" which is a function where the user uses the iPad to pin out an "issue" on a drawing, address a responsible person/company, describe briefly what the issues are and then code the "issue" to an "issue type". Issue type is information that links the certain "issues" to a specific occasion like "Pre commissioning" or "Customer inspection". The iPad is after those steps synchronized so that the information can be uploaded online and accessible to the person responsible for the issues. The workflow that the "issues" feature serves to simplify and solve is described in Figure 4

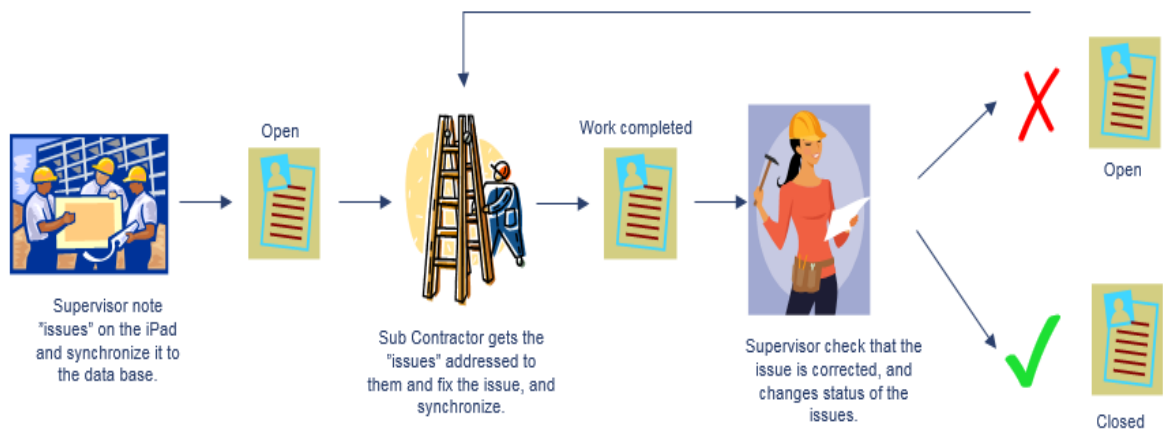


Figure 4: The workflow of the "issue" process (CaseCompany, 2016)

The Tool consists of an application that works offline and stores the data temporarily on the iPad, until it is synchronized and upload the data to the database. This means that the usage of *The Tool* doesn't require constant internet-connection but only when synchronizing. All information and data that are created on the iPad then gets stored on the data base so that all issues can be tracked and traced.

The Tool has binary purpose for the Case Company's quality work:

- Digitalize a previous analogous work to save time and administrative work.
- Be a simple tool that actually favors quality documentation, so that the quality work improves.

The IT-provider expressed that the purpose and aim with *The Tool* are:

"Improve construction quality control and jobsite safety with cloud-based checklists, equipment tracking, tasks, issues and daily report."

- *"Improve construction quality control and reduce rework"*
- *"Use construction checklists to monitor jobsite safety and streamline inspections"*
- *"Track construction equipment and collect asset data from mobile devices"*
- *"Optimize field performance with construction daily reports"*

These purposes shows the wide potential that *The Tool* has, with different integrated features to cover the whole production phase. This is however a

possibility for future developments for the Case Company, as *The Tool* currently are the main focus.

4.3 Implementation of *The Tool*

The implementation of *The Tool* on new projects in the Case Company follows a pre-decided procedure that works as follows:

Step 1, Interest request: The responsible manager for the project, usually the Project manager or Site manager, sends an interest request by mail for a “*The Tool* education” to the person responsible for *The Tool* in that region.

Step 2, Initial meeting: The person responsible for *The Tool*, together with the Project manager, books an initial meeting. The purpose of the meeting is that the parts will decide how that certain project shall approach the usage of *The Tool* and what features they want to use and to what extent. The attenders of the meeting usually consist of the Case Company’s supervisors, site manager and project manager. The purpose of the meeting is also, from the central organization, to get a picture of how interested the site organization are to use *The Tool*.

Step 3, Construct the project structure: This step occurs when the decision has been made that the project shall use *The Tool*. The project information with drawings, positions and issue types are then created in *The Tool* by the regionally responsible person, and the project are put up online on the IT-providers global servers. As soon as the project are constructed in *The Tool* and put online it’s available for the invited members to start using it. The only requirements from the site organization is to provide the responsible person for *The Tool* with names, e-mails and names on sub-contractors as well as some short data about the project (start-end date, address etc).

Step 4, Education with site organization: This step is a theoretical and practical education for the site organization. The theoretical part is a “step-by-step” presentation in how “issues” are created in *The Tool*, and the practical part is that the participants themselves can try to create “issues”. The education is usually divided in two parts, one for the employees at the Case Company and one for the sub-contractors and inspection organization. The education usually is 3-4 hours were the most time is spend on the Case Company’s site organization.

Step 5, Support during the project: The responsible person for *The Tool* supports the projects during the construction phase. The amount of time needed for supporting the sites differs from site to site, depending on the level of knowledge and adaptability to *The Tool*. The support provided for the sites are often

administrative support such as changing settings, adding information and basic app handling support.

4.4 Findings from interviews

The Following chapter will present the outcome of the interviews and the general view from the interviewees on the problem statement. The Interview questions was created in order to find answers to the research questions and problem statement. This chapter will highlight the most common answer and tendencies on each research question, so that the possible proposed solutions to the problem statement is as generic as possible.

The interviewees consisted of different employees with different roles within the Case Company. They will be mentioned as:

Supervisor 1

Supervisor 2

Supervisor 3

Supervisor 4

Supervisor 5

Site Manager 1

Site Manger 2

Project engineer 1

Project engineer 2

Development Manager

Quality Manager

Subcontractor 1

Subcontractor 2

Experienced problems in production

Out of all the questions and discussions with the different interviewees, the similarity in answers about the daily problems was strikingly. All of the interviewees at least mentioned that one of the most common daily problems was communication related. It was clear that communication was the reason to a lot of the daily production problems, and that it had been so for a long time. The definition of what a communication problem actually is differed but the general opinion was that it was hard to get the right information, to the right person at the right time.

“Communication between us and our subcontractor is always a time-thief, when we don’t get the right information in the right time, it becomes an expense in sense of lost time” (Supervisor 1)

The interviewees further said that the effect and subsequent problems of poor communication are that there occurs a lot of so called “fire-fights”. Fire-fights in this sense is a description of a unplanned problem that occurs suddenly, that has to be solved immediately, in order to keep the time schedule. Those sudden problems are described to have a several negative effects, it’s time consuming since they are unplanned and has to be improvised solutions, it takes time from other activities that were planned to be executed and it’s more likely to be an insufficient solution and lack of quality.

“... When fire-fights occurs you have to solve unplanned problems and you lose your planning totally!” (Supervisor 2)

There were also common thoughts about the problematic situations that can occur due to people’s different ways of handling problems. The combination of lack of communication and people acting and interpreting situations in different ways sometimes made daily production unpredictable. Some of the interviewees proposed that they would like to have tools and methods in production that focused on presenting information as simple as possible, so that the human interpretation factor can be reduced.

“... I can tell my guys to do a certain task and when I then check if it’s done, they have done something completely different...” (Subcontractor 1).

The general opinions about quality work

The opinion about what quality work actually is was quite different from the interviewees, and also how their personal definition of quality had changed during the years. All of the interviewees expressed that they put a lot of pride in delivering a product with high quality, but the difference was how they defined quality. The interviewees also described different ways to how good quality is reached, and how to ensure that the quality demands are met.

“... I want to be proud of what we as a company have delivered, and I want it to be lasting quality, not just something that have high quality when we deliver the house” (Supervisor 3).

It was clear that most of the interviewees stated that they put a lot of pride and effort in doing their task with a high level of quality, and that the result should be free of defects. But an observation and tendency among the interviewees was that several of them had not reflected over *how* they managed to achieve what they

achieved in respect to quality, but that it rather was a result of their experience and common knowledge.

“We just ensure that our work is right the first time, so that we don’t need to do it all over again” (Subcontractor 2).

As further questions was asked about *how* they work with quality work and how to ensure the right quality the answers differed, and tended to be role specific. The craftsmen expressed how important it was to have the right competence and right amount of time, and the supervisors and managers all mentioned that proper documentation and controls was essential. One of the Project engineers also mention how important it is with adequate preparations:

“The most important phase of quality work, in my opinion, is before the work is done... After the job is done the quality is there, if the pre work was insufficient the quality will be thereafter” (Project Engineer 2).

When asked about how the projects, as an entity, work with quality work and what the specific strategy is there was quite a bit of uncertainty. Some of the interviewees expressed explicitly that there was no clear outspoken strategy for how to reach high quality, but that it rather was a result of one or a few people on site that took responsibility over it.

“ We didn’t actively work with quality work until we got a new Site manager who had work with this specific tool, he showed us, and then we understand that it actually was quite simple, so we all started using it..” (Supervisor 1).

“... Ehm... we haven’t really gotten started with it yet [When asked: How do you work with quality in your daily tasks?]” (Supervisor 3).

It became clear that the interviewees all wanted a digital mobile device that could make their quality work simple and fast, since they all stated that the combination of tight time schedules and time consuming quality checks doesn’t support a sufficient quality work. The time was a factor that was commonly mentioned to be vital in order to develop a better quality work, time to learn new tools and ways of work.

“...It takes time in the beginning to learn a new quality tool, for example, but when I know the base, it saves me a lot of time, and also saves time for the craftsmen! “ (Supervisor 4).

There was also a general perception on the different sites that there was a lack of expressed strategy of how to work with quality, provided from the central parts of the Case Company. Several of the interviewees expressed that they didn't know what the Case Company's general quality strategy was and how to daily work with it, and that the level of quality awareness differed considerably between projects, due to different site personnel. This perceived image of quality situation was also expressed from one of the middle managers:

“Our quality management isn't strong enough, yet, to position our self as an outstanding company regarding quality... for the moment the level of quality on our projects depends more on committed individuals” (Development Manager).

The common thought from the interviewees was that there generally was though requirements regarding the quality but not sufficient guidelines of how to reach those requirements. It seemed that the underlying, common, reason to work with quality was to pass the hard requirements, and that the passing of those was a grade of good quality.

“...If I can document my work with pictures i can “keep my back free” and show that I have done it correctly” (Subcontractor 1).

Some of the interviews, though, made it clear that they saw the reactive quality approach as a problem, and wanted to inculcate a culture and behavior that approach quality more protectively, so that long term quality results can be achieved. *Site Manager 1* and *Development Manager* explicitly said that the Case Company aren't good enough, yet, to outperform our competitors on quality. Further they said that substantially better quality than competitors will be a decisive factor as the competition in construction sector grows.

How can the quality work and quality culture be improved?

The impression and common opinion was that quality work was something that the projects wanted to work with, and be good at, but with a vague strategy of how to reach that. Several of the interviewees mentioned that since quality awareness, and digital tools supporting, are relatively “new” to the projects there are leaks in the daily work which makes quality work more time consuming than time rewarding. The *Quality manager* of the Case Company was very clear in how he thought that the Quality Company should handle the situation with insufficient quality culture:

“We need to have people in all regions, who runs the daily work with quality, all the time! As well we need to lift the quality question to higher levels in the

organization and constantly discuss and improve our methods. The projects also have a responsibility to always stay updated and demand support and help in those questions, and strive to increase the quality awareness in their project teams” (Quality Manager, Case Company).

The interviews with the site personnel gave an impression of that the quality awareness and culture didn't extend beyond the limits of each certain projects, but that the quality culture rather was unique in each project. This could be both an advantage and disadvantage as the organizations who worked intensively on their quality development took it on to the next project and spread it there. Those site organizations that didn't continuously work on their quality work did the same thing in the next project as well. The commitment according to improve quality varied from site to site and among employees.

“Some of the projects I have been to are very well aware of how they should handle quality issues and different tools to support them, since they are committed, while some other projects are quite the opposite” (Supervisor 2).

It became clear that several of the site employees thought that a clear definition of expected quality work should be included in each role descriptions. When there are no clear anticipation of what each role should contribute with, regarding the quality work, the work is easily overlooked. The different quality functions in *The Tool* could for example be daily tasks that should be included in the role description, was a proposed suggestion.

It's mentioned from several of the interviewees that quality work still has lower priority compared to other daily activities out on site, it requires some kind of new incitement that encourages people to put in the extra time.

“When we do our quarterly economic forecast we go through our “work preparations” (Arbetsberedningar) and often receives a lot of positive feedback on them regarding mostly safety, but we seldom get cred for our daily quality work, it's like the environmental work, we don't talk about that so much” (Project engineer 2).

The lack of resources, mostly employees, that have as their main task to improve the quality culture becomes more and more clear as the requirements gets higher. The *Quality Manager, Middle Manager* as well as the *Project Engineer* all argued that the current level of resources allocated to quality work isn't enough and in line with the strategy.

“If the company have a strategy to improve and focus on increased quality, in order to grow as a company, we need to improve our resource allocation so that it meets our requirement’s, we are too few working with The Tool, general digitalization and other quality improving mechanisms” (Site Manager 2).

What are the Benefits and deficits with *The Tool*

Since the interviewees had different experience in using the tool there were different levels of understanding and knowledge about it. But the general opinion and thought about the purpose and benefits of the tool was unanimous, it provides clear descriptions of quality issues, it provides fast communication between the different contractors and it helps to trace common defects and issues. *The Tool* also made it possible to work proactively with several of those previously mentioned daily problems, according to one of the project engineers.

“The Tool makes it possible for us to log all of our issues that comes from daily reactive work, which in turn increases the awareness of those issues, and makes it easier to prevent them” (Project Engineer 1).

The reduction of communication time, on the large amount of issues during a project cycle, was also expressed to be a success factor for supervisors and subcontractors. When there is a direct and automatic linkage between persons using *The Tool* it was also perceived to reduce the amount of misunderstandings and lost information that previously was on paper, e-mail or telephones. This of course demanded that the projects had reached a level of high percentage of usage per employee, which was not the case for several of the sites, but rather a few individuals that did all the work.

Regarding how the Case Organization has implemented *The Tool* there was a general opinion that it’s very important and good that there are persons who daily can support the projects when there occurs questions about *The Tool* and that that is a must for the usage to grow. The general reason for the need of a support organization is that *The Tool* sometimes are perceived to be difficult and not respondent the way that the users like. It’s stated, though, that these daily small issues with *The Tool* often occurs to those people how are new to the application.

“When I first started to use it [The Tool] I immediately saw benefits of it, but I was quite frustrating in the beginning when I accidentally pressed the wrong buttons, and got lost in the app” (Site Manager 1).

The transition from analogous quality documentation to digital have improved the traceability tremendously, according to the majority of the interviewees. The previous work with analogous quality documentation often resulted in lost notes, misunderstandings in telephone calls when describing a quality issue to a subcontractor, delayed inspection protocols and several ours in administrating all quality issues on paper. The current digital way of handling issues in *The Tool* provides easy ways of tracing a specific issue with exact time and date attached.

“Before we had this tool it always required a lot of time describing and distributing issues, its position and status, sometimes the protocols with issues got lost and we had to correct them when the customers found them, now we can find a specific issues and its information within seconds” (Supervisor 4).

Several of the interviewees mentioned that the construction sector for a long time have been poor at transferring knowledge and experience between projects, and that the analogues and paper like work have been an affecting factor to that. With *The Tool* those problems disappear, at least for the quality issues, as all documentations are saved in the data base.

“As the usage of The Tool is in the first phases it’s hard to say in what extent the saved data can help us, but I’m pretty damn sure that it will help us a lot to be able to see the most common problems in previous projects!” (Site Manager 2)

The economic extent that *The Tool* can help the Case Company is substantial, according to *Supervisor 1*, as the traceability of issues makes it easier for the company to pinpoint who is responsible for a certain issue. Discussions about ÄTA (change or adding work) costs will be based more on actual facts and less on people opinions and arguments.

According to *Project Engineer 1* the problem today, though, seems to be that the subcontractors doesn’t use *The Tool* to the extent that’s needed in order to adequately work with quality issues.

“If we do all the work with documenting quality issues for our subcontractors, we will never be able to “force” them to take 100% responsibility for the issues. As long as you’re not feeling responsible for a task, you will not give it 100% effort” (Project Engineer 1).

One of the problem areas that the interviewees thought was that there needs to be more resources in the beginning of a project, supporting the usage of *The Tool*. As

the tool is new and digital the hardest part is the beginning, according to *Supervisor 3*, and that is the phase where resources need to be allocated.

“I think that we need to increase the kind of support that the regional responsible person has, the most common issues with The Tool are often easily solved, when we have someone with knowledge to ask. But the problem is that there may be 10-15 questions each day about minor usage problems, and we can’t call for help each time, so if we had more persons with good knowledge, on each project, it would definitely increase the usage!” (Supervisor 5).

What needs to be changed?

Both *Site Manager 1* and *Quality Manager* pointed out that they thought the way to get the usage of *The Tool* to really increase is to really stress the factor that *The Tool* will help everybody save time, money and unnecessary re-work. If the main purpose and benefits of *The Tool* isn’t understood from the user’s perspective, it will be very hard to increase the level of usage.

“We need to get our employees and subcontractors to understand that The Tool isn’t there to just find issues, but rather prevent problems and improve quality, we need to stress that!” (Site Manager 2).

The comparison with the car industry come to speak when we discussed how the tool and general quality work could and should be more standardized. The different quality approach in car industry also come to speak.

“When you buy a new car, you just assume that everything is in place, you don’t have the permission or need for an inspection when the car is delivered and you simply just make a complaint if something is wrong. The standardization is obviously much higher but it seems like they have approached the quality to customer on a more beneficial way” (Supervisor 2).

The core of the discussion was that the construction sector and in this case the case company has created a trend of inspection routines that takes a very large amount of time, and doesn’t really add a value, according to *Middle Manager*.

“The most important, quality related, task we have is to find out how to ensure better quality from the beginning, like using The Tool and increase the quality awareness, and not focus on reactive work such as inspections, that only tells us what quality we already has” (Site Manager 2)

5 DISCUSSION/ANALYSIS

The following chapter will aim at comparing and investigating similarities and differences between the theoretical research questions and the empirical findings.

What are the current level of Quality awareness in the Case Company?

Sandholm (2005) together with Löwstedt (2017) both state that an organizations goes through different stages of maturity when faced with a new challenge or group composition. As the implementation of *The Tool* still is in the early stages of the process it is likely that the Case Company therefore still sits between the Awakening and Grouping stage. This conclusion is also drawn and confirmed by the *Development Manager* and *Quality Manager* who still argues that the Case Company do not yet have a sufficient quality awareness in its projects. *Project Engineer 2* as well as *Quality Manager* mentioned that there is of high importance to have incitements and a clear quality strategy in order to increase the employees' quality awareness. Those incitements could consists of defined goals of measured quality, number of documented quality issues, recognition within the company when high quality is reached or financial benefits such as bonus when reached quality target.

Jacobs (2013) argues that if an organization stretches or stress an implementation too early or with too wide a scope, it will be difficult to get the organization on track, as it is too far from the daily routines. This phenomena seems to be the perceived imaged according to several of the more senior employees, where both *Site Manager 1* and *Sub Contractor 1* explicitly expressed that the implementation of *The Tool* had been stretching their daily routines too much, which created an automatic resistance to learn a new device. It is important to not force an organizational change too much but at the same time Sandholm (2005) argues that change to more innovative and effective work methods continuously needs to be developed if customer satisfaction and loyalty shall remain or increase. Implementation of *The Tool* hence is a balance between not forcing a change to fast but still stress the mindset of continuously innovation and improvement.

The employees expressed that the personal and organizational benefits of using *The Tool* in the inspection phase was clear and made sense with less administrative work and less lead times, but in order to use it during the whole production phase it was not considered to yet have enough personal benefits. Vakola (2014) argues that the personal benefit of a change is vital if an implementation should be accepted by employees, otherwise the personnel tend to stick with their usual routines. The traditional way of work in the construction sector today is obviously very deep-seated with a self-reinforcing mechanism to keep the way of work the same as it has

been before, according to the interviews. This self-reinforcing mechanism means that if the Case Company want to increase the daily usage of *The Tool* it needs to be expressed clearly what the personal benefits are for each user.

The *Quality Manager* said that in order to increase the level of daily quality work the Case Company needs to provide possibilities to increase the quality awareness in every projects, which can be done through more scheduled time to quality questions, resources and incitements. Wasif (2008) argues that it is vital to have the right resource allocation in order to make an implementation or change as effective as possible to a company's competitiveness, and that is what *The Tool* aims to do according to the *Development Manager*. Sandholm (2005) further states that new methods and ways of work requires time for training and that is probably what the Case Company need to allocate when doing the project time schedule. The education occurring in the beginning of a project is probably not enough to get the employees good enough on *The Tool* that they can push the usage forward.

Create a continues learning

The reason why *The Tool* first was implemented in the Case Company was to increase the delivered quality and hence generate more satisfied customers and better economy. The quality documentation part, though, is just a single loop learning regarding quality improvements. Argyris (1992) explains that single loop learning does not consider the actual root cause to a specific problem, but rather how it in the easiest way can be fixed. The beneficial parts with *The Tool* is that all gathered data is stored and easily accessible which makes it possible to learn from previous quality issues, and to possibly improve processes so that those issues does not re-occur which is a clear example of double-loop learning. The *Site Manager 2* said that when projects easily can access important quality data it will be a lot easier to learn from mistakes and share the knowledge between employees and projects. The extended benefit of double-loop learning from *The Tool* is that the availability of information serves as a basis for each individual to personally be able to reflect and come up with better building improvements.

The interviewees made it clear that a decisive factor regarding the usage of *The Tool* and general quality awareness was the leadership and how the people on site addressed quality issues. Some of the sites that worked intense and effective with quality documentation had some person or persons that took personal responsibility in using *The Tool*. Those persons made it easier for their colleagues to get the help they needed, and to get pass the initial technical problems with a new tool. Atkin (2008) mentioned that in order to reach high external quality there needs to be prerequisites to high degree of internal quality, and high internal quality is met when employees takes responsibility to develop an effective usage of a new tool. The Case

Company therefore need to have site managers or other leaders on site that propose and strive for the utilization of *The Tool*, since that have been shown to affect the level of usage.

One of the goals from the Case Company is to make *The Tool* widely used among the projects so that the knowledge about quality issues can be shared between them. In order for that to happen the *Operational Manager* argued that there need to be a culture where one does not just see benefit for the specific project, but instead have a realization that sharing quality documentation between projects will benefit all in the Case Company. Deming (1986) further said that cultural and organizational goals and strategies, such as sharing knowledge, must come from the top management and people in charge, otherwise there is a risk that a thoroughly plan of how to reach the goal will be missing. As projects within the Case Company are managed a bit differently depending on the site manager it seems even more important to have commonly expressed decisions and guidelines from top management on how to work with quality and *The Tool*, if a wider usage shall be achieved.

What should the Case Company do to increase its quality work with help from *The Tool*?

As Sandholm (2005) further states it is important to see an implementation as long term and that sustainable financial benefits often doesn't occur directly. Sandholm (2005) also argues of the importance to get the employees within the organization the right training and the right prerequisites to learn, otherwise it will be hard to reach excellence in the implementation. The interviews clearly stated that there was a shortage of resources to support as well as lack of time to learn new methods and *The Tool*. Together with Sandholm's (2005) statement this can support an implementation approach that focuses more on re-enforcing a long term strategy, available for all projects, and with clear prospects and goals. If an encouraging culture towards proactive quality work is created, the possibility of higher *Tool* usage will increase. The long term benefit of *The Tool* will depend a lot on the double-loop learning that improves the employees' competence and steadily improves the way to build, which probably will benefit the Case Company in more areas than just quality issues.

The technical benefits with *The Tool*

Josephsson et al. (2005) state that if unnecessary work and wastes shall decrease in construction projects there need to be more standardized work methods implemented. *Project Engineer 2* said that *The Tool* have made the quality documentation much more effective and standardized, compared to how quality documentation was prior to the digital tools. People are different and think differently which means that it's beneficial from a qualitative perspective to reduce

the human decision factor, to some degree, and base more of qualitative decisions on fact rather than personal opinions (Deming, 1986). *The Tool* is built on the basis that the accumulated quality data and information through the usage will make decisions and improvements based on facts easy. In the long term there would be a benefit if *The Tool* could work intelligently and provide solutions on critical building elements before built, based on previous quality documentation on a similar moment.

Josephsson et al. (2005) further states that the right quality of a product is achieved when it's built, not when it is inspected. The inspection itself therefore is not a value adding step but rather a finding of the actual level of quality. With *The Tool* the insurance of the right quality can be achieved by continuously documenting and sharing the information or issues between the people involved in a certain task. As the information about a quality issue is addressed to the responsible person automatically, it reduces the chance of the issue being missed. The *Supervisor 3* described that a lot of the quality issues at site isn't due to poor technical competence, but rather an effect of poor communication, which *The Tool* solves with the automatic communication path between employees. The communicative advantages with for example pictures in *The Tool* also reduces the possible language barriers that might occur with foreign sub-contractors.

Financial and cost benefits with *The Tool*

As the construction sector has been shown to be a relatively low marginal sector, every saving of unnecessary cost is important. De Feo (2017) states that the direct cost, for example quality issues, is as much as approximately 9% for a construction company. If the Case Company with *The Tool* can reduce its quality deficits, by learning from the data, it will be a financial boost straight to the profit margin. To express and provide evidence to the projects on how *The Tool* reduces costs are probably of high importance, since several of the interviewees expressed that they would like to understand what the actual financial benefit of the usage are. If a model of economic benefits could be conducted the decision to use *The Tool* in each project would be based on facts and probably easier to justify.

As *The Tool* has the purpose of being a resource that should be used continuously throughout the construction process, and not just at the end phase, it will most probably reduce the quality issues on the legal inspection with the customers. One could argue that a reduction of issues shown at inspection with the customer should result in financial indirect benefits by more satisfied customers. The cost of the inspector also decreases since the time for inspection decreases. The Case Company currently have an inspection phase in the housing section that often include 3-5 inspections with an authorized inspector. This phase is both time consuming and expensive. If *The Tool* would be used during the whole process of construction, and

with continues quality controls performed by the employees, the inspection phase could possibly be reduced regarding both time and budget. *Project Engineer 1* argued that if the site personnel ca be able to take responsibility for the quality issues when they occur, and not wait with solving them until inspection, there are a lot of time and money to be saved and possibly shorter project cycles.

The *Site Manager 2* also mentioned that the possibility of taking pictures and see exact dates of a created or closed quality issues in *The Tool* results in easier handling of change-and-adding-work costs. Since quality documentation in *The Tool* have the reliable foundation of facts, the need of personal opinions and argumentation in a negotiation between two contractors can be spared and save time and money.

6 CONCLUSION/RECOMMENDATIONS

It can be concluded that the quality culture and mindset towards quality work on project sites in the Case Company currently are insufficient, and needs to be improved. The root cause to the insufficiency and decreasing external quality seems to be that there are no clear communicated quality culture and guidelines that the projects can follow. It is hard to digitalize a work that don't exists, as the case currently is with the quality work. The general opinion regarding quality documentation through *The Tool* is that the benefits are mostly in the inspection phase where the structure of how the quality work shall be done is clear. Some of the interviewees expressed that to use *The Tool* daily was considered too time consuming relative to the perceived benefits. In order to achieve a continues daily usage the Case Company hence need to establish a culture where quality work naturally is part of the daily work, and that documentation through *The Tool* is seen as a value creation activity that will benefit the organization in the long run.

It can also be concluded that *The Tool* helps the projects in the Case Company to work more resource-effective when used properly. The large amount of information that gets stored within *The Tool* enables employees to learn and analyze previous quality issues, so that it can benefit future projects in the sense of increase knowledge. Increased learning and competence regarding quality issues will in the long run probably decrease re-occurring issues.

In the inspection phase of a project the benefits with *The Tool* are clear, as it saves time for the employees at the Case Company through less administrative work and shorter inspection time. The inspection phase is legally mandatory which can be argued to be a reason to why *The Tool* are used in such a wide extent there, while the weak usage of *The Tool* on daily basis can be correlated to the perceived lack of quality work strategy. It therefore seems of high priority to create a clear procedure and method statement of how quality work should be carried out on a daily basis.

In order to increase the usage of the tool and hence improve the quality there need to be more people responsible for pushing the implementation and usage forward. The need of some kind of digital leader at each site, with responsibility for developing the quality work and support the site organization seems to be of importance. Since a lot of the more senior generation in the construction sector has shown to be restrictive to the usage of digital tools, a digital leader could possibly help change that mentality. If quality work is accepted as a value adding process among the employees, then the step to accept and learn *The Tool* as a quality resource should be easier than it is today.

7 RECOMMENDATIONS FOR FURTHER RESEARCH

In further research it is suggested that the usage of the quality data base can be further developed, as the large amount of stored quality data in *The Tool* could work as improvements to future projects. Since the only investigated and used device, in this thesis, is *The Tool* there could be arguments for further research on how to improve the actual tool.

The literature indicates that all implementations of new work methods or tools should be considered long term and with patience. Further research could therefore be done when *The Tool* have been more attached to the daily work and supported with the right resources, since the effect of long term benefits will be visible first within years.

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