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# Integration of lean management system into the digitalized factory

An Investigation into the use of an IT-tool for Layered Process Audits and Leader Standard Work

Master's thesis in Quality and Operations Management

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CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden 2022  
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Report No. E2022:111



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Cover:  
Visualization of a digitalized system

Gothenburg, Sweden 2022

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## **Abstract**

The purpose of this thesis is to introduce and to support the implementation of Layered Process Audits and Leader standard work in one manufacturing area at a large Swedish company. Further, the thesis aims to understand how an IT-tool can aid the implementation cross multiple levels of the organization. Further, the thesis aims to gain knowledge of the main benefits and challenges that come with implementing Layered Process Audits and Leader Standard Work into an organization. In this thesis a Layered process audit refers to a system where different levels in the organization audit each other in order to prevent quality issues.

The thesis used a qualitative research strategy with Action research being the main qualitative approach applied. A literature review and nine interviews with employees at different levels in the organization was conducted during the thesis. Based on the literature review in the field of Layered Process Audits, Leader Standard Work, implementing new technology, organizational change and data quality, a theoretical framework was constructed. The interviews contributed with knowledge regarding earlier technology implementations, the organization's way of working and insights in how the organization can benefit from implementing Layered Process Audits and Leader Standard Work. This data later constructed the empirical results. By analyzing the empirical results along with the existing theory, three main conclusions could be drawn.

The analysis showed that the IT-tool can enhance the deployment of Layered Process Audits and Leader Standard Work due to its easiness to use and helping the organization to structure their ways of operating. Cultural aspects, such as resistance to change is one hinder that the IT-tool may cause. Many previous technological implementations has failed at the organization, due to cultural aspects and mediocre implementation efforts. Finally, the thesis concluded that the implementation of Layered Process Audits and Leader Standard Work facilitate change initiatives and improves communication between different functions in the organization.

Keywords: Layered Process Audits, Leader Standard Work, Implementation of new technology, Digitalization in manufacturing industry, Organizational change



# Acknowledgment

There are many that we would like to thank for their participation and involvement during this 6-month project. We are truly grateful for all your time, commitment and support.

First, we would like to thank our thesis supervisor, Jan Lenning for all his amazing support and help during the course of our project. Your input and feedback has helped us tremendously.

A big thank you is also directed to the project owner, J.K, for believing in us and providing us with support and resources to complete our project at the company. We would also like to thank N.J, S.K and C.K for their considerable contributions by helping us to conduct test-runs, keep us on schedule through weekly meetings, and overall assistance. We would like to thank all who participated in test-runs and interviews, your contribution has been crucial for the project's success.

Lastly, we want to thank the examiner of this master thesis, Ida Gremyr, for both taking the time to provide input to our thesis, and also for an amazing job as director of the MPQOM program at Chalmers.

May 2022, Gothenburg

Felix Järnberg & Marcus Samuelsson





# Contents

## List of Figures

## List of Tables

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Background . . . . .	1
1.2	Company context . . . . .	2
1.3	Purpose . . . . .	3
1.4	Research questions . . . . .	4
1.5	Limitations . . . . .	4
<b>2</b>	<b>Theoretical framework</b>	<b>5</b>
2.1	Lean . . . . .	5
2.2	Quality management . . . . .	6
2.3	Leader Standard Work . . . . .	9
2.4	Layered Process Audit . . . . .	10
2.5	Digitalization in the manufacturing industry . . . . .	11
2.5.1	The implementation process . . . . .	12
2.5.2	Management involvement . . . . .	14
2.5.3	Education . . . . .	15
2.5.4	Implementation of new technology . . . . .	15
2.6	Organizational change . . . . .	17
2.6.1	Change approach . . . . .	18
2.6.2	Redesigning processes . . . . .	19
2.6.3	Mobile devices . . . . .	20
2.7	Data-driven decision making . . . . .	21
2.7.1	Data quality . . . . .	22
2.8	Theoretical synthesis . . . . .	23

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<b>3</b>	<b>Method</b>	<b>26</b>
3.1	Research strategy . . . . .	27
3.2	Research design . . . . .	28
3.3	Action research in practice . . . . .	28
3.4	Literature review . . . . .	30
3.4.1	Source criticism . . . . .	30
3.5	Interviews . . . . .	31
3.5.1	Workshop and Observations . . . . .	33
3.6	Data processing . . . . .	35
3.7	Research quality . . . . .	36
3.7.1	Validity . . . . .	36
3.7.2	Reliability . . . . .	37
3.7.3	Replicability . . . . .	37
3.7.4	Action research quality . . . . .	38
3.7.5	Research Ethics . . . . .	39
3.8	Method discussion . . . . .	40
<b>4</b>	<b>Empirical results</b>	<b>42</b>
4.1	The IT-tool . . . . .	42
4.2	Interviews with Coordinators . . . . .	43
4.3	Interview with level 1 manager . . . . .	44
4.4	Interview with level 2 manager . . . . .	46
4.5	Interview with level 3 manager . . . . .	47
4.6	Interview with Vice lean manager . . . . .	49
4.7	Interview with EHS manager . . . . .	51
4.8	Interview with Lean manager . . . . .	53
4.9	Interview summary . . . . .	55
4.10	Introduction and evaluation of an IT tool supported for LPA & LSW	57
4.10.1	The Circle of Change . . . . .	58
<b>5</b>	<b>Discussion</b>	<b>60</b>
5.1	RQ1 - Benefits with implementing LPAs & LSW into the organization	60
5.2	RQ2 - Advantages using an IT-tool when implementing LPA & LSW	63
5.3	RQ3 - Hinders deploying the new IT-tool . . . . .	65
5.4	Weaknesses and strengths with the IT-tool . . . . .	68
5.5	Organizational change . . . . .	69
5.6	Limitations and suggestions for future research . . . . .	71
5.7	Discussion about The circle of change . . . . .	72

6 Conclusion	73
References	
A Appendix 1	I

# List of Figures

2.1	Leader standard work example (Adapted from Seely, 2019)	9
2.2	Example of Layered process audit frequencies	11
3.1	Summary of methodology	26
3.2	The Action research cycle, (Adapted from Coughlan & Coughlan, 2002)	29
3.3	Interview questions linked to research questions	37
4.1	IT-tool mock up on different devices	43
4.2	The circle of change	59

# List of Tables

2.1	Practice, Principles, and Techniques of QM (Adapted from Dean & Bowen, 1994) . . . . .	7
2.2	Improvement practices and techniques . . . . .	24
2.3	Teamwork practices and techniques . . . . .	25
3.1	Interview information . . . . .	33
4.1	Interview summary . . . . .	56
5.1	Mandinach (2006) criteria assessment . . . . .	69

# 1

## Introduction

In the current industry climate of the Fourth Industrial Revolution (I4.0), physical development has slowed down as digital development has taken over (Ghobakhloo, 2020). Almost all industries are affected by this unrivaled transformation which is changing our work lives as we know it. This new era that we are enduring requires a change in the current technology used industry wide to cope with the ever changing landscape (Ghobakhloo, 2020). The use of modern devices can save both time and money for companies. However, implementation of new technology is not a straight forward process as it demands changes business processes and organizational structure - posing a change management challenge (Markus, 2004).

Nowadays quality and precision have also become more vital than ever as a result of the paradigm shift, making operational performance at manufacturing sites critical (Fin, Vidor, Ceconello, & de Campos Machado, 2017). Statistics and data collected from manufacturing processes have shown that a major part of quality issues are caused by poor process controls or as a result of an inability to follow appropriate process instructions (Yadav & Thakar, 2021). Standardized operations could be employed to keep process controls under check, thus minimizing the issues (Fin et al., 2017).

### 1.1 Background

As previously stated, poor process control is the root of many quality difficulties, making it critical to develop and improve the company's operating strategy (Yadav & Thakar, 2021). In this technologically innovative era, many people would consider it foolish to develop and improve without adding new technology (Wahab, Mukhtar, & Sulaiman, 2013).

Working using pre-defined procedures is not a new concept and since the 19th century, audits have been used to ensure that a corporation adheres to a set of standards (Matthews, 2006). An audit can be conducted in a variety of areas, such as environment, management, and processes and for an organization, many customers demand that you follow specific standards. An independent auditor certifies that the company meets the requirements for certification, such as ISO (Mak, 2011).

Managers who had seen the benefits with predefined procedures realized that a standardized technique of working should be employed in everyday operations. Incorporating checklists is a typical way of enforcing standardized work, and helps to structure the day which leads to more productive and effective work (Yadav & Thakar, 2021). This was the beginning of what would eventually be known as Layered Process Audits (Yadav & Thakar, 2021). Layered process audit is an auditing system including various levels of the organization which focuses on processes rather than the final product (Sjöholm, 2021).

Many businesses have benefited from new technology, which has helped them become more efficient and succeed in both business operations and a variety of other areas. Many other organizations have found that combining technology with operations and lean manufacturing is a winning strategy (Wahab et al., 2013). Using layered process audits in conjunction with an IT tool could thus be a successful step for a corporation moving toward a digital future.

## 1.2 Company context

This thesis will be undertaken at a manufacturing company that has worked intensively with lean production. The factory in Gothenburg, that is the subject for this thesis, have completed phase 1 of their internal Lean production system implementation process, now it is time to move on to phase 2. The various phases in the internal manufacturing system indicate how well the factory is meeting global manufacturing objectives. This requires a greater level of participation from everyone, which is critical to the success of lean production systems and the benefits obtained via continuous improvement. Two cornerstones of this change are Leader Standard Work and Layered Process Audits. Leader Standard Work is a concept in which managers utilize daily and visual controls to ensure that everyone is working to the same set of standards (Mann, 2005). Layered Process Audits is a system for assuring that standard operations are followed, including various levels in the organization (Yadav & Thakar, 2021). Poor process control is something that the company has been struggling with in the past, leader standard work and layered process audits



can be a solution to this problem.

As mentioned before, the company featured in this thesis has extensive experience with lean practices, mainly in manufacturing and has developed its own production system based on this. Lean is a key component of the company's day-to-day operations, and the corporation has invested much in growing and excelling in this area. The following is the company's definition of lean:

*"Lean is the continuous pursuit of reducing lead time of each value stream while optimizing value (Quality, Delivery, Cost etc.) minimizing waste (Quality, Flow, Flexibility etc.) protecting and involving all employees."*

The definition above is also the definition used by the project team in this thesis.

In order to reach phase 2 of the lean manufacturing system, the organization must perform layered process audits. This would necessitate the development of an IT solution to aid managers and operators in their everyday tasks in order to spread and maintain the lean management system.

This thesis includes the introduction and implementation of an IT application that facilitates layered process audits and leader standard work, as the factory is a digitized plant. This implementation should take place on the working floor, but certain managers will also be involved testing the IT-tool themselves. As a result, the organization will be able to keep track of their everyday activities while also retaining crucial data.

### 1.3 Purpose

Based on the presented background information, poor process control and inability to follow standard operations are causing quality issues. With this as the foundation for this thesis, the following purpose was established.

*The purpose of this thesis is to introduce and to support the implementation of Layered Process Audits and Leader standard work in one manufacturing area at a large Swedish company. Further, the thesis aims to understand how an IT-tool can aid the implementation cross multiple levels of the organization.*

### 1.4 Research questions

To achieve the purpose of this thesis, the following research questions have been formulated:

- What are the main benefits by introducing and implementing Layered process audits and Leader standard work throughout the organization?
- Does the use of an IT-tool enhance the deployment of Layered Process Audits and Leader Standard Work?
- What could hinder the implementation of the new IT-tool supporting Layered Process Audits and Leader Standard Work?

### 1.5 Limitations

In order to manage the scope of this thesis and to ensure that the results are relevant to the overall purpose and that the project could be completed within the time span of roughly 6 months, certain limitations were necessary to consider. The first limitation of this thesis is that the IT-tool is to be implemented in a pilot area consisting of one manufacturing unit of the organization. Another limitation that has been made is that the IT-tool is not going to be deployed to a full extent within the pilot area. Instead, a selected number of employees will use and test the tool and evaluate it. Additionally, the research team has been provided with a IT-tool from the company and will therefore test the implementation of Layered Process Audits and Leader Standard Work exclusively using this tool.

# 2

## Theoretical framework

This chapter presents the literature used in this thesis. The purpose with the theoretical framework is to limit the scope and focus on relevant and interesting theory that later is used to answer the research questions. The first subchapters are focused on lean, total quality management, leaders standard work and layered process audits , while later focus lays on implementation and last on data collection and data quality. This reflects the method that the project group has used working with this thesis.

In subchapter 2.1, the definition of Lean is presented. In the subsequent subchapter, 2.2, quality management is covered followed by an explanation of Leader Standard Work in subchapter 2.3. Subchapter 2.4, introduces Layered Process Audits. Subchapter, 2.5 discusses digitalization in the manufacturing industry, followed by subchapters 2.6 and 2.7 which present organizational change and data-driven decision making respectively. Finally, the theoretical framework is summarized in subchapter 2.8.

### 2.1 Lean

Rotter et al. (2019) state that there is no universally accepted definition of Lean due to the fact that the implementation and tactics for Lean vary greatly across industries, making it difficult to agree on a single precise definition for Lean. However, according to the authors, the most commonly referenced and used definition of Lean is as follows:

*"An integrated sociotechnical system whose major purpose is to remove waste by concurrently lowering or limiting supplier, customer, and internal variability".*

Furthermore, Rotter et al. (2019) explain that industrial improvement approaches,

such as Lean management, originated in the operations and manufacturing industries, but have now spread to other industries such as healthcare and construction. The overall goal of lean is to decrease waste and use resources as efficiently as possible (Shaman & Sanjiv, 2013).

### 2.2 Quality management

Quality Management has roots in the Japanese automotive industry and is considered part of the foundation of Lean manufacturing (Anvari, Ismail, & Hojjati 2011; Dahlgaard, Khanji, & Kristensen, 2008). Since its inception, it has become one of the most researched themes in the field of operations management and is now a universally accepted target for many companies (Nair, 2006). In addition, quality management has grown to become a management philosophy which has found its way into most business sectors (Sousa & Voss, 2002; Hackman & Wageman, 1995). Sousa & Voss (2002) further claim that the quality management practices have also progressively been integrated into normal business operations in modern organizations, as the practices have lost their faddish undertone and become more generally accepted.

Hellsten & Klefsjö (2000) describes that the main goal with quality management is to create a culture based on core values, which Dean & Bowen (1994) refers to as "principles". All three principles are implemented by organizations through the use of certain practices (Dean & Bowen, 1994; Hellsten & Klefsjö 2000). Sousa & Voss (2002) argues that quality management practices play a significant role for both quality as well as operational performance. These practices are activities such as analyzing processes or collecting information about customers and are, in turn, supported by a set of techniques (Dean & Bowen, 1994; Hellsten & Klefsjö 2000). Hellsten & Klefsjö (2000) explain that core values or "principles" can not be properly implemented without suitable techniques.

Dean & Bowen (1994) define quality management as:

*"a philosophy or an approach to management that can be characterized by its principles, practices and techniques".*

The authors explain that principles refer to *customer focus*, *continuous improvement* and *teamwork*. The principles of Total quality management are described in Table 2.1, along with an explanation of related practices and techniques.

**Table 2.1:** Practice, Principles, and Techniques of QM (Adapted from Dean & Bowen, 1994)

	<b>Customer focus</b>	<b>Improvement</b>	<b>Teamwork</b>
<b>Principles</b>	The necessity of offering products and services that meet customer wants is paramount: requires an organizational focus on consumers.	Frequent customer satisfaction can only be attained by continuous improvement of processes that generate products and services	Collaboration throughout an organization, as well as with customers and suppliers, is the greatest way to accomplish customer focus and continuous development.
<b>Practice</b>	<ul style="list-style-type: none"> <li>- Direct contact with customers</li> <li>- Gathering information about customer needs</li> <li>- Design with regards to customer needs and deliver services and products</li> </ul>	<ul style="list-style-type: none"> <li>- Analysis of processes</li> <li>- Reengineering</li> <li>- Problem Solving</li> <li>- PDCA</li> </ul>	<ul style="list-style-type: none"> <li>- Look for solutions that favor all involved parties in a process</li> <li>- Create teams of various types</li> <li>- Skill training of groups</li> </ul>
<b>Techniques</b>	<ul style="list-style-type: none"> <li>- Surveys and focus groups</li> <li>- Transform customer needs to product specifications through QFD</li> </ul>	<ul style="list-style-type: none"> <li>- Flowcharts</li> <li>- Pareto Analysis</li> <li>- Statistical process control</li> <li>- Fishbone diagrams</li> </ul>	<ul style="list-style-type: none"> <li>- Methods such as the nominal group technique to develop the organization</li> <li>- Methods for team-building e.g., clarification of roles and group feedback</li> </ul>

It is explained by Dean & Bowen (1994) that customer focus is the most essential principle, which is also the center point of a model proposed by Bergman & Klefsjö (1994). However the model by Bergman & Klefsjö (1994) focuses on Total quality management, which is a further development of quality management, and refer to principles as "core values". The goal of ensuring that customers are satisfied is central to quality management and is expressed by an organization's strive to design and deliver services and products that fulfill customer needs. The underlying rationales behind customer focus being the most important principle are beliefs that organizational success, in the long run, requires focus on customer satisfaction throughout the entire organization (Dean & Bowen, 1994). Practices related to customer focus can be advocating direct customer contact and collecting data on customer expecta-

tions (see Table 2.1). Relevant techniques, as described in Table 2.1, include surveys and quality function deployment.

The second principle, continuous improvement, refers to a commitment to consistent evaluation of administrative and technical processes in hopes of developing newer, better methods (Dean & Bowen, 1994), and Bergman & Klefsjö (1994) also includes continuous improvement in their cornerstone model with similar practices and techniques. Dean & Bowen (1994) posit that underlying this principle, are the theories that organizations consist of interlinked processes and that they can maintain customer satisfaction if these processes are constantly improved. As can be seen in Table 2.1, the relevant practices to continuous improvement include reengineering and process analysis. In addition, the applicable techniques include statistical process control and flowcharts. While Dean & Bowen (1994) include this focus on developing processes within the principle "continuous improvement", Bergman & Klefsjö (1994) have chosen to include both "improving continuously" as well as "focus on processes" as two separate cornerstones with their own underlying tools & techniques in their model.

The third principle, teamwork, is described by Dean & Bowen (1994) as the collaboration between managers and other personell, cross functions, and between suppliers and customers. Teamwork between managers and other personell is explained by the authors as being based on the assumption that non-managerial employees are capable of providing meaningful contributions to organizations when they have sufficient preparation, as well as the authority to impose them. Furthermore, Dean & Bowen (1994) clarify that teamwork between functions is based on the concept that organizations as systems are inefficient if functions prioritize their own outcomes over other function's, and underlying the principle of teamwork among customers and suppliers are the benefits of partnerships, such as loyalty, synergy etc. As can be seen in Table 2.1, identifying the needs of all organizations and groups participating in decision making, as well as sharing responsibility and credit, are examples of teamwork practices. Additionally, Table 2.1 shows that techniques such as role clarification and group feedback are used to strengthen team-building, and therefore also teamwork. In the cornerstone model by Bergman & Klefsjö (1994), the principle of "Let everyone be committed" can be interpreted as being relevant to the principle of teamwork. Techniques for this principle are "quality circles" and "improvement groups", which Bergman & Klefsjö (1994) propose in their model.

The three principles of customer focus, teamwork, continuous improvement are all closely related to each other (Dean & Bowen, 1994). Continuous improvement and

focus on processes are used to develop business processes that create customer satisfaction (Dean & Bowen, 1994). Since the processes that are targeted by continuous improvement exceed the functional, hierarchical and organizational boundaries, teamwork becomes crucial (Dean & Bowen, 1994).

### 2.3 Leader Standard Work

Standard work is the most well-known method of completing a task, and is based on following predefined procedures (Mann, 2005). The author explains that standard work for leaders, known as Leader Standard Work (LSW), is based on this method and is a strategy for leading and sustaining improvements in culture, habits, and performance. LSW also includes the behaviors, actions, and tools that a leader deploys on a regular basis. Mann (2005) further states that LSW entails standardized work for leaders as well as working with operators to develop standardized practices, but also a philosophical transformation in leadership.

Another element of LSW is that it affects the entire company, and the concept behind this principle is that managers at all levels of the organization should cross-check and assist one another (Seely, 2019). As shown in Figure 2.1 below, the team leader should inspect the operator to ensure that they are regularly completing their duties, and the team leader is then monitored and supported by a supervisor (Seely, 2019). The system should then function in the same way throughout the organization. The idea is to assist leaders in establishing a routine, and to create guidelines for expected leadership behavior which also improves accuracy by comparing the actual result to the original plan (Seely, 2019).

Role	Responsibility
Executive	Ensure improvement
Manager	Monitor and support supervisor
Supervisor	Monitor and support the team leader
Team leader	Ensure operator follows standard procedures
Operator	Perform the task consistently according to standard

**Figure 2.1:** Leader standard work example (Adapted from Seely, 2019)

The addition of focus on results and processes is also a central part of Lean management and LSW (Mann, 2005). The foundation is to have a process focus, but it is also critical to see the process in action, and the production team leads should therefore devote a significant amount of effort to either monitoring or enhancing the process, whereas senior managers should concentrate on improving it (Mann, 2005). However, Mann (2005) mentions that some managers can become too focused on the outcome and therefore miss out the importance of the process, but argues that more experienced managers can detect the irregularity in a process and therefore overcome such problems. Due to inexperienced managers having too low knowledge about the process, the author advocates that Lean design necessitates a large number of team leaders.

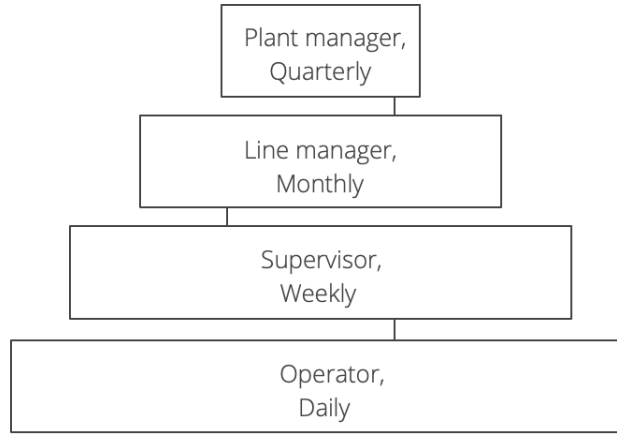
### 2.4 Layered Process Audit

The automotive industry is a massive industry and is one of the world's most important economic activities (Lozano, Aguirre, Gutiérrez, & Aguirre, 2020). As a result of the industry's global significance, there is a lot of competition and therefore innovative ways of working are constantly being developed and adopted by manufacturers. For instance, the automotive industry was one of the first to embrace Layered Process Audits (LPAs) and also uses this way of operating more than other industries due to the competitiveness of the industry (Lozano et al., 2020).

Layered Process Audit (LPA) is a system that focuses on standardized processes and quality improvement, and are used to standardize and manage industrial activities (Yadav & Thakar, 2021). LPAs are differentiated from traditional audits due to the fact that they deal with standard operations and ensuring process control on a frequent basis, as opposed traditional audits which mainly focus on evaluating businesses with a longer time-span in between assessments (Yadav & Thakar, 2021).

The LPA system is built on the importance of auditing processes by various levels of the organization and is used to protect against quality flaws, customer complaints, and other issues (Yadav & Thakar, 2021). The operators conduct process audits in their area on a regular basis, while managers higher up in the organization conduct audits in larger areas, on a less regular basis. As a result of the multiple layers of management involved in such an audit, it might be regarded a powerful tool for change (Yadav & Thakar, 2021). An example of the different levels and their respective time frames between audits, is presented in Figure 2.2





**Figure 2.2:** Example of Layered process audit frequencies

A common problem in many businesses today, is the feeble communication among different functions, however, Yadav & Thakar (2021) argue that LPAs facilitates and enhances communication between different functions as a result of multiple levels of management being involved in the audit design. Moreover, rather than evaluating the final product, the goal of layered process audits is to evaluate the processes where products are made, and have both tangible and intangible benefits, with the majority of them being linked to process compliance and hence having a direct impact on product quality (Lozano et al., 2020).

Moreover, traditionally LPAs has been conducted using regular checklists on paper, but the rising level of digitalization means that an opportunity to use an IT-tool for LPAs emerged (Lozano et al., 2020). According to the authors, if it is intended to use an IT-tool to conduct LPAs, implementation of new technology and its repercussions must be considered.

### 2.5 Digitalization in the manufacturing industry

Much research has highlighted digitalization as being a key technology within manufacturing (Zhou, 2013). The author emphasizes digitalization as well as intelligentization, and argues that these are essential technologies to produce revolutionary technological improvements in modern manufacturing.

Furthermore, Zhou (2013) claims that the use of digital and intelligent technologies like digital control and self-adaption control would result in considerable increases in precision and productivity, which will enable the creation of a computerized produc-

tion integration system. Moreover, Zhou (2013) argues that management is critical in this situation since it allows the company to manage all of its resources in one place and that engineering and commercialization are essential for this manufacturing transformation and digitalization to take place. Zangiacomi et al. (2020) agree that management engagement is important, but also states that the managers will benefit the most from the factory’s digitalization with the argument that digital tools can assist managers in strategic decisions by all collected data available.

In order to advance in the digital revolution, cross-disciplinary capabilities have become a necessity (Aaldering & Song, 2021). As new opportunities for value creation emerge from these incorporated machines and data-operated models, machine learning and big data will demand a wide range of skills, hence recruiting and identifying the appropriate individuals will be crucial to achieve success, and it may be what separates the winners from the losers (Aaldering & Song, 2021).

To encourage innovation, Aaldering & Song (2021) also stress the need of research collaboration, and the authors exemplify that with more data, it will be easier to make evidence-based judgments. Furthermore, Zhou (2013) argues that, utilizing digital capabilities will provide distinct value and allow firms to differentiate themselves from competitors, and further explains that the concept of innovation must be firmly established during the integration of digitalization and intelligentization. The firm must define what innovation means for them and increase focus on engineering and commercialization of scientific and technological outcomes (Zhou, 2013).

### 2.5.1 The implementation process

When an organization’s management group creates a policy, they expect it to be implemented, and that the desired consequence of that execution will be close to what the policymakers expect (Smith, 1973). The implementation of new processes demands a number of organizational qualifications that few businesses have. These qualifications are *the structure and personnel* which refers to the stability of the organizational structure, *the leadership of the administrative organization* which refers to the nature and style of the leadership and *the implementing program and capacity* which explains how the implementation process is done (Smith, 1973). If the organization does not possess these organizational qualifications, Smith (1973) argues that there is a serious risk that the policy may not fall out as expected in the organization, this shows how important the implementation process is.

Instead of the three critical factors mentioned by Smith (1973), Al-Mashari & Zairi (1999) suggests that there are five essential characteristics that must be incorporated for a successful implementation: *change management, managerial competency and support, organizational structure, project planning and management, and IT-infrastructure*. In addition, these initiatives must be in line with the company's overarching strategy. Due to the fact that alignment between the new implementation and IT is critical, a robust IT-infrastructure may assist and support the deployment (Al-Mashari & Zairi, 1999). Furthermore, Zmud & Cox (1979) argues that from both a technological and organizational standpoint, the complexity of the system being implemented is critical. Data structures and integrating with other internal systems are examples lifted by the authors which creates technical complexity. In general, the larger the system, the greater the complexity (Zmud & Cox, 1979). Moreover, Zmud & Cox (1979) posit that organizational difficulties are about the tool's dependability or impact on duty and responsibility. When new ideas or techniques are implemented, duties are frequently altered, according to the authors. The more managers affected by the tool, the more complex implementation.

A system's implementation is frequently built on a series of activities, each of which corresponds to a different step of the process which are *Initiation, Strategic design, Technical design, Development, Conversion, and Evaluation* (Zmud & Cox, 1979). Initiation and strategic design are the first two steps of a system's implementation. Zmud & Cox (1979) means that initiation involves project description and justification and strategic design refers to determining the project's scope and requirements. The following step is technical design, which entails turning the strategic design into hardware, software, and process requirements. The acquisition of hardware and software, as well as their testing, are all part of the development step. Finally, conversion is the introduction of the new system within the organization and the final step is evaluation, which assesses the system's efficiency (Zmud & Cox, 1979).

According to Meyers, Durlak, & Wandersman (2012), it is critical to improve for future applications and to learn from the acquired experience and to reflect on the process and share it with others in the organization. This should not be carried out by a single person, but by a group of people who were part in the process. This provides information from several angles that will be useful in the future (Meyers et al., 2012).

### 2.5.2 Management involvement

Al-Mashari & Zairi (1999) states that two of the most important aspects that determines the success of the implementation process are top management support and top management commitment. Top management is in charge of the organization's activities, and their primary goal is to create a sense of commitment among the participants in the implementation (Zmud & Cox, 1979). Therefore, it is of utmost importance to consider both top management support and commitment in order to communicate a clear vision for the future (Al-Mashari & Zairi, 1999). Moreover, it is also critical that the new implementation fits into the company's overall strategy, according to the authors. This is because it is easier to comprehend why the implementation is required if it is a natural component of the broader strategy, as well as the fact that the implementation should help the new strategy to be followed and improved (Al-Mashari & Zairi, 1999).

Meyers et al. (2012) discusses methods for increasing the interest of decision-makers. One strategy is to align the implementation with the company's overarching strategy and mission as well as values. This is something that Al-Mashari & Zairi (1999) mentions as well. Another suggestion made by Meyers et al. (2012) is to create implementation champions who will campaign for the use and value of the implementation.

Hammer (2007) posits that due to the fact that executives come from a variety of backgrounds and have varied levels of experience, problems can arise. The author explains that executives' experiences may influence how they view a particular process, and that various managers may approach the problem from different angles. Furthermore, Hammer (2007) exemplifies that some managers are concerned with technology, the other with human resources, and the third with organizational structure.

Finally, Zmud & Cox (1979) argue that the functional manager is primarily responsible for the overall implementation effort and therefore determines the success of a system implementation, and these managers must be dedicated, and their efforts are frequently tied to strategic design and conversion. Zmud & Cox (1979) posit that the operating manager should be in charge of all implementation activities involving operating employees and create the four levels of involvement, which are *consultation*, *influence*, *commitment* and *responsibility*. These involvement levels connects organizational activities and resources to the project and will be more carefully explained in subchapter 2.7 (Zmud & Cox, 1979).

### 2.5.3 Education

According to Zmud & Cox (1979), employees must grasp the benefits of a new system and how it will affect them both during as well as after the implementation in order to contribute to it. The authors explain that ignorance and uncertainty will lead to implementation resistance if such knowledge is not available. As a result, training programs must be used to meet these requirements (Zmud & Cox, 1979). Education is also mentioned by Al-Mashari & Zairi (1999) as a critical aspect for a successful implementation process, where IT abilities, total quality management, and interpersonal skills and approaches are all necessary to realize the implementation.

Zmud & Cox (1979) argue that employees should first be informed about the new system, as well as how it will effect their department. It is also necessary to hold training sessions for the implementation of this unique system. In these sessions, employees are given further knowledge and background facts, as well as the chance to ask questions. Furthermore, Zmud & Cox (1979) state that a description of how this implementation should be done in practice should also be included in this session.

### 2.5.4 Implementation of new technology

Implementing new technologies has a number of benefits, among them are increased efficiency, productivity, and quality (Jones & Smith, 2004). The authors explain that some companies today are missing out on a lot of the possibilities that modern technology has to offer, around 40 percent of businesses are not experiencing the intended benefits of modern technology. The authors' study further showed that 10 percent of these businesses claimed that implementation issues were to blame for not attaining the desired results, where the majority of the issues were caused by human or organizational factors.

Several things must be considered in order to successfully adopt new technology into an organization (Jones & Smith, 2004). The authors argue that technology characteristics, organizational structure, environmental conditions, and human aspects should all be considered during the implementation process. It's critical to find a balance between all of these implementation components to successfully implement new technology, and the authors emphasize the necessity of employee participation and teamwork.

Furthermore, Jones & Smith (2004) state that employee involvement is a good approach to increase motivation, which in turn will lead to greater employee acceptance of new technologies. This also allows the employees to use new technologies that

could benefit their own personal demands. This, in turn, should lead to greater employee satisfaction as well as a better adoption of the new technology. Sjödin, Parida, Leksell, & Petrovic (2018) state that when it comes to integrating technology, it can be difficult to understand the potential benefits that the implementation can provide. This can also create an uncertainty among both employees and executives, according to the authors. Furthermore, Ensminger, Surry, Porter, & Wright (2004), suggest that the designer of a new technology must have great knowledge of the deployment process and recognize this as a critical factor for successful technology implementation. The primary reason for this is that it gives credibility to the technology and allows designers to respond to difficult questions and satisfy users who wish to make changes. Jones & Smith (2004) further states that employee participation is critical not only for installation, but also for performance and results after the new technology has been implemented.

Moreover, Jones & Smith (2004) posit that it is critical for the management team to try to lessen employee resistance to change, and one way to do so is through employee participation. The authors also recommend that all those who are affected should be gathered in a team meeting. Participants are able to ask questions and feel more involved in the decision-making process as a result of this. Corporation between management and employees is therefore crucial (Hammer, 2007). Management involvement is something that both Ensminger et al. (2004) and Ham, Kipping, & McLeod (2003) mentions as one of the most important factors when implementing new technology. This, combined with a successful change management program that emphasizes pilot testing and is managed by a chief executive makes it easier for others to accept the change and work harder to solve the challenges that may arise (Ham et al., 2003).

Sjödin et al. (2018) identified three main categories as major obstacles to deploying technology and building smart factories. Among the three major obstacles, the authors highlight *People* as being one of the most significant problems. Moreover, the authors state that factory workers lack a vision and knowledge of technology and the application of smart factories. The main reasons are attachment to previous generations of industrial technologies, as well as the perceived danger to established competences. Sjödin et al. (2018) have established three main concepts for implementing smart factory solutions. These three concepts are: *Cultivate digital people*, *Introduce agile*, and *Configure modular technology*.

According to Sjödin et al. (2018), the entire workforce must evolve as the digital transformation progresses in order to drive smart manufacturing adoption. Com-

petencies and abilities should evolve in parallel with changes in the environment to ensure that personnel can keep up with the rapid pace of technological innovation, and the authors further state that managers must also make a big effort to attract and empower employees with digital skill (Sjödín et al., 2018). The first critical step when implementing smart factory solutions, according to the authors, is introducing agile processes. Second, Sjödín et al. (2018) emphasize the necessity to use the Stage-Gate model and other similar strategies for implementing process improvements, additionally stating that in the smart factory, agile processes enable flexibility and autonomy. The third essential consideration that Sjödín et al. (2018) present, is managing the complexity of digital systems, which can be accomplished through the use of modular technologies. When a factory gets digitalized, it can bring a lot of benefits, but it can also bring a lot of confusion and frustration if it is overly complicated. If technology is broken down into smaller modules and delivered one at a time, the organization's adoption will improve and the overall complexity will be reduced (Sjödín et al., 2018).

## 2.6 Organizational change

Change management is frequently defined as a process of renewing the direction, structure, and capabilities of an organization to meet the ever-changing needs of external and internal customers (Moran & Brightman, 2001). Every organization and firm must therefore be able to identify future needs (By, 2005). This requires a great deal from the organization's management team, as they are the ones who make strategic decisions.

All human and social changes, as well as cultural adjustment approaches, are included in change management (Al-Mashari & Zairi, 1999). The introduction of newly designed processes is seen as a crucial component. Additionally, change management also requires the revision of reward systems, communication, and the creation of a change culture (Al-Mashari & Zairi, 1999).

By (2005) means because the need for change is frequently unpredictable, it is generally reactive and triggered by an organizational or global issue. According to the author, around 70 percent of all change programs that are initiated, ultimately ends in failure. Further, the author states that the main reason that change initiatives fail, is due to a lack of a valid framework for successful implementation and management of organizational change. The existing frameworks lack empirical data and are frequently based on untested hypotheses.

Both Hammer (2007) and Sjödin et al. (2018) means that the organizational culture is important for implementing new technology. Price & Chahal (2006) explains that culture is difficult to measure, making it difficult to determine whether one's culture is good or not. According to Price & Chahal (2006), culture should be viewed as a key to improving performance.

By (2005) also concurs that organizational culture is a key component in embracing change and new initiatives. A company with a positive culture that embraces change will smoothly implement it, whereas a company with a poor change tolerance will resist it and focus on the issues rather than the positives. This could also be the case when implementing new technology, hence culture plays an important role in this thesis (By, 2005).

### 2.6.1 Change approach

When it comes to developing a computer-based information system, Zmud & Cox (1979) discusses two possible approaches. The traditional approach, in which the system analyst is the driving force behind implementation, and the change approach, where the analyst collaborates with a user in the problem-solving team to carry out the implementation. Zmud & Cox (1979) argues that the best option depends on the abilities of the people engaged, as well as the system's complexity. The traditional approach should be used to develop a system that automates a procedure, is independent of other organizational systems, and results in little organizational change. When the change process is poorly defined, the system must connect with other organizational systems, and when significant organizational change is expected, the change approach is preferred (Zmud & Cox, 1979).

When adopting the change approach for significant organizational change, the implementation can be perceived as counter-productive at first (Zmud & Cox, 1979). When it comes to change, people are more likely to accept it if they understand it and have a say in what happens. As a result, Zmud & Cox (1979) argue that the organization must develop an environment conducive to change, were it is critical to involve individuals who will be affected by the change early in the process, since this makes it simpler for them to accept the change. Al-Mashari & Zairi (1999) also emphasize the necessity of fostering a change-oriented culture, arguing that it is one of the most significant components in a successful implementation. The ability of an organization to adapt to change is used to evaluate its change management. The authors propose that major influencers of both people and groups be enlisted through effective one-to-one and one-to-many interactions. Graetz & Smith (2010)



agrees that a change-oriented culture is essential, but also emphasize the importance of maintaining control after the change.

In order to create a change-oriented culture, which both Al-Mashari & Zairi (1999) and Zmud & Cox (1979), emphasize as an important factor to change, participants must be actively involved. Another important factor for employee involvement, mentioned by Graetz & Smith (2010), is that the leader's vision is spread and widely accepted by the employees in the company. This encourages everyone to work toward the same goal, which is critical for success.

### 2.6.2 Redesigning processes

According to Hammer (2007), the performance of a process is determined by its design, which refers to how well defined, and how simple the task is to complete. The authors continue to explain that redesigning the process is frequently the only option to significantly enhance performance by the *performers*, which are those who have the the required knowledge and abilities to perform a task. Hammer (2007) implies that a well-designed task facilitates performance and improves process control, and while Hammer (2007) explains that process design is crucial for process control, Yadav & Thakar (2021) suggests that LPAs fill the same function.

In continuation, Hammer (2007) posits that most leaders agree that redesigning business processes may improve both performance and customer satisfaction, which results in increased profit. Many firms have attempted to redesign business processes in order to improve cost efficiency, quality, speed, and profitability; some have succeeded, while others have failed (Hammer, 2007). The main reason for this failure is due to the difficulty of changing processes, according to the author.

When investigating a hospital that was integrating computerized booking systems, a number of cultural barriers as well as a number of other important issues when changing processes were discovered (Ham et al., 2003). The authors discovered that while altering a process is difficult, recruiting a young set of physicians who were willing to change accelerated the present work process. Some employees are averse to change because they are comfortable doing what they have always done (Ham et al., 2003).

It is not always enough to redefine process work, roles must also be redefined, and new jobs must be supported by an increase in staffing and training (Hammer, 2007). In order to affect change, the author suggests that it is necessary to transform the organizational culture. Roles and duties must also be redefined so that the manager

can supervise the process rather than the actions. In addition, rather of supervising people, they must develop them (Hammer, 2007).

Hammer (2007) also mentions that when redesigning a process and ensuring that it functions properly, the process approaches maturity. When a process is under control and doing well, it is said to be in this state. The author claim that executive assistance and a supportive environment are required to achieve this. Ham et al. (2003) also mentions the importance of an involved management team and states this as a key for successfully changing processes. Further, Hammer (2007) proposes five process enablers that can be assessed based on their maturity: *design*, *performers*, *owner*, *infrastructure* and *metrics* are the five process enablers identified by (Hammer, 2007).

The process is an issue that has been recognized by Sjödin et al. (2018) as critical to deploying technology. When it comes to processes, working with digital transformations is difficult, according to the authors. Factory implementation of new technologies is frequently time-consuming due to a lack of a systematic methodology, and rigid culture might make it tough to change a procedure that has been done the same way for a long period (Sjödin et al., 2018). In this circumstance, modern business transformation models are required, according to the author.

### 2.6.3 Mobile devices

Matyi, Veres, Banyai, Demin, & Tamas (2020) conducted research at a large Hungarian manufacturing firm and discovered that 68 percent of employees had access to a mobile device. According to the study, these mobile devices were mostly used to view e-mails, track holidays and schedules, and view company news. Matyi et al. (2020) also determined that mobile devices save operators a significant amount of time on a daily basis. Utilizing a mobile device instead of a laptop or desktop computer saves the user approximately 5-10 minutes per day. With a large number of employees using mobile devices, the organization would save a lot of money (Matyi et al., 2020).

The final conclusion by Matyi et al. (2020), is that digitization is a must-have in our modern era, both in terms of development and financial viability. Modern technology can help to save both time and money (Matyi et al., 2020). Mobile devices will also make it easier for operators and executives to view physical processes digitally, which is another compelling reason to include mobile devices into the factory according to the authors. Morkos et al. (2012) states that the biggest advantages by employing

mobile devices into a manufacturing site is the capacity to access information from any location, improved communications, data storage and convenience.

### 2.7 Data-driven decision making

Brynjolfsson, Hitt, & Kim (2011) concluded that companies that use data-driven decision making have a five to six percent higher productivity than those who do not. Other performance indicators suggested by the authors, such as *asset utilization*, *return on equity*, and *market value*, also show data-driven decision making since decisions are based on facts.

Despite the fact that companies are collecting more data than ever before, managerial choices are frequently dependent on a leader's gut feeling rather than data-based analytics (Brynjolfsson et al., 2011). Systems like customer relationship management, supply chain management, and enterprise resource planning are responsible for much of this data collection, and these systems are frequently equipped with analytical and business intelligence capabilities which produces a lot of valuable information (Brynjolfsson et al., 2011). Mandinach, Honey, & Light (2006) state that the knowledge of the individual determines whether data becomes information or not. When data is related to a context, it becomes information, and this information can be utilized to organize and interpret a company's surroundings, as well as to make a connection between data and context (Mandinach et al., 2006).

Furthermore, Mandinach et al. (2006) argue that data-driven decision making can be supported, enabled, and facilitated through the use of a technological tool, and the value of incorporating technology into data-driven decision-making is becoming clearer. Provost & Fawcett (2013) state that some industries has used data-driven-decision making for decades, where the communication and banking industry started using this in the 1990s, implementing technological tools into their business. Moreover, Mandinach et al. (2006) state that in some circumstances, the technological tool and the obtained data are intertwined and must be handled as a single entity, and in other circumstances, despite the fact that the technological instrument would have an impact on the data, many contend that it should be considered separately (Mandinach et al., 2006).

Moreover, Mandinach et al. (2006) posit that it is also crucial that the tool is easy to use and does not require too much effort, otherwise, people would avoid using it. The authors have highlighted a number of features that influence how a tool is used, that is for example *accessibility*, *length of feedback loop*, *comprehensibility*, *flexibility*,

*alignment*, and *linkages to teaching*.

The interface and UX-design are very significant and can boost *accessibility*, which refers to how easy a product is to use (Mandinach et al., 2006). The period between when data is gathered and when the user receives the data in a meaningful form is referred to as the *length of the feedback loop*. Mandinach et al. (2006) explains *comprehensibility* as how the technology shows data and how easily it can be understood. *comprehensibility* is typically improved by using a variety of presentation modes. The data handling-ability that a technological tool has, is referred to as *flexibility* (Mandinach et al., 2006). The more *flexibility*, the easier it is for even the most inexperienced users to understand and process the data. Additionally, the authors refers to *alignment* as how well the tool facilitates data alignment, resulting in data that is valuable, understandable, and of high quality. The final factor explained by Mandinach et al. (2006), *linkages to teaching*, is related to instruction, implying that the data must be related to practice.

Given these functions and capabilities, a significant question is whether the technological instrument allows for effective data interrogation that matches the end users' expressed goals (Mandinach et al., 2006). As a result, selecting a technological instrument is a difficult option. The quality of the tool will influence how the data is evaluated, as well as the types of questions that may be asked and who can answers them (Mandinach et al., 2006). Mandinach et al. (2006) argues that selecting a tool is a difficult and crucial decision for successful data-driven decision making. Furthermore, Provost & Fawcett (2013) posit that analyzing data and drawing conclusions is a critical stage in big data and data-driven decision making, which might result in a variety of outcomes and conclusions depending on who is analyzing the data. When data is well-structured and easy to comprehend, most analyses will seem the same, but when data is more difficult to understand and analyze, the results may vary (Provost & Fawcett, 2013).

### 2.7.1 Data quality

Laranjeiro, Soydemir, & Bernardino (2015) state that it's important to consider the quality of gathered data since poor data can have disastrous consequences on both a social as well as on a economic level, it is therefore critical for practitioners and researchers to understand the importance of having good data. Additionally, Laranjeiro et al. (2015) state that the consequences of bad data can affect the organization negatively were poor data can lead to consumer and employee dissatisfaction, as well as increased operating costs. Furthermore, poor data can also have an impact on

decision-making and foster a culture of distrust inside a company. Moreover, Laranjeiro et al. (2015) argue that poor data might make it harder to design and execute organizational strategies from a strategic standpoint.

Alwin (2010) argues that people typically have unrealistic expectations about survey results, and that one should expect excellent measurement validity. Furthermore, the author claims that some survey data may be unreliable due to factors that affect both reliability and validity. Number of answers, length of introduction and options, and whether or not you have a "don't know"-option are all examples of factors that have an impact on both the validity as well as the reliability of survey data (Alwin, 2010). Further, the author posits that the manner in which the data is gathered is equally important, and it has great significance on data quality if the data is obtained using a phone, pen and paper, or a smart device.

## 2.8 Theoretical synthesis

This section focuses on summarizing the most essential information presented in the theoretical framework. The theoretical synthesis major purpose is to structure the framework and focus on the most significant and intriguing aspects. This will later be useful when comparing the theory to empirical findings. The theoretical framework is summarized with regards to the principles of continuous improvement and teamwork proposed by Dean & Bowen (1994). Additionally, the content of the theoretical framework is broken down into tools and techniques with regard to teamwork and continuous improvement respectively. The relevant practices and techniques for teamwork are presented in Table 2.2 and Table 2.3 presents the practices and techniques for continuous improvement. A table for practices and techniques with related to customer focus was chosen not to be included, as this is not the central focus of the thesis.

**Table 2.2:** Improvement practices and techniques

Practices	Techniques
1. LSW is a strategy for leading and sustaining improvements in culture, habits, and performance (Mann, 2015)	1. The concept of LSW is that managers at all levels of the organization should cross-check one another (Seely, 2019)
2. LPAs is a system that focuses on standardized processes and quality improvement, and are used to standardize and manage industrial activities (Yadav & Thakar, 2021)	2. Auditing processes by various levels of the organization with different time spans (Yadav & Thakar, 2021).
3. Digitalization as well as intelligentization are essential technologies to produce revolutionary technological improvements in modern manufacturing (Zhou, 2013).	3. Application of digital and intelligent technologies such as digital control and self-adaption control will result in significant gains in precision and productivity, allowing the establishment of a computerized production integration system (Zhou, 2013).
4. Developing a computer-based information system (Zmud & Cox, 1979).	4. Use of either the traditional approach in which the system analyst is the driving force behind implementation, or the change approach, where the analyst collaborates with a user in the problem-solving team to carry out the implementation (Zmud & Cox, 1979).
5. Implementing new technologies has a number of benefits, among them are increased efficiency, productivity, and quality (Jones & Smith, 2004). Organizational structure, environmental circumstances, and human factors should all be addressed (Jones & Smith, 2004). It is critical to strike a balance between these implementation factors.	5. Align the new technology with the company's overall strategy, will in turn also make the management team more involved (Meyers et al., 2012).
6. Redesigning processes. Hammer (2007) states that the design of the process determines whether it is simple to complete or not.	6. New jobs and roles must be defined in order to support the new process work (Hammer, 2007). Ham et al. (2003) posit that the cultural aspect should not be overseen when redesigning processes.
7. Establish new policies.	7. The implementation of new processes necessitates a set of organizational skills: the structure and personnel, the leadership of the administrative organization, and the implementing program and capacity (Smith, 1973).
8. Data collection. Brynjolfsson et al. (2011) posit that many managerial decision is still based on gut feeling even though there is more data than ever available.	8. Mandinach et al. (2006) state five factors for successful data collection when using an IT-tool, Accessibility, Length of feedback loop, Comprehensibility, Flexibility, Alignment, and Linkages to teaching.

The numbers in the table above are connected, which means that technique number one corresponds to practice number one etc. The table above provides an overview of key concepts for continuous improvement from the theoretical framework, which can be seen in the "Practices" column. Additionally, the table also provides an insight into what the theory suggests that a company does in order to successfully implement these concepts, which can be seen in the "Techniques" column. What can be seen in table 2.2 is that LSW and LPA are closely linked to each other since both of

them focuses on auditing and checking each other at different levels in the organization. The main difference between them is that LPA focus on critical processes that directly affects the outcome which LSW does not. Further, the table shows that the organizational structure and leadership is important when implementing change.

**Table 2.3:** Teamwork practices and techniques

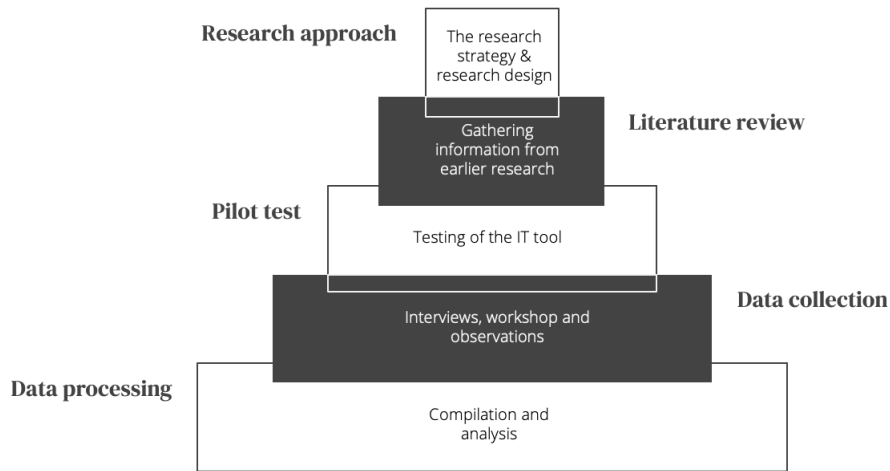
Practices	Techniques
9. Change management is generally characterized as a process of updating an organization's direction, structure, and capabilities to meet the ever-changing requirements of external and internal customers (Moran & Brightman, 2001).	9. According to Al-Mashari & Zairi (1999), topmanagement support and commitment are two of the most essential factors that affect the success of the implementation process.
10. Employee engagement and cooperation are key factors when implementing new technology (Jones & Smith, 2004).	10. Align the new technology with the company's overall strategy, will in turn also make the management team more involved (Meyers et al., 2012).
11. Sjödin et al. (2018) states that competencies and abilities is essential and should evolve in parallel with changes in the environment to ensure that personnel can keep up with the rapid pace of technological innovation, and the authors further state that managers must also make a big effort to attract and empower employees with digital skill.	11. Proper education of employees and recruitment of necessary competencies to ensure that personnel can keep up with the rapid pace of technological innovation, and managers must also make a big effort to attract and empower employees with digital skill (Sjödin et al., 2018). Sjödin et al., also emphasize the need of Stage-Gate models to implement process improvements.

An important takeaway from both table 2.2 and table 2.3, is the fact that aligning the new technology with the organization's overall strategy can aid the implementation of new technology (table 2.2) by increasing employee engagement and cooperation 2.3. Education is also stated as an important factor for keeping up with technological innovations.

# 3

## Method

This chapter explains the methodology applied by the research team in order to collect the necessary information and data to answer the project's purpose. Figure 3.1 below includes to main steps of the overall methodology used in this thesis.



**Figure 3.1:** Summary of methodology

In subchapter 3.1, the research strategy is presented. The following subchapter, 3.2, presents the research design, which describes the characteristics and approach of the research. In subchapter 3.3, the research strategy in practice is explained, followed by a description of how data and information was collected from literature and interviews in subchapters 3.4 and 3.5 respectively. subchapter 3.6 includes strategy for data analysis is presented. In subchapter 3.7, the topic of research quality is presented along with a description of the methods applied to ensure validity, reliability, replicability and research ethics. Lastly, a discussion about the applied methodology



presented in subchapter 3.8.

## 3.1 Research strategy

When conducting a study, there are two main approaches that researcher choose, namely a qualitative or a quantitative approach (Patel & Davidsson, 2011; Bell, Bryman, & Harley, 2019). Patel & Davidson (2011) explain that quantitative research focuses on measurements in data collection, i.e. focus on quantifiable factors, where as qualitative research centers around "soft" data, which refers to data collected via interviews or texts. Furthermore, the thesis was exploratory in nature. Exploratory research means that the researchers attempt to discover something that is previously not known (Elman, Gerring, & Mahoney, 2020). The thesis can be considered to be exploratory, since the goal was to acquire data to evaluate LPAs, LSW and the IT-tool at the organization, which they have previously not had, hence something that is previously not known. However, Elman et al. (2020) explain that this type of research is risky, since it is now possible to know in advance if something innovative will be discovered in the research.

The overall strategy of the thesis was to construct a theoretical and a empirical framework and then compare these frameworks to analyze and answer the research questions. The goal of developing a theoretical framework was achieved through a iterative literature review and the empirical framework was created through gathering data from interviews. The overall purpose of the thesis, to introduce and to support the implementation of LPAs and LSW through the use of an IT-tool as well as to understand how the tool might aid the implementation requires data directly from test-users. The research team deemed that this type of data would be useful in the form of personal opinions rather than from data in the form of, for instance, numbers. In addition, Meredith (1998) explains that qualitative research methods are suitable for exploratory purposes around phenomena that are not well researched, which was the case for this thesis. The purpose of the thesis, along with the plan to gather data from opinions of test-users in the form of personal opinions, made the choice of a qualitative research approach most suitable for this thesis.

Furthermore, Patel & Davidson (2011) describe that a central part of the implementation of a study is also to relate collected data to existing theory. In addition, Patel & Davidson (2011) state that the method for relating empirical material to theory is central in all scientific work. After selecting a research approach, the research team needed to decide in what way the empirical material would be related to the existing theory. In this thesis, the team chose to use the inductive research approach. The

approach is based on researchers developing new theory from studying a research object (Patel & Davidson, 2011). Due to the fact that this thesis aims to examine the use of an IT-tool and further to explore the tool's effectiveness, the inductive research approach was deemed most suitable for the thesis.

## 3.2 Research design

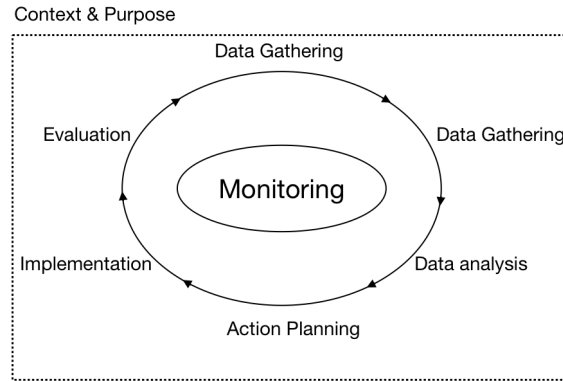
Qualitative research differs from quantitative research in the way that researchers relate to the subjects of their studies. Generally, qualitative researchers pay greater attention to the relations between themselves and the subjects of their studies (Bell et al., 2019). The authors state that this has led to the development of several qualitative approaches that allow the research participants to have a more active role in the research. One such approach is called *Action research*, which was applied in this thesis. The approach combines taking action and conducting research simultaneously (Coughlan & Coughlan, 2002). Here, "taking action" refers to actively making something happen as opposed to purely observing. Furthermore, Argyris et al. (1985) describes *Action research* as experiments that are conducted on real problems in organizations to assist in their solution and an iterative process of problem identification, planning, action and evaluation. The authors claim that the overall goal of the approach is to both solve a problem as well as contributing to academic theory.

The choice to use Action research in this thesis was relevant given that much of the research was conducted in a real life setting at a company. The research team worked closely with people from the company who had an active roles in the research with the development of audit rounds, testing and maintaining rounds, evaluating, planning and more.

## 3.3 Action research in practice

The action research cycle, see Figure 3.2, describes how action research works in practice (Coughlan & Coughlan, 2002). The cycle illustrates how one Action research cycle is done, with the starting point being "Context & Purpose", followed by six main steps and a meta-step to monitor. Since Action research is a iterative process, the cycle was completed several times during the course of the thesis.

The main objective of the starting point is to understand why the project is necessary to do and what social, economic, technical, and political forces that drive the



**Figure 3.2:** The Action research cycle, (Adapted from Coughlan & Coughlan, 2002)

necessity for action to be taken (Coughlan & Coughlan, 2002). This step was achieved through meetings with the main project owner where the research team was presented with all necessary information to understand how and why the project needed to be conducted as well as the benefits for the organization.

When it comes to the first main step, "Data Gathering", the research team obtained data through interviews and from the IT-tool. In the second step, "Data Feedback", the data is compiled. The research team compiled the data from interviews by taking notes during the interviews and the data regarding usage of the IT-tool was compiled by the software itself. The third step, "Data analysis" is where the data is looked at together with members of the organization. The research team looked at the data from interviews as well as from IT-tool usage before each weekly meeting with members of the organization and brought up important points. These points included if a pilot user expressed thoughts about changes to rounds or if the IT-tool software showed that rounds were not performed (Note: that data regarding usage of the IT-tool was solely used in this process and not for any further analyses). This led to the next step, "Action Planning" where the research team, together with meeting participants formulated a plan for the next course of action in the project. In the following step, "Implementation", the action plan was implemented. Most often this included changes to existing rounds and creation of new rounds. All this ultimately resulted in the last step of the cycle, "Evaluation". Here, the research team and research participants evaluated the action plan to assess the outcomes. Additionally, the meta-step "Monitoring" was done throughout each cycle. The process was always monitored through continuous planning, implementation and evaluation of each step.

## 3.4 Literature review

The research team conducted a literature review which provided results and conclusions from earlier research regarding LPAs, LSW, as well as other topics related to the subject. According to Patel & Davidson (2011), articles published in scientific journals is one of the most common ways in which knowledge is acquired. It is further explained that the most appropriate approach to discovering scientific articles is through the use of scientific databases. Therefore, a significant part of the research teams literature search consisted of searching for articles through the use of databases such as *Google Scholar*, *Chalmers Library* and *Research Gate*. In order to obtain relevant articles, Patel & Davidson (2011) explain that searches should initially be limited to one topic in order to identify relevant themes and key concepts within the subject. The research team chose the topic of "Layered Process Audits" to be considered the main subject. By reading articles, the research group could identify certain key words which allowed the group to find other articles relating to the thesis' purpose of understanding wheter or not an IT-tool is suitable for Layered process audits and Leader Standard Work. Examples of key words used in the search for articles were: *Layered process audit*, *IT-tool*, *digitalized factory*, *Implementing new technology*, *Organizational change*, *Total Quality Management* etc.

Furthermore, the literature review helped with the construction of a research instrument, which is described by Denscombe (2010) as a tool used to obtain information in research. The research instrument developed by the research team consisted of questions relevant to the research topic and was applied during the interviews, see Appendix 1 for the standard interview form (research instrument).

### 3.4.1 Source criticism

Patel & Davidson (2011) explain that reviewing the sources used in an academic study, is an essential part of the work. The authors also state that critical examination of sources results in the study having a credible basis. To ensure high quality of the articles as well as all additional sources used, source criticism was applied.

Denscombe (2010) describes that it is not possible to a full extent for researchers to prove that the data collected is entirely correct. However, the author claims that researchers can increase credibility and thus persuade the reader that the collected data, with a high probability, is correct.

The sources used in the thesis have been examined with the use of four criteria, as Platt (1981) and Scott (1990) have argued, documents should be evaluated with: *meaning*, *representativeness*, *authenticity* and *credibility*. To examine a source's *meaning*, it was taken into account how clear the information was presented in the source. This refers to whether or not the information can be interpreted as being clear and unambiguous. When examining a source's *representativeness*, three things were investigated: If the type of source was common in the field of the subject; If the source was complete ; If the information presented in the source was used from the same context from which information was retrieved. Furthermore, to evaluate the *authenticity* of sources, it was checked whether the source appeared to be genuine or not. Lastly, the *credibility* was scrutinized by checking whether the source was free from obvious partiality and faulty information. All sources that were used in the thesis, fulfilled all criteria mentioned in this paragraph.

## 3.5 Interviews

An interview is a well-established research method for collecting data (Lochrie, Curran, & O’Gorman, 2015). The method consists of researchers and research objects having a conversation in order to develop a deeper understanding of key themes and research issues. In this thesis, 3 interviews were conducted with employees below level 1, 3 interviews with employees at level 1, 2 and 3 and 3 interview with people above level 3. The interviews gave data relating to opinions of the proposed IT-tool, thoughts and experiences about implementing new technology and changing business processes, and more.

The interview method applied to all interviews was the semi-structured interview method. This form of interview means that topics will be decided beforehand, but that the respondents have great freedom to design the answers themselves (Clifford, 2016). Patel & Davidson (2011) explain that the more freedom respondents have to design their answers, the greater the chance will be of researchers obtaining more developed and nuanced answers related to personal impression. The use of semi-structured interviews was suitable for the thesis, since it is important for the researchers to obtain information relating to the personal views of the respondents to properly evaluate the implementation of LPAs. A few, open questions were formulated before the interviews (see Appendix 1) to ensure that certain topics are covered. During the interviews, follow-up questions were asked, which according to Patel & Davidson (2011) creates a more relaxed conversation, leading to more nuanced answers. The interviews were recorded so the team had access to the data,

with a few exceptions. Denscombe (2010) argues that interviews should be recorded if possible. When it came to interviewing people below level 1, it was not easy to find the time to conduct any lengthier interviews. Therefore, the interviews were held at their work stations, with much background noise being a factor. This made recording of the interviews difficult, so solely note taking was used for these interviews. To ensure that the information from those interviews was correct, the notes were read by the respondent directly after the interview to ensure that the notes matched the expressed opinions.

Furthermore, Denscombe (2010) also states that interview transcripts enable searches in the data, which in turn facilitates analysis. Instead of transcribing the interviews fully, as this is a greatly time consuming process, one team member focused on leading the interview while the other took extensive notes. According to Denscombe (2010), one hour of interview material takes between two to three hours to transcribe into text. In addition to taking extensive notes, time stamps were also noted, so the team knew at what time the respondents discussed different topics and could therefore listen to their thoughts.

The interviews were mainly conducted in a physical environment with the exception of two interviews which were conducted through video calls.

The different forms of interviews have their own advantages and disadvantages. Opdenakker (2006) explains that interviews in a physical environment, which the authors name Face-to-Face-interviews (FtF-interviews), are characterized by a synchronization in time and space. This means that the communication takes place in real time, which provides social clues such as body language and emphases on words, that in turn, can provide the interviewers with information exceeding what is said. Opdenakker (2006) continues to argue that another advantage of FtF-interviews are that there is no delay between asked questions and answers. The respondent answers directly, which results in spontaneous answers that are related to the respondent's personal opinions. One crucial disadvantage with FtF-interviews however, is that they can be time consuming Mann & Stewart (2000).

The video call-interviews were conducted through Microsoft Teams. Video calls have the advantage that it is less time consuming than FtF-interviews, since it reduces travel Denscombe (2010). Additionally, the author argues that the same advantages that FtF-interviews entail, can be obtained from video call interviews due to the visual connection which is present for both interviews forms. The respondents roles, their level, interview form, date and the length of the interviews are presented below

in table 3.1.

**Table 3.1:** Interview information

Role	Level	Interview form	Date	Duration
Operator 1	Below 1	FtF	2022-02-18	20 min
Operator 2	Below 1	FtF	2022-03-04	20 min
Operator 3	Below 1	FtF	2022-03-11	20 min
Manager 1	Level 1	FtF	2022-04-21	30 min
Manager 2	Level 2	Video call	2022-05-06	30 min
Manager 3	Level 3	Video call	2022-05-09	30 min
Vice Lean Manager	Above 3	FtF	2022-05-04	30 min
EHS Manager	Above 3	FtF	2022-05-05	45 min
Lean Manager	Above 3	FtF	2022-05-06	45 min

The company at which the thesis project was conducted had already decided which operators were going to test the IT-tool. Since these specific operators used the IT-tool, they were selected for the interviews. The company had also decided that the level 1, 2, and 3 manager were going to test the IT-tool and were therefore chosen to be included in the interviews. The Vice Lean manager was selected due to the fact that he was heavily involved in the project, and was even temporary project supervisor at one point during the thesis. Furthermore, the EHS manager was selected as it came to the research team's knowledge that she had much experience with and an IT-tool that the company uses. Lastly, the Lean manager was selected since he was also the project owner and main supervisor for the thesis project.

### 3.5.1 Workshop and Observations

The research team lead a workshop, where low-level (below level 1), mid-level (Level 2 & 3) and senior employees (Above level 3) were invited from not only the pilot-area, but also from other manufacturing areas. The workshop was two and a half hours long and consisted of two presentations as well as a case-assignment for the participants. The goal of the workshop was to spread the word about LPAs, LSW and the IT-tool as well as for the participants to try the tool out. One of the presentations consisted of describing why LPAs and LSW should be more widespread within the organizations, while the other was focused on the IT-tool itself. Additionally, the participants completed a case with the assignment of using the tool to create operator rounds.

The main observational goal of the workshop was to see how easy or how hard it would be to educate others in using the tool, given that proper education is an

important part of change initiatives. The workshop enabled the research team to observe how people, who have never seen the tool, interacted with it. It also gave insights about their thoughts on LPAs, LSW and regarding the IT-tool.

Early on in the project, all operators and lower-level managers were gathered and instructed on how to use the IT-tool. When the project team explained the meaning of LPAs and LSW, the operators got a glimpse of the bigger picture and the purpose of implementing this IT-tool. They were given the opportunity to ask questions in order to ensure that everyone understood what needed to be done and why. The observational goal of this presentation, was to see the operators' reactions to hearing about a new IT-tool.

The IT-tool was first implemented among the operators, the main reason for this is that their way of working is more standardized than the managers and it therefore seemed easier to start there. Another reason for starting at the lowest level was that the project group believed that the resistance to change would be largest there, giving them extra time to learn the IT-tool and the process. The IT-tool was used to make the operator ready for the morning meetings that the manufacturing team has every morning. There were questions regarding files that should be updated, quality issues and special orders. This helped the operator to be ready for the morning meeting and provide necessary information.

After implementing the tool at the ground level, the project group collected the vice lean manager along with the lean manager to design a structure for next level managers. This was necessary since the project group did not have sufficient knowledge about the organization and their way of operating. The tool was later presented for level 2 and 3 manager and the purpose was described. The education for the managers was not as extensive as for the operators, this was mainly due to lack of time from the managers side but also due to their technical knowledge being better than the operators.

Observations were also made during the weekly-meetings with the main project group consisting of the research team as well as the people from the company, such as the project owner/supervisor. In addition, observations were made during presentations that the research team held for management of the manufacturing division as well as for managers of other manufacturing divisions.

Most of the observed information was "stumbled" upon with the exceptions of seeing how operators reacted to first hearing about the tool, as well as to see the level



of difficulty to teach people to use the IT-tool. The reason that it was decided in advance to look for the operators' reactions to hearing about the IT-tool was that the research team had thoughts that they would react somewhat negatively. To look for reactions related to the education in the workshop was decided since, as previously mentioned, education is an important part of change initiatives. Observations were discussed within the research team after interesting ones were made and written down in a document.

## 3.6 Data processing

Once data is collected, it should be prepared for analysis (Sreejesh, Mohapatra, & Anusree, 2013). Both Bengtsson (2016) as well as Patel & Davidson (2011) state that there are no predetermined methods for processing and analyzing qualitative data. Patel & Davidson (2011) discuss that different researchers will work in different ways and explain that a central part is that the researchers work systematically and present how their applied methods for processing and analyzing the data. However, Sreejesh et al. (2013) recommends that collected data should be encoded. Encoding data involves assigning colors or symbols to different statements and themes.

As stated in section 3.5, extensive notes were taken during the interviews, to ease data processing. When encoding data, the data should be categorized into different groups depending on the content (Denscombe, 2010). As stated in the previous paragraph, Sreejesh et al. (2013) explained that coding can be done by assigning different colors or symbols to different categories. Therefore, the research team assigned certain colors to the different paragraphs in the transcripts whose content falls in line with the topics in the theoretical framework. For example, when the data regarding pros and cons with using the IT-tool was found in the transcripts, these were marked with the color blue. Denscombe (2010) believes that this method makes it easier to find overlaps, which means when different interview objects have highlighted the same topics.

In line with the inductive approach applied in this thesis, the analysis will aim to bring forward new information about the IT-tool's effectiveness when it comes to conducting LPAs.

## 3.7 Research quality

To evaluate business research, three of the most important criteria are *Reliability*, *Validity* and *Replicability* (Bell et al., 2019). The authors describe the term *Validity* as referring to whether or not the intended purpose of the research is actually examined in practice. *Reliability* refers to if the research is conducted in a credible manner and if the results can be repeated, and the last criterion *Replicability* is closely linked to *Reliability* but instead it refers to if the study itself can be repeated Bell et al. (2019). Additionally, Herr & Anderson (2005) has formulated five criteria in which the Action research methodology can be validated.

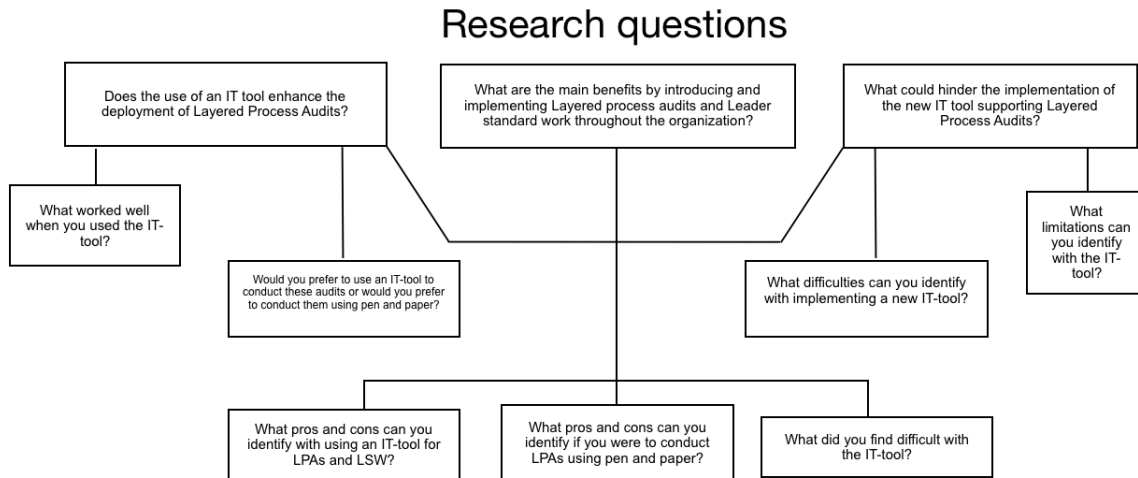
In addition to ensuring the quality of the action research, as well as the *Reliability*, *Validity*, and *Replicability*, the research team considered research ethics. Ethics are important to consider, since the study was included the participation of real people. Therefore, the research team needs to consider ethical approaches so that neither the company nor the people participating in the study come to any harm.

### 3.7.1 Validity

The term validity refers to the accuracy and precision of the data used in a study (Denscombe, 2010). Further, Patel & Davidson (2011) explains that validity also includes the suitability of the data in relation to the study issues and also presents two ways to ensure the validity of the work. This is done by ensuring the work *content validity* and *simultaneous validity*.

To strengthen *content validity*, Patel & Davidson (2011) explain that a logical analysis of the content in the research instrument is used. The logical analysis means ensuring that the content in the research instrument, i.e. the interview questions in this thesis, can collect sufficient data for the research. The research team examined the questions to ensure that they covered the problem area. This was done by linking the interview questions to the main research questions.

The links between the research questions and the interview questions is showcased in Figure 3.3.



**Figure 3.3:** Interview questions linked to research questions

To ensure *simultaneous validity*, Patel & Davidson (2011) explain that the research instrument should be tested on different groups. This was fulfilled since multiple interviews were carried out with people from different levels and with different roles. The research team noticed that the questions worked in every interview since information regarding all intended topics were obtained (see chapter 4). Patel & Davidson (2011) further explain that the collected data, should be compared with regard to a criterion selected by the research team. Based on this, the research team chose the criterion that the collected data could be linked to the theoretical framework in order to be eligible for analysis. The research team deemed this to be possible for the data used in the thesis, thus fulfilling *simultaneous validity*.

#### 3.7.2 Reliability

A good research instrument should yield similar results when the instrument is applied Patel & Davidson (2011). The research team took some actions to strengthen the reliability of the research as much as possible. Reliability was partly strengthened by extensively documenting and presenting all data gathering steps in this thesis. Reliability was also strengthened to a certain extent by conducting multiple interviews and later examining if the similar results were obtained from the interviews.

#### 3.7.3 Replicability

The results from research should not be influenced by the researcher's own characteristics or expectations Bell et al. (2019). If a lack of objectivity is present in the conducted study, the results will have a low level of credibility. A way to ensure

that the results of a study is truthful, scientists may seek to replicate a study. If replication is not possible i.e similar results can not be obtained, questions regarding the validity of the results may arise.

Action research, and Qualitative research in general, is criticized for its lack of repeatability and consequent lack of rigor (Bell et al., 2019). However, in order to strengthen replicability, the research team thoroughly documented the entire methodology applied in this thesis. By doing so, it allows anyone to replicate the study if they please. However, as stated earlier in this paragraph, qualitative research is generally hard to replicate. Therefore, an exact replication of the study would not be possible without the exact same circumstances.

#### 3.7.4 Action research quality

*Quality, validity, trustworthiness, workability* and *credibility* have all been proposed as criteria to describe evaluate good action research Herr & Anderson (2005). Campell & Stanley (1963) suggest that positivists prefer validity as criteria to evaluate research, while Campell & Stanley (1985) argue that naturalistic researchers prefer trustworthiness. However, Herr & Anderson (2005) argue that even though validity and trustworthiness is important to neither term is sufficient for action research since none of the two terms acknowledges the research type's action-oriented results.

Herr & Anderson (2005) have formulated five criteria which action research should be evaluated with, these are: *dialogic and process validity, outcome validity, catalytic validity, democratic validity* and *process validity*.

The first criteria, *dialogic and process validity*, refers to that the "goodness" of the research is peer-reviewed (Herr & Anderson, 2005). At the time of writing, this has yet to be done. However, the thesis will be evaluated by peers before the final submission. Herr & Anderson (2005) describe that the second criteria, *outcome validity*, relates to the success of the research. This criteria is closely related to the criteria of integrity, used by Jacobson (1998, p. 130), where the author states that "the quality of action which emerges from it, and the quality of data on which the action is based". Outcome validity ensures that rigorous action research reframes the original problem in a more complex way which often leads to the formulation of new questions or problems. The research team considers that the outcome of the thesis has contributed to new questions a problems such as how the IT-tool can help to implement LPAs and LSW in other manufacturing areas, how the tool should be maintained by the company, how LPAs and LSW in general can be spread through-

out the organization etc. Furthermore, the validity of the outcome is dependent on the *process validity*, which refers to the degree in which problems are framed and solved in a way that boosts ongoing learning of the individual or system (Herr & Anderson, 2005). The link between process validity and outcome validity, is described by Herr & Anderson (2005) that the outcome will reflect any superficial or flawed processes. The research team judges that the thesis has contributed to continuous learning for the organization as more and more people are being involved and expressing their interest in learning about LPAs, LSW, the IT-tool, and how they might begin to introduce and implement it in their respective manufacturing areas.

*Catalytic validity* is described by Lather (1986, p. 272) as "the degree to which the research process reorients, focuses, and energizes participants toward knowing reality in order to transform it". Herr & Anderson (2005) posit that to strengthen this catalytic validity, all involved parties in the research should deepen their understanding of the social reality of the research area and help to take action to change it and/or reaffirm support. Through weekly meetings and discussions with the parties involved, the research team considers that most of the parties involved understood the reality of the research area. Additionally, support to implement the IT-tool was obtained from involved parties. The criteria of *democratic validity*, is closely related to catalytic validity as it refers to the level of collaboration with parties involved in the researched problem area. Again, this was achieved through weekly meetings with involved parties in the research area. However, all parties were not equally involved, for instance some people above level 3 played a smaller role in the research but still involved in the research.

#### 3.7.5 Research Ethics

When designing project work, it is essential to consider the ethics of the carried out research (Denscombe, 2010). Thus, the individual protection requirement was weighed in during all interviews Vetenskapsrådet (2002). The basic individual protection requirement can be divided into four main requirements. The main requirements, according to Vetenskapsrådet (2002) are: *the Information requirement*, *The consent requirement*, *the confidentiality requirement* and *the use requirement*.

*Information requirement* refers to whether or not sufficient information regarding the study is presented to participants. *the consent requirement* involves gaining a participants consent to use their answers in the research. *the confidentiality requirement* includes ensuring anonymity if this is requested by participants. *the use*

*requirement* refers to that the collected data on individuals for the research purpose, may not be used for other purposes.

In this thesis, the respondents were informed about their tasks and the conditions that apply to their participation. Further, information from respondents was only used in the study if consent was obtained. The respondents also had the right to interrupt the interviews at any time. Sensitive information provided by either the company or respondents was treated with confidentiality and only used with permission from either the company or the respondents.

## 3.8 Method discussion

The research team considers the thesis to be conducted in line with practices of good research. This is mainly due to the efforts to support validity and reliability of the thesis as a result of constructing a well-developed research instrument. However, one of the weaker parts of the thesis is the level of replicability, which hard to judge. The entire methodology is presented and backed-up by following advice from credible authors in the research methodology field, making it possible to replicate it entirely but only during the same circumstances, i.e. working with the same project at the same company. Therefore, the research team can only argue that the replicability is high in one specific case but not generally.

Due to the fact that a large part of the thesis was collecting data regarding opinions about the IT-tool, the choice to use a qualitative approach as well as its related data collection methods was made. The choice of a quantitative approach would not have made sense with regard to the lack of focus on "hard" data (numbers, data sets etc.) being possible to collect in relation to the stated research questions.

In continuation, the choice to use the inductive research approach was suitable for the thesis due to the thesis' aim of examining the use of an IT-tool for LPAs and identifying road blocks that occurred. This created new theory (which is the goal of the inductive approach) relating to implementation of an IT-tool for LPAs and its challenges. If the research team had chosen a deductive research approach which arguably could be considered the most dominant research approach Woiceshyn & Daellenbach (2018), the analysis methodology would not have been suitable for the thesis' purpose. The reason for this is that the deductive approach focuses on comparing the empirical material with already existing theory as opposed to formulating new ideas and theory, which is the goal of the inductive approach.

The data collection process was considered to have high credibility. This is mainly due to the fact that only credible sources that fulfilled the criteria discussed in section 3.4.1 were used in the study.

The data collection process was conducted with the help of a well-designed research instrument to collect information during interviews. The research instrument was constructed with the help of a literature review where key topics and concepts in the research area were identified. The literature review itself consisted of finding literature relating to the research topic by searching for scientific articles from databases such as *Google Scholar*, *Chalmers Library* and *Research Gate*. Since the literature consisted of scientific sources and that source criticism was carried out on all sources according to recommendations from Denscombe (2010) (See section 3.4.1), the research team considers that all literary information is relevant and credible. Thus, the research group also believes that the research instrument was of high quality, which in turn contributed to accurate and relevant information being retrieved from the interviews. However, one issue that may have affected the outcome of the study, could be linked to biases. The company had decided in which manufacturing area where the study took place, which was at one of the more digitalized areas at the organization. This could have led to easier implementation of the IT-tool than if it were deployed elsewhere, since the people in the studied area might have been more open to IT-solutions than others. This means that the results could have been very different if the study was conducted somewhere else.

As described in the second paragraph of section 3.6, there are no predetermined methods for processing qualitative data. However, what is most important is that researchers present how processing took place. The research team chose to encode the data following recommendations from Sreejesh et al. (2013) which led to assigning colors to the different topics discussed during the interviews. Since the research team presented how the data processing was carried out and that it was conducted in accordance with recommendations from research methodology authors, it is judged by the team that the handling of data was of high quality.

# 4

## Empirical results

This chapter presents the empirical data gathered for this thesis. The main purpose with the empirical results is to present data and information that the project group has collected when conducting this study. Data and information have been collected from nine interviews that has been made with employees at different levels. In Subchapter 4.1, the IT-tool is presented, followed by subchapter 4.2 presenting results from the interviews with the coordinators. In the following subchapters, 4.3, 4.4, and 4.5, the results from the interviews with the level 1, level 2, and level 3 manager are displayed, in that order. Furthermore, subchapters 4.6, 4.7 and 4.8 shows the results from the interviews with the Vice Lean manager, EHS manager and Lean Manager are presented respectively. Subchapter 4.9 includes a summary of the interviews and the last subchapter, 4.10, presents results regarding the research team's observations as well as a model developed by the research team.

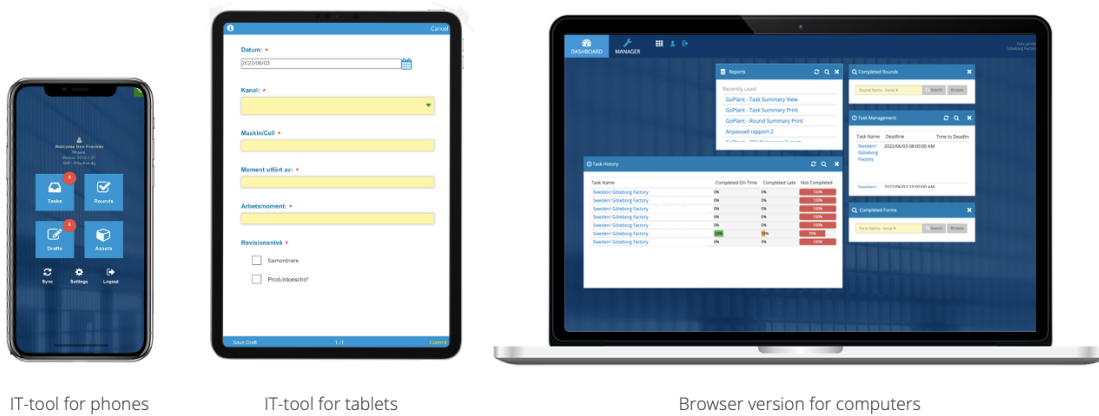
The empirical results will later be compared and discussed along with the theoretical framework in chapter 5. The empirical results will be used to explore how LPAs and LSW can efficiently be implemented at the company and possible challenges with the implementation of new technology. Furthermore, the goal with viewing the empirical results and the theoretical framework is to formulate new theories relating to the thesis' subject area.

### 4.1 The IT-tool

The IT-tool was handed to us by the company and the idea with the tool is to replace pen and paper. The tool is scalable, productivity-boosting, time-saving and enhances data collection and data storage according to information gathered from interviews. The idea is that operators, supervisors, managers etc. conduct rounds, which consist of following a set plan to for example follow a check-list on a phone



or a tablet, to assure that specific processes are being followed properly, or that certain routines are followed. The IT-tool is supports use on both IOS and Android, which allows for great flexibility. There is also a browser version of the IT-tool, with support for both MacOS and Windows. The browser version is used to create the rounds and assigned them to people. Assigning a round to a person is known as a "task", and deadlines for the tasks can be set and the person who is supposed to complete the task can obtain e-mail reminders from the IT-tool. Mock-up versions of the IT-tool can be seen down below in Figure 4.1.



**Figure 4.1:** IT-tool mock up on different devices

## 4.2 Interviews with Coordinators

All coordinators were positive when it came to the usage of an IT-tool to perform LPAs and LSW and one coordinator expressed that they would much rather use a digital tool instead of for instance pen and paper to conduct LPA-rounds due to the high level of flexibility and simplicity, stating that *"We use a lot of pen and paper already and this requires a lot of manual handling, using the application is much easier"*. Other opinions on this matter was that the use of an IT-tool was preferred over pen and paper due to the fact that it is simple and quick to use. The use of pen and paper to conduct LPAs was thought to be time consuming, more complicated and annoying. The only statements that spoke against the use of an IT-tool was that the battery for the device can run out if charging is not taken care of and that the device itself can be misplaced or lost.

When asked about alternative ways to conduct LPAs in addition to an IT-tool or pen and paper, the only response with a suggestion for a substitute was the use of

large whiteboards. However, the coordinators expressed that whiteboards (which they already use a lot in the factory) would not be a great system for conducting LPAs. The main reason for this, according to the coordinators, is that saving data is difficult. It's also a lot easier to utilize an IT-tool that you always have with you than it is to write on a whiteboard.

When implementing new technology, one of the coordinators stated that it is crucial to get into a routine with using the new IT-tool. The main reason is that it can be hard to establish a new routine since they deal with many distractions. Another coordinator also expressed asserted that it is important that everyone follows what is agreed upon so that it becomes a routine.

One common opinion expressed by all three coordinators was that it is vital that those who will use the IT-tool receive the right training about not only the IT-tool and how it should be used, but also about LPAs and why it is needed in the work place. The coordinators expressed that they didn't get adequate training and introduction to the software or new ways of working in some circumstances which adds to the complexity of the implementation process. All of the coordinators agreed that it's important to have introductions and to explain what's going to change and why.

When it came to potential roadblocks with the implementation of new technology, one coordinator stated that the intended IT-tool needs to be easy to use and that everything can be found quickly so that the person does not need to spend time navigating through different folders etc. Everything should be simple and consistent. Another coordinator suggested that all potential difficulties can be avoided if proper education is received and stated that *"When implementing new technology, information and education are the most important factors to consider"*.

### 4.3 Interview with level 1 manager

Instead of completing LPAs and LSW on paper or whiteboards, the level 1 manager prefers to use an IT-tool. The manager adds that they have previously utilized whiteboards to implement various initiatives and have discovered that there are numerous disadvantages using whiteboards excessively. For example, whiteboards take up a lot of space, something they don't have at the production. Further, the manager mentions another disadvantage, if you want to show a colleague what you've done, you can't bring the whiteboard with you. Then you have to walk out to the board and examine it, which takes time and is ineffective.

The manager also emphasized the significance of historical data, which can be easily accessed through an IT application and argues that when determining what may be done better and what hasn't worked in the past, historical facts must be used and examined. According to the manager, the tool must have a nice overview view so that you can quickly see what the end result would look like. That data should be easy to discover and understand is something that the manager places high value on when using an IT-tool. Otherwise, the manager will have a hard time identifying any significant drawbacks to employing an IT-tool.

According to the manager, the major advantage of the IT-tool employed in this study is that it is very simple to use. The manager also notes that if a good IT-tool is utilized, the task will be completed more quickly. If the operators believe the tool is simple to use, they will be more inclined to utilize it rather than pen and paper, which requires someone to be in charge of all information. The manager states that *"I don't see any limitations with this application, I only see possibilities"*.

The manager notes that the application may be used for a lot more than only LPAs and LSW and uses maintenance as an example. A servicing checklist for forklifts would be a great area for this application and it may be widely used and expanded throughout the factory and in a variety of areas.

When it comes to deploying new technology, the most critical factors to consider are information and education. Everyone concerned must comprehend why and how this new technology will be utilized. If this is not done correctly, the new technology will most likely not be used as intended, and its full potential will be missed.

Because they work in shifts, the challenge is to gather everyone for education and information. This is a difficult task, and there are two options that the manager proposes. Either you gather everyone at the same time, which is difficult because they work shifts. Otherwise, one education every week is required until all parties concerned have received the knowledge. The manager prefers to collect everyone, but the fact that they work shifts makes this difficult.

Another key aspect of teaching is to hold follow-up meetings where you may demonstrate the application's features and explain why they are vital. The level 1 manager argued that *"If you don't do this, you won't know if the operators are using the application correctly and you can be missing out on several benefits"*.

Finally, the manager goes on to say that the operators have been quite excited

about the new technology and that they completely comprehend the advantages of adopting it. They discovered that the IT-tool was simple to use, as well as the benefits and purposes of utilizing it, when they tested it.

### 4.4 Interview with level 2 manager

The level 2 manager believes that implementing an IT-tool has made working with LPAs and LSW easier and more efficient. Further the manager states that E-mail notifications are critical for reminding people to conduct their rounds, especially when they are not performed often. This is something that other tools that were previously implemented lacked. The most crucial factor, according to the level 2 manager, is to shift behaviors and work habits. This is the foundation for change, which is ultimately the most crucial factor.

*"In the end, it is all about changing behaviors and habits. If this is not done, the change will not last in the long run"*

The level 2 manager prefers to conduct LPAs and LSW with a digital tool since the biggest advantage is that you can bring it with you wherever you go. The level 2 manager adds that the audits were conducted using a mobile device, and that accessibility is a major aspect in getting people to use the digital tool. A user-friendly interface also makes the IT-tool more likely to be used. When creating LPAs with pen and paper, as the level 2 manager sees an option if not using an IT-tool, there is a significant amount of manual effort involved. For example, transferring all manual data into excel or another application in order to create presentations and reports which takes long time, hence data collection and storage is one of the biggest benefits of adopting an IT-tool.

Other IT-tools utilized in the factory today, assist operators and managers in structuring their work, which is very important. You are given notice of what you must accomplish, and this ensures that things are completed in reality. It also aids management in keeping better track of, in this case, workplace safety, which the manager believes they lacked previously. They have a monthly follow-up meeting to discuss safety concerns based on the information collected by the IT-tool. From this meeting, decisions regarding safety strategy is developed and implemented in the factory.

The level 2 manager states that the most important factors for a successful implementation of new systems, processes, and programs are that information is widely distributed, that everyone understands the purpose and why change is needed, and

that workshops in the new program are held to help people understand how it works.

Other applications they've attempted to implement have required a more complex system structure. As a result, employees must contact it-support every time they wish to change something in the application, and expanding the application's use without the assistance of a programmer is difficult. The issue, according to the level 2 manager, is that the application's responsibility is not located in the factory. This is an issue since no one is accountable and the only method to receive assistance is to call it-support. After a couple of years developing this application, the management team decided to end the development in favor for other IT-tools.

LPAs and LSW, according to the level 2 manager, can be applied to any process in the factory. The manager believes that implementing LPAs and LSW will have a beneficial impact on delivery, quality, and safety, and that it should be included in their quality management system. Almost every process in this system may benefit from LPAs and LSW.

### 4.5 Interview with level 3 manager

For LPAs and LSWs, the level 3 manager prefers to use an IT-tool. The main reasons for this are that the implementation is simpler and more efficient. Because today's operators are accustomed to using digital tools in their daily job, deploying a new IT product is not a significant challenge. Other advantages of employing an IT-tool instead of manual tools mentioned by the level 3 manager include data storage, trend analysis, and the creation of a good structure. In terms of efficiency, the level 3 manager believes that while pen and paper is probably as fast as an IT-tool for the operators when doing LPAs, manual data handling and analysis takes significantly longer time than receiving data from a database. When data is handled manually, there is still a possibility of data loss, however, this is not the case with an IT-tool. These are the biggest disadvantage using manual tools, according to the level 3 manager.

The level 3 manager suggests that the optimal solution would be a poka yoke system in which the operators are unable to deviate from the agreed-upon method of operation. When building a standard way of working, it should be so good that the operators will find it difficult to deviate from it, and the manager explains that *"the utopia is when we can create standardized way of working that the operators cannot deviate from"*. There are processes in place that can ensure this for both operators and leaders but it is also a matter of structure and dedication, as systems may re-

quire you to follow certain routines in order to continue working. The manager goes on to say that this is unlikely to be applied in all parts or sections of the firm, but it can primarily be done in routine operations.

The level 3 manager sees a disadvantage with establishing leader standards since it may conflict with the creative and innovative aspects of leadership. Leaders should be inspiring, and one of the most important aspects of leader standards is completing assignments and activities on scheduled time. Although the level 3 manager sees a risk with leaders becoming practitioners, he also emphasizes that this only is a possibility and that it does not have to be this way. When implementing LSW, effort must be taken to ensure that it does not interfere with creative and innovative leadership. Much of a manufacturing system's focus is on standards and repeating the same task over and over again, this is a monotonous manner of working.

One disadvantage that the level 3 manager perceives with implementing an IT solution is that it is initially costly. Pen and paper, as well as whiteboards, have the advantage of being cost effective. However, if the IT-tool improves efficiency, it can be claimed that it is a more cost-effective option as well, although it involves greater upfront costs.

The level 3 manager says that the IT-tool is simple to use, and one of its strengths is the automatically generated E-mails that remind leaders and operators to conduct audits. This is something that other IT-tools that have been installed lack, and reminders is effective for getting things done. It is vital for users to grasp the big picture and why it is critical that they complete their audit. The manager further mentions that one constraint of using the IT-tool is the desire to collect all relevant data in a single database. According to the level 3 manager, this would make it easier to justify why they should employ this particular tool. It is desirable for all data to be accessible to all systems.

The level 3 manager believes that the IT-tool can and will help the organization to better adopt LPAs. Notifications and E-mails are critical to make this work in practice and the tool's transparency is one important factor for success since this allows you to see who has completed their audits and who has not. This facilitates follow-up meetings and increases the likelihood that strategic decisions will be made based on it.

According to the level 3 manager, the management team and how they operate with the new IT-tool are the most crucial factors in deploying new technology. They

require a well-functioning and standardized implementation system that all leaders can utilize as a guide for implementing new initiatives. They must have the proper structure and inspire employee curiosity so that they would request data because they want to know how things are going or whether they have improved. It's also critical to establish new routines and behaviors in which people want to utilize the new tool rather than being forced to do so.

Current applications that they already are using have primarily helped the management team and the organization with structuring their work and making decisions. Everything is being followed up more closely, and the need to know how things are going is growing. Because everyone has access to the data, it has also aided communication inside the organization. This generates a dialogue where everyone has the same knowledge, which has resulted in improved strategic decisions for the company's KPI and other crucial metrics.

### 4.6 Interview with Vice lean manager

The Vice lean manager believe that LSW is the only way to get things done in reality and argues that introducing new methods and ways of working is difficult, the only way to do so successfully is to check whether they are performing their rounds and duties or not. There will be no change if no one takes action. To have an impact on the operators, this should be done by at least a level two manager.

Furthermore, the manager states that 5s audits and defined work have been performed with pen and paper in the past, but that it has not worked well. The main reason for this is that the production leader completed his audit, but the next level managers did not, and as a result, the company has not seen any benefits of conducting audits at various levels. The IT-tool, which has now been installed in a pilot area, has been done in four different layers which has already impressed the manager stating that *"I don't see any barriers implementing this, instead, I see opportunities"*. Moreover, the vice lean manager says that they would have seen a lot more of these benefits if the audits had been done with an IT-tool rather than pen and paper. The manager further emphasize on the importance of reminders and states that *"This IT-tool allows us to send E-mail reminders whenever a round is due. This is excellent and crucial, as this is what we have previously struggled with"*.

The fact that an IT-tool creates an interest among other production sites and managers suggests that this will work. However, the manager also emphasize on the importance of understanding how to effectively use the IT-tool. If no one is in

charge of the application's use and maintenance, it will almost likely fail in the long run. When deploying and evaluating new IT-tools and applications, this is always a risk. As mentioned by the manager before, if no one is responsible for follow ups, the process, or in this case tool, will probably not be used as intended. The manager explains that *"One thing we haven't done well in the past is reminding managers to finish their duties in order to complete a LPAs or LSW. We've put the framework in place and encouraged everyone to contribute and do their part. However, they frequently do it in the beginning and then forget to complete their round further into the implementation process"*.

In addition, the vice lean manager mentions having problems with too many different IT-tools since they now use one tool for safety, another for maintenance, and multiple excel sheets for other critical processes. The manager believes that incorporating some of these activities into the newly established IT-tool would be quite beneficial. The major reasons for this is that all data and information is collected in one location, and operators will not have to learn more than one program to fulfill their jobs. Many applications have been adopted, and when a new program is introduced, the management team often devotes a significant amount of time and effort to transitioning everything to the new program. This is problematic since other programs that were previously implemented have been de-prioritized.

When deploying new technology, the manager emphasizes the importance of the user interface as one of the most important factors. For a program to be effective in the long run at the company, the tool must be simple to use. The manager goes on to say that they've used a variety of systems over the years, some of which have worked well and others which haven't and the major reason for this, is the user interface. Operators are less likely to employ a tool if it is difficult to use.

The Vice lean manager continues by discussing the culture and behavior that has been observed among both operators and managers. Managers and operators are both supportive of change as long as they are not immediately affected. This is an issue because it produces resistance to change, and it must be overcome. According to the manager, one solution is to introduce the change and have all participants realize the benefits. This can frequently shift the participants' minds, causing them to adopt a new attitude.

*"When the winds of change blow, some individuals construct wind turbines, while others construct walls"*



### 4.7 Interview with EHS manager

The organization is currently implementing short-term initiatives on specific regions or procedures in order to conduct audits on multiple levels. According to the EHS manager, the problem is that when all extra resources leave without following up, the processes tend to revert to their previous state. As a result, the EHS manager recommends that layered audits should be performed in the long run for all change projects, as this is the most effective way to ensure that participants are following the new processes.

The EHS manager clearly sees the benefits of performing layered audits in an organized manner but explains that the problem with this being done only in a short period of time, the organization needs to work in a systematic manner on this. When the EHS manager examines root cause analysis, roughly 80% of the time, the operator did not follow the established manner of operation. The outcome of this can be both injuries and quality issues and most of the time this is due to a failure to follow the standardized method of working. The EHS manager states that *"Managers and administrative personnel do not realize all benefits they would obtain by implementing standardized ways of working"*. The issue isn't that the company doesn't have any standardized working methods, it's that they're difficult to find. The operator should be able to see the standardized method of accomplishing the operation, but this isn't the case now because it's hidden in another system and hence unavailable to the employee. For managers and administrative personnel, the EHS manager sees a number of benefits in employing these standardized ways of working. This is something that should be implemented throughout the organization, not just by operators.

When asked about the use and benefits of the application they are currently using for safety and accidents, the EHS manager says that one of the biggest advantages is that a lot of historical data has been saved, which the management team reviews every year and uses to develop a strategy related to workplace safety. As a result, this data is used to avoid injuries and issues from occurring and it also provides a good overview of where in the plant the greatest safety risks exist. This program connects both incident and accident reports to a safety policy and risk analysis in order to prevent such events from happening. It took almost eight years from the first pilot testing to having this application up and operating in all of Gothenburg's factories, and there are still a few small details that haven't been addressed. According to the EHS manager, installing new programs and systems should be treated with respect because it is a long journey that takes a lot of time and resources from the business.

The EHS manager goes on to emphasize that it's vital to inform everyone involved about why this new technology is being implemented and what one wants to achieve. Everyone engaged must understand how it benefits them on a regular basis and a multilayered audit should be undertaken every time a change is implemented in the organization, according to the EHS manager. Most people will begin by doing things in a different way, but will eventually return to how they have always done it. This is due to the fact that the human brain excels at learning new things but struggles with relearning them. The manager argues that *"The human brain is very good at learning new things but to relearn takes a lot of time"*.

When deploying new technologies or processes, it's common to have a timetable to specifically relate to. You make sure to educate people and assist them in getting started, but then you're satisfied and don't check in on what's going on. This is why so many change-related projects fail. Instead of moving on to the next project, this should be viewed as the beginning of the project, with the knowledge that there is still a lot of work to be done.

Another crucial point raised by the EHS manager is that an IT-tool must be turned off at particular times in order to avoid employee frustration. For example, if the tool is available during the summer vacation, everyone will be overwhelmed with E-mails and assignments when they return. This is something that the person in charge of the IT-tool must handle.

The EHS manager further state that it can be difficult to demonstrate to the senior management team what business benefits of deploying an IT-tool there is, since the benefits often are intangible. Better and more clear communication was one of the primary benefits with previously implementing an IT-tool for safety and accidents. Employee surveys revealed a shift in collaboration, with employees believing that we worked better together after deploying this application. In the long run, this will result in improved safety, quality, and delivery but it can be hard, especially early in the project, to show how the implementation of an IT-tool benefits the organization from an economical standpoint.

Workshops are recommended by the EHS manager as an excellent way to train personnel on new programs or processes. This is a time-saving method of working because you can gather a large number of individuals at once, it's also beneficial because everyone gets the same information during the session. Another essential aspect of education that the EHS manager emphasizes is the importance of being available and accessible to answer questions and demonstrate how difficulties may

be solved. Employees are more likely to solve the problem if they know who to contact.

### 4.8 Interview with Lean manager

The lean manager believes that executing LPAs and LSW on a broader scale in the factories has a lot of potential. The current deployment is a trial project that has only been tested in one production channel, the corporation has 35 manufacturing channels at this manufacturing location, and the manager says that all 35 channels have the same need for this tool and way of working. They will make sure that the IT-tool is easy to use and that it performs properly in the pilot channel before moving on with the project and implementing it wider in the organization.

LSW and LPAs, according to the lean manager, will have a significant impact on quality, safety, and delivery. The manager uses maintenance as an example of where LPAs and LSW will push the company in the right direction. They have an IT-tool for scheduled maintenance today, but they don't have a good way of operating when it comes to the daily duties that the operators are supposed to do, cleaning the machine and changing the oil, are examples of this. The manager believes that if LSW and LPAs are properly implemented, they will result in a shift in workplace behavior. The manager argues that *"If our goal is to gain long-lasting benefits from this, we need to change behaviors and routines on both managerial and factory level"*. This, in turn, may make it easier to adopt such changes in the future, resulting in a positive shift in the way operators operate and behave on the manufacturing floor.

A challenge that the lean manager has encountered is that they have not been able to stick to newly adopted processes and ways of functioning over time. They have historically lacked a reliable method for following up on newly deployed processes, and as a result, some of them have been abandoned. The manager uses the example of a recent investment in a new machine worth several million SEK. Before they began operating the machine, they carefully considered the new way of working, which included numerous supporting processes. They employed all supporting processes at first, but eventually they just focused on the processes that were required for the machine to work, and many of the other processes were no longer used. This is described by the manager as having too high goals and doing everything too quickly in the hopes that it will work right away. Instead, they should have concentrated on critical operations first, then added supporting processes once the critical processes had performed as expected. They'd put a lot of money into it, so they wanted everything to be perfect and operate right away.

According to the lean manager, another significant benefit of applying LPAs is that jobs that operators and supervisors do not want to undertake are checked. Some activities may be tedious or time consuming, but they must be completed nevertheless. Today, no one checks to see if these activities have been completed. The biggest advantage of using an IT-tool for this is that you can track historical data and see how often and well different tasks have been completed.

Furthermore, the lean manager states that the IT-tool has improved but not simplified the execution of LPAs and LSW. It can be a hindrance at first when installing a new IT-tool and there is always a hurdle that must be conquered. Licensing, expenses, and administration are always associated with such tools and must carefully be taken care of in order to conquer the barriers. Moreover, the manager claims that both managers and operators have an interest in new IT technologies, this might give the impression that something interesting and innovative is happening, which can help to improve and simplify the implementation process.

The lean manager discusses why employing an IT-tool is preferable and what the biggest benefits are from doing so. The manager emphasizes statistics, data storage, and historical data as the most significant advantages of a well-developed IT-tool. The reason for this is because storing data with other tools that aren't connected to a database is difficult. Tools such as MS Excel or pen and paper can be used instead of the IT-tool featured in this report but data storage is a major issue. Because the plant is digitized, employing pen and paper or giant whiteboards to apply LPAs is not in line with the factory's overall strategy. The storing of data is the biggest issue with MS Excel as well, according to the manager. It's difficult to save historical data in a useful manner, and there's no method to send out e-mails reminding people to complete tasks which also is a big disadvantage if comparing MS Excel to the IT-tool featured in this report.

The lean manager further states that the company is already working with LPAs and LSW without realizing it, although on a lower scale than they had hoped. When completing tasks, all managers have standards, but they are not established as standard work. The advantages of defining standard work and standard processes for specific activities are that they can be discussed and shared with others, which will likely lead to interesting debates and save time for managers because they will receive input from others on how to conduct the task differently. As an example of LPAs that the company currently are conducting, the manager mentions a procedure known as redflag. When they receive a consumer complaint about the product's quality, they examine the process and raise a red flag. This is then communicated

to the rest of the organization, and a process begins with determining what went wrong and ensuring that it does not happen again. Managers are then expected to check in on this redflag process on a frequent basis to ensure that they are following standard procedures. They remove the redflag and the problem is considered fixed after they no longer get any consumer complaints relating to the process.

The fact that managers from higher levels of the organization go out on the working floor to check if the standardized processes are being followed has proven to be the most successful aspect of the redflag implementation. As an operator, this has impacted the way of acting and approaching the situation. When the manager comes out to check on them, the operators realize how important it is to operate in a certain way, which inspires and encourages them to do so. Managers and operators will be able to communicate and understand one other better as a result of this. This is something that the lean manager considers to be really important, and it is something that many businesses are having difficulty with.

Today, another IT-tool is utilized to track safety rounds and issues. This is applied in a way that could be compared to layered process audits and leader standard work. This tool has been very beneficial to the organization, especially in terms of increasing their expertise and comprehension of recurring safety issues. The data is accessible to both company and union representatives, making the discussion more transparent. This has been greatly appreciated by both parties.

### 4.9 Interview summary

A summary of all findings from the interviews are presented down below in table 4.1. The findings in the table has been structured the same way as the theoretical synthesis in chapter 2 and is based on practices and techniques presented by Dean & Bowen (1994). The numbers next to each practice corresponds to the number in Table 2.2 and Table 2.3.

Table 4.1: Interview summary

Practices and techniques	Coordinators	Level 1 manager	Level 2 manager	Level 3 manager	Vice lean manager	EHS manager	Lean manager
LSW (1)		Maintenance is an area that the application, together with LSW can be utilized.	Every process and system may benefit from LSW	This could be in conflict with creative and innovative leadership	This is the only way to make things happen in reality	This is important since it can help us to follow standard procedures	This will have a significant impact on quality, safety and delivery
LPA (2)	LPAs should be done with the use of a digital tool, this is mainly due to flexibility, simplicity and the fact that data is saved and stored	The level 1 manager prefers an IT-tool instead of whiteboards or pen and paper when conducting LPAs	Working with an IT-tool has made the implementation of LPA more efficient and easier	Pen and paper is probably as fast as IT-tool but handling the data will take much longer time	5S has been done with pen and paper previously and this has not worked well	The most common reason for a root cause analysis is that the standardized way of operating has not been followed	Increase and improves the communication between different functions
Digitalization (3)	It is very important that the IT-tool is easy to use and understand	This particular IT-tool is very easy to use, this increases the likelihood that it will be used in the future	Other applications used in the factory is now the basis for making safety strategy decisions	Advantages are data storage, trend analysis and creation of a good structure	Important that an IT-tool creates interest among employees and that operators understand how to use the tool effectively	It can be hard to explain to senior management how an IT-tool can make the business better	Being able to view historical data is one of the greatest benefits with an IT-tool
Implementing new technology (4 & 5)	The coordinators emphasize on the importance of education and knowing the main purpose	Education and information are the most critical factors, everyone must know why and how it will be used	The single most important factor is that information is widely spread so that everyone understands the purpose	Could initially be costly to implement new IT-tools	The user interface is one of the most important factors when deploying new technology	The human brain is not good at remembering things which can make it hard to accept new technology	There are always expenses connected to the implementation of new technology
Redesigning processes (6 & 7)		The manager emphasize on the importance of historical data for analysing what has not worked in the past	The responsibility must be located in the factory	The goal is to have a system so robust that the operators cannot deviate from it	Management has previously been putting a lot of effort into introducing new processes and programs resulting in de-prioritization of other programs	It is very important to inform everyone and make sure that they understand why change is needed	They have had a hard time to stick to newly adopted methods over time
Data collection and data quality (8)	Conducting LPA on whiteboards does not make it possible to save data	Collected data should be easy to overview and easy to understand	Data collection is one of the main benefits by using an IT-tool, it saves a lot of time	Strategical decisions can be made on the collected data	Employees are positive to change as long as they are not affected	From applications used in the factory today, strategic decisions is made on the collected data	MS Excel is not good at storing data, this is essential for an IT-tool
Change management (9)		Follow up meetings are important when changing processes or methods	Behaviours and habits must be changed in order to receive all benefits of change	Transparency and follow up meetings are critical	Resistance to change can be overcome by changing culture and behaviours	Right now a lot of short term effort are made to receive change, this does not work in the long run	Changing behaviour is the most important factor for successfully changing the organisation
Employee and management engagement (10 & 11)	It is important that those who will use the IT-tool receive the right training	Important to gather everyone and explain how and why we need to change the process or method		The management team and how they operate is a critical factor when deploying new technology		Workshops can be used to train and engage both operators and managers	Management involvement has been one of the critical factors for the redflag process and its success

The table shows that every interviewee except the level 3 manager is solely positive to the implementation of LSW. All interviewees states that they prefer to conduct LPAs with an IT-tool instead of using pen and paper. A common view is also that the IT-tool should be easy to use and that the implementation will be simplified if the IT-tool first creates an interest among employees. Education and knowing why a new process or technology is being implemented is essential. Being able to save historical data is stated as one of the main benefits with an IT-tool by several interviewees. In order to facilitate change management in the future, the company culture must be change accepting.

### **4.10 Introduction and evaluation of an IT tool supported for LPA & LSW**

The IT-tool that was used in this thesis was provided by the company. As a result, the project team has had no opportunity to change or adjust the tool in question. The provided IT-tool allows users to create check-lists that can be assigned to specific employees to fill out. All data is stored and should be able to use it as pleased. However, as will be discussed further in this subchapter, the provided IT-tool is not fully developed yet so some features such as data-visualization are poor.

When all coordinators and lower-level managers were gathered and instructed on how to use the IT-tool, the research team made some interesting observations. Even though the coordinators got insights into the bigger picture and purpose of the IT-tool, they immediately showed resistance to change by asking questions of who will be affected implying that this would possibly lead to an increased workload. Furthermore, the coordinators immediately brought up problems that may arise by implementing this IT-tool such as charging of the iPad.

During the implementation of the IT-tool among the coordinators, the research team saw that the attitude changed and that the common thought quickly became that the IT-tool was helpful. This resulted in high use among the coordinator, using the IT-tool almost everyday from the start of this thesis.

The research team experienced that the managers was not as resistant to change as the coordinators. They were from the beginning interested and adopted the IT-tool fast. To ensure that the managers conducted their rounds, email reminders was introduced and this was appreciated by all managers. All managers thought that the IT-tool was easy to use and directly saw the benefits of conducting this at several

levels.

Moreover, the research team agrees with the coordinators and the managers view that the IT-tool is very easy to use, both for operators and for those managing the tool. The owner of the IT-tool explained that the intentions is that everything that today is done by pen and paper should instead be done with this tool and the easiness to use is a critical factor for this.

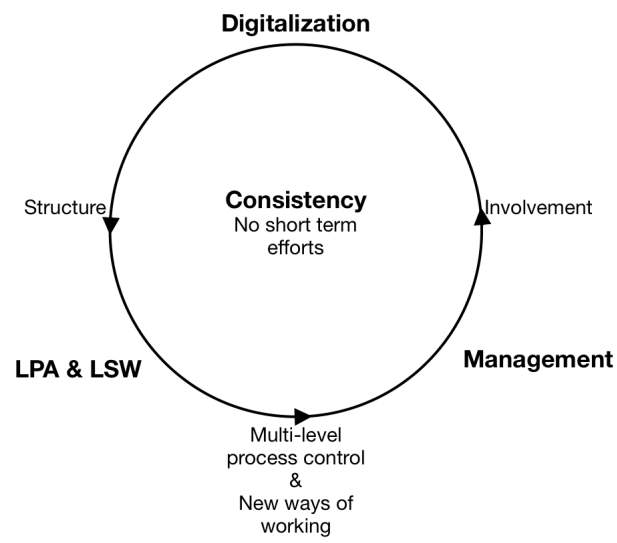
What did not work well with the tool was its data-visualization which has not been fully developed yet by the company in charge of the IT-tool. The poor data-visualization was pointed out by the level 1 manager when they tried to generate graphs from the collected data. There was a possibility to export valuable data into MS excel but that requires a lot of extra work and manual data handling which many interviewees has mentioned as the largest benefit with using an IT-tool.

From the workshop held towards the end of this thesis, the research team observed that the interest for both LPAs, LSW and the IT-tool itself was huge. Participants from other factories in the Gothenburg area was participating and initiating that this tool would be a great fit for their factories. During the workshop, it was noted that the participants quickly learned how to use the IT-tool, implying that it was simple to use. After an hour, almost every participant was able to make their own rounds and checklists. Another observation made during the workshop was that the participants discovered features that the study team had not previously noticed or discovered. This indicates that the IT-tool has additional features and functions that can be explored further.

### 4.10.1 The Circle of Change

The research team developed a model, see Figure 4.2, in order to clarify crucial elements and their relationships while using an IT-tool to implement LPAs and LSW. The model is based on the discussions above and includes three elements that are necessary for the organization to consider in order to achieve change in today's modern business environment. The three elements are: *Management*, *LPA & LSW*, and *Digitalization* which are all linked through the effect one has on the other. In the center of the model is the term *Consistency*, which represents how the organization should work with the elements. There should be no short term efforts since a lack of long term commitment has led to many change initiatives failing in the past at the organization. Therefore, the importance of consistency and working with this model for a longer period of time is critical.





**Figure 4.2:** The circle of change

# 5

## Discussion

In this section the discussion is presented. The main purpose with the discussion is to compare and evaluate the empirical results together with the theoretical framework and answer the research questions that was formulated in the introduction of this thesis. The first subchapter, 5.1, discusses research question 1 - Benefits with implementing LPA & LSW into the organization. This is followed by 5.2 and 5.3 where advantages using an IT-tool when implementing LPA & LSW in which research question 2 is discussed and hinders deploying the new IT-tool in which research question 3 are discussed. The next subchapter, 5.4 discusses weaknesses and strengths with the IT-tool. In subchapter 5.5, organizational change is discussed followed by 5.6, where Limitations and suggestion for future research is discussed. In the last subchapter, 5.7, the model developed by the research team is discussed.

The key concepts from the theoretical framework that are used in the discussion can be found in Table 2.2 and Table 2.3. A summary of the data that is used from the interviews in this discussion can be found in Table 4.1.

### **5.1 RQ1 - Benefits with implementing LPAs & LSW into the organization**

The vice lean manager as well as the EHS manager states that LPA & LSW is a great way, and maybe the only way, to make process and technology change happen in an organization. The fact that managers double-check each other to ensure that the new style of working is being followed is the primary reason that both managers recommend this method when introducing or modifying processes. This is in line with what Seely (2019) illustrates when arguing how LSW affects the entire firm when implemented throughout the organization. Establishing a routine and changing behaviors is clearly stated as a must for this to function.

The level 3 manager is the only one of the interviewees who is not enthusiastic about implementing LSW in the company. He argues that LSW is heavily focused on completing scheduled duties, which he believes would strangle the creative and innovative side of leadership. This is not in line with what Mann (2005) stresses, that senior managers should have a focus on not only monitoring processes but also improving them and further emphasize on the importance of a philosophical transformation in leadership for deploying LSW. The level 3 manager may not fully comprehend the notion of LSW, which is a constantly changing job that should not remain locked and rigid for decades. The level 3 manager has a valid argument, and this should be taken into account when implementing LSW, however LSW is much more than just controlling each other at different levels of the organization since LSW also includes improving processes, changing habits and transforming leadership. This indicates that there might be deviating views of whether an implementation of LSW is solely positive, all interviewees except one expressed positive thoughts and experiences of implementing LSW. But regardless of how unique and brilliant the leadership concepts are, they must be executed.

The level 3 manager emphasizes the significance of solid processes and standardized ways of working from which it should be difficult to deviate, if not impossible. This in line with Mann (2005) argues that a focus on processes is one of the most important aspects of implementing LSW. The level 3 manager states that LSW or LPAs may not be required if the methods are sufficiently strong. This is also something Hammer (2007) brings up, arguing that how well defined and easy a task is to execute determines how well it is performed. Because we are talking about humans, not robots, the chances of this happening are very small. Things will constantly happen that catch the operator's attention, which poses a danger of process deviation. This is described as utopia by the level 3 manager, which implies that he believes it will not happen for a long time.

The lean manager states that the leaders use standard processes and approaches, but that they are not specified as standards and have therefore not been put down on paper. Furthermore, the lean manager argued that the organization would really benefit from LSW, since it would make the leaders' work more organized and manageable. Hammer (2007) recommends this method for successfully completing tasks and changing processes.

Even though they have not referred to it as a layered process audit, several interviewees stated that LPA is not new to their organization and the corporation is currently conducting LPAs in several different parts of the organization without re-

alizing it. According to Lozano et al. (2020), this indicates that the company is on pace with the automobile industry.

Workplace safety is the company's largest and most elaborated field of work with LPAs today. They have an application that they use on a daily basis that allows managers to check in on each other and conduct audits to ensure that processes are followed. One of the main benefits of deploying this application and creating LPAs, according to the EHS manager, is that it has helped the organization structure their way of working. The EHS manager also adds that this greatly improved communication between different functions, which Yadav & Thakar (2021) also mentions as being one of the largest benefits with implementing LPAs.

According to By (2005), identifying future demands is a critical component of an organization's ability to change, which requires a lot of effort from the management team. This is something that the organization has done in the past, such as investigating the possibilities to implement LPAs. The management team later recognized the need for an IT-tool or a new way of working and took steps to implement it. Furthermore, the entire firm has now developed a lean management program that included numerous things they were already doing. This suggests that the Gothenburg manufacturing was ahead and could accurately foresee future needs.

Furthermore, to aid the digitalization process and introducing new processes and ways of working, Zhou (2013) and Zangiacomi et al. (2020) argue for the criticality of management involvement. Managers from the organization expressed that the role of management is of great importance. However, as the EHS manager expressed, it is difficult to demonstrate and involve senior management in digitalization processes such as the implementation of new IT-tools, since the results are often intangible. One way to involve more senior management could be with the use of LPAs. The research team experienced a lot of interest among managers, even on senior manager level, this might indicate that this differs a lot from manager to manager. It could also be an indication of LPAs already making difference within the organization. The EHS manager continues to emphasize the need for clear communication with management so they understand the impact that the intangible benefits can have, which LPAs certainly can help understand.

The lean manager mentions that working with redefining processes is difficult and it is important to divide the responsibility among the participants when changing a process. If one individual feels in control of implementing the new process, he or she will likely grow in that role, increasing the likelihood that the process will

be successful over time. This is something that the organization could adopt in order to make redefining easier and more sustainable in the long run. According to Hammer (2007), it is equally critical to rethink process activities and roles while changing processes. Furthermore, Ham et al. (2003) state that changing processes and asking operators or executives to modify their ways of working will almost always result in resistance and this was also what the research group experienced when first introducing the IT-tool to the coordinators.

Hammer (2007) also mentions process maturity, which the EHS manager claims the organization has failed to achieve. The EHS manager argues that when implementing new or redefining processes, the organization has undertaken short-term efforts. This effort then vanished before the process reached the maturity level. This has been a major contributor to failure when it comes to modifying or adopting new processes. According to Ham et al. (2003), the management team's involvement is also a crucial aspect and if the effort put in to make this new process operate fades away after a short time, management involvement disappears as well. When analyzing why project implementations fail, this is another issue to examine. This indicates that if management is not involved, the coordinators will most likely not be that either. This emphasizes the need of LSW and LPAs, in which management visit the factory and verify that standard processes are being followed. This will most likely create a sense of importance among the workers, as the management appear to be interested in seeing how things go. Only seeing management on the plant floor gives the impression that something significant is happening. Furthermore, according to Al-Mashari & Zairi (1999), Zmud & Cox (1979), and Meyers et al. (2012), if the new implementation is in line with the company's overall goal, there is a greater chance that management will be involved. It's also critical that someone in the management team feels accountable for the implementation. Otherwise, there is a significant danger that the implementation will not be completed and that the desired benefits and advantages will never be realized.

## **5.2 RQ2 - Advantages using an IT-tool when implementing LPA & LSW**

The level 2 manager claims that operators and supervisors are familiar using IT-tools, which makes implementation easier. Those who argue that the IT-tool has made LPA implementation easier cite the argument that the tool is simple to use and that the alternative is pen and paper or whiteboards, neither of which is a better option. This is also something that Mandinach et al. (2006) is referring to

as accessibility. When asked about using pen and paper or whiteboards to conduct LPAs, the primary objection was that you couldn't carry them with you all the time like a mobile device and that the data couldn't be recorded easily or automatically. This complicates the data's function, which is primarily to make strategic decisions. Mandinach et al. (2006) agrees with this, but adds that, whether the data becomes useful information or not, is dependent on the person analyzing the data.

One major benefit of conducting LPAs or LSWs with a mobile device, as noted by the majority of interviewees, is the flexibility of always having it with you. Flexibility and accessibility are also important factors for people to use the IT-tool, according to Mandinach et al. (2006). Furthermore, according to Morkos et al. (2012), mobile devices increase communication by increasing data access. As mentioned before, the organization uses an application to track and act on safety issues and the EHS manager mentions that the largest benefits from this implementation is that it has improved communications between different functions in the organization, this is partly due to the implementation of LPAs but also due to the use of the application. The main benefit with using the IT-tool that the research team experienced is its easiness to use along with the fact that email reminders can help the users to conduct their audits on time.

Brynjolfsson et al. (2011) argued that managerial choices are frequently dependent on leader's gut feeling rather than data-based analytics. This statement did not seem to match the way that the studied organization worked. One example of this is that the organization uses applications today to store data, analyze and visualize it, as well as make decisions on how to proceed by taking this data into account. The organization puts the data into context when they visualize it and analyze it, thus turning it into valuable information to use as a basis for decisions, which is in line with what Mandinach et al. (2006) proposes about turning data into information. This habit of using data as a basis for decision making, which is supported by Zangiacomi et al. (2020), possibly opens up for convincing management of the benefits. As a result management will likely be more positive to the implementation of new technological tools.

The fact that information and data always are with the operator is a huge benefit, but also that the operator can have instructions, scheduled tasks and meetings in the mobile device. Morkos et al. (2012) states that improved communications, data storage and being able to access information from any location are the main advantages with mobile devices. The operators are today familiar working with mobile devices such as iPads, every manufacturing channel in the factory has their

own iPad, which is lowering the equipment implementation barrier as well as the educational barrier when implementing LPAs & LSW. This is in line with Matyi et al. (2020) stating that 68% of employees used mobile devices in their everyday work. The research team discovered that the resistance towards implementing the IT-tool was much higher among the coordinators than the managers. This could be due to educational barriers supposing that the coordinators have less technological experience than the managers. The lean manager, along with the research team, claims that there has been a lot of interest in the IT-tool among managers, which may have made the implementation easier.

In addition, the implementation of LPAs & LSW is enhanced since the IT-tool helps the organization with structuring not only data, but also the way of working. Sending emails and notices is also a huge benefit when working with an IT-tool since this helps the manager or operator to remind other colleagues of performing their tasks. This is also something that several interviewees mentioned that the organization has had previous problems with. Introducing an IT-tool is also a part of the organizations overall strategy since the factory works a lot towards digitization. Integrating technology to the overall strategy is something that Al-Mashari & Zairi (1999) also mentions as an important factor when introducing new technology to the organization. The organization is fully aware of the benefits that digitalization brings and has worked for years to move more and more towards digitalization. It was noticed that people from the organization are very aware of digitalization and are generally accepting of this transition. One obvious piece of evidence to support this, is the fact that none of the interviewees suggested that conducting LPAs would be more beneficial with pen and paper or large white-boards, and had a positive mindset toward the researched IT-tool.

### **5.3 RQ3 - Hinders deploying the new IT-tool**

For all interviewees except one, the IT-tool is not deemed to be a hindrance, but the lean manager claims that the IT-tool has improved but not simplified the implementation of LPA and LSW, implying that there is a hurdle that must be overcome when such tools are implemented. Matyi et al. (2020) mentions that most operators already use technological tools in their everyday work, which in turn should lower the barrier when implementing new technology. When installing an IT-tool for the first time, there will always be challenges with obtaining the appropriate licenses, administrative work, and costs associated with IT-tool deployment. Ham et al. (2003) states that the cultural barriers should not be overlooked when trying to

implement new technology and that this also can create a resistance towards change. It is therefore not only the technological aspects that can create barriers but also cultural aspects. Both managers and operators, according to the vice lean manager, are open to change as long as it does not affect their area of work. Of course, this varies from person to person, but this is a common example of a poor organizational culture that most organizations face at some point. Both By (2005) and Ham et al. (2003) states that such a culture can create a resistance to change making it more difficult to implement new technology and new ways of working. Even while some people are optimistic and enthusiastic about change, those who are not have a bigger influence on others. This will then permeate throughout the company, making any change difficult.

The EHS manager along with others also mentions that they have had change projects that have failed. This could be attributable to the change program and its structure, but when addressing why change initiatives fail, the organizational culture should not be overlooked. There are certainly many other elements that have influenced individual change projects, but if the pattern is that many initiatives fail, the cultural aspect should be investigated. Changing habits, routines, and behaviors is mentioned as a significant part in achieving organizational transformation in the majority of the interviews. This is in line with Al-Mashari & Zairi (1999), Hammer (2007), and Sjödin et al. (2018) arguing that it is the single most significant aspect in achieving organizational change and to successfully implement new IT-tools.

Mann (2005) explains that LSW is about more than just following pre-defined procedures, it is also about culture and practices among leaders. Many of the interviewees mentioned LSW as a crucial aspect in successfully conducting change projects such as implementing new IT-tools. Furthermore, the vice lean manager expressed that resistance to change has been a problem, both among operators and managers. This conforms with Mann (2005) reporting that culture and organizational behavior could cause resistance to change.

When it comes to implementing new technologies, the EHS manager explained that the organization has historically put forth a brief but intense effort before moving on to the next project. The manager claims that this hasn't succeeded since after a period of great effort, habits and behaviors generally revert to their previous state. Al-Mashari & Zairi (1999) suggest that *project planning and management* is an essential part in the implementation process, this is something that the company may have lacked. Furthermore, the EHS manager mentions ownership of the imple-



mentation as another important element to consider. The implementation will most likely fail if no one feels responsible or has ultimate duty and this might have been the case. Meyers et al. (2012) state that evaluating previously implementations is an important factor for improving, this is something that the company could have done in order to analyze why some implementations were successful while others were not. Moreover, the EHS manager concurs with the lean manager that the deployment of new technology should last for a longer period of time. It is quite simple to ignore critical variables while rushing through the adoption of new technology, this is a risk when the focus is on doing it quickly rather than doing it well. Some flaws and problems will occur during the implementation, these flaws may be missed and not treated as they should be, resulting in further implementation complications, this makes Meyers et al. (2012) argument about evaluating previously implementations even more accurate.

Jones & Smith (2004) believes that employees should feel like they are a part of the IT-tool development process in order to reduce any potential opposition to change. This isn't mentioned as a significant component in any of the interviews and may be a point that the organization has overlooked and should investigate further in order to ensure that new technology tools are implemented with full staff participation. This is significant because it reduces employee resistance to change and allows the software to be tailored to the company's needs. When implementing this the specific IT-tool for this project, operators and managers has not been a part of developing the software even though the software is owned by the company itself. The research team first experienced resistance when introduction the IT-tool, this can be due to the fact that none of the coordinators was a part of developing the IT-tool. Later, when the IT-tool was tested by the coordinators, the common expression was that it was easy to use and their attitude towards the IT-tool was mainly positive.

Moreover, Laranjeiro et al. (2015) state that the quality of the gathered data is critical and that poor data can have disastrous consequences such as lower customer satisfaction or higher operating costs. It is therefore crucial for the organization to ensure that the right questions are posed in the IT-tool, and constantly review and/or update the questions to make sure that useful data is collected.

Information and education are the two most important criteria for successful implementation, according to the coordinators, who are almost always affected or involved in new tools or procedures that are being implemented. These factors are also brought forward by Zmud & Cox (1979). The coordinator emphasizes the need of not just receiving the appropriate education but also comprehending why it is

being implemented and how it will influence them which is supported by Zmud & Cox (1979) who argues that the implementation's goal should be widely shared throughout the organization in order for it to succeed. Another factor that should be considered when implementing new IT-tools and technology is the competence that the company has in educating, maintaining and developing the IT-tool, this is something that Aaldering & Song (2021) emphasize and states as an important factor for successfully implementing new technology.

Finally, none of the coordinators cite management engagement as a crucial aspect in the implementation process, which Zmud & Cox (1979) and Al-Mashari & Zairi (1999) both believe is important. Instead, they emphasize the importance of changing routines, as Mann (2005) previously discussed when applying LSW.

## 5.4 Weaknesses and strengths with the IT-tool

Mandinach et al. (2006) states that accessibility, length of the feedback loop, comprehension, flexibility, alignment, and linkages to teaching are all crucial aspects for an IT-tool to be used properly.

Interviewees from the organization expressed that the the studied IT-tool was a useful tool to gather data, but that visualization of the data was poor, which is in line with what the research group experienced. Mandinach et al. (2006) argue that technological tools have the benefit of supporting, enabling and facilitating data-driven decision making, which is consistent with the opinions from the interviewees. However, some interviewees expressed that the function of visualizing data with researched IT-tool, was rather lackluster. Unfortunately, the studied IT-tool is not fully developed, thus making it impossible to showcase data visualization to the full extent, and lowers the *Flexibility*, *Alignment* and the *Comprehension* of the tool, as Mandinach et al. (2006) suggest. In addition, Provost & Fawcett (2013) posit that analyzing data and drawing conclusions is a critical stage in big data and data-driven decision making, and therefore, the researched IT-tool does not work sufficiently at the time of this thesis.

Mandinach et al. (2006) also state that people will not use an IT-tool if it is not easy to use or if it requires too much effort. All the interviewees concur that the researched IT-tool is very user friendly when testing it. Mandinach et al. (2006) further state that the interface and UX-design are very significant and can boost accessibility. Everyone who tested the application found the interface of the application itself to be simple and straight forward, and that it was hard to make mistakes. One

interviewee even expressed that the interface was the one of the most important components for an IT-tools success. All this can be considered to be a very positive sign and aid the implementation process, since both the theory and reality match, thus making the *accessibility* for the tool considered good.

The *feedback loop* in this program is quick, once a user has completed activities, one can immediately see the results on the screen. This makes the feedback and result available for all users in real time which is in line with Mandinach et al. (2006) stating that it is important since the users can easily access the data in a meaningful form. Finally, because the data is collected from multiple layers within the organization, linkages to teaching is deemed strong and can be used to make strategic decisions, this is mainly because the data can be closely related to practice. A summary of all Mandinach et al. (2006) stated factors related to the IT-tool used in this thesis are presented in Table 5.1.

**Table 5.1:** Mandinach (2006) criteria assessment

<b>Factor</b>	<b>Evaluation</b>
<i>Accessibility</i>	Strong
<i>Length of feedback-loop</i>	Strong
<i>Comprehension</i>	Weak
<i>Flexibility</i>	Weak
<i>Alignment</i>	Weak
<i>Linkages to teaching</i>	Strong

It can be concluded from Table 5.1 that the problems with visualizing data is the main issue with the IT-tool, thus making both *Flexibility*, *Alignment* and the *Comprehension* weak. Since storing and analyzing data has been mentioned by several interviewees as one of the greatest benefits with an IT-tool, this lowers the impression a lot.

## 5.5 Organizational change

Smith (1973) states that *structure and personnel*, *the leadership of the administrative organization* and *the implementing program and capacity* are three essential factors for a successful implementation of new processes.

The first factor, *structure and personnel* is based on how the organizations stability and culture is. The interviews shows that the company has a very clear structure with a hierarchical order of managers. The structure can therefore be said to be stable and clear. But something that has been mentioned a lot in the interviews

is the culture that in some cases has a resistance to change. A poor culture for change is problematic and something that the company needs to improve. *The leadership of the administrative organization* refers to the style of the leadership within the organization. Leadership style is something that has not been main focus for this thesis and therefore not something that can be sufficiently analyzed. The last critical factor according to Smith (1973) is *the implementing program and capacity*. Several interviewees has mentioned that implementation programs have failed. This can be due to one of the above mentioned factors but also due to a poor implementation program. This is something that must be further evaluated in order to draw conclusions. Evaluating previously made implementations to draw conclusions of what worked well and what did not is something that Meyers et al. (2012) suggests.

The level 2 manager and the Lean manager both explicitly expressed that LPAs and LSW will contribute to higher quality, better delivery and higher safety. This will likely lead to a higher level of customer satisfaction, which is the most essential principle or "core value" which are included in the models by Dean & Bowen (1994), as well as Bergman & Klefsjö (1994). The concepts of LPAs and LSW are relatively new to the organization and is definitely not wide-spread throughout the organization. Improving continuously is one of the core principles in both the model by Dean & Bowen (1994) as well as the cornerstone model by Bergman & Klefsjö (1994). The core value of "Focus on processes" in the model by Bergman & Klefsjö (1994) is also relevant here, since the processes need to be analyzed and reviewed if the organization aims to improve current as well as new processes. Furthermore, the EHS manager and Vice lean manager also clearly see benefits with performing LPAs, but explain that it can be difficult to involve senior management and employees. This indicates that the organization needs to increase their degree of teamwork between functions in order to accomplish continuous development, which is in agreement with Dean & Bowen (1994). Moreover, the Vice lean manager suggests to increase collaboration and to involve all parties that will be affected by the change, which is in line with what Bergman & Klefsjö (1994) mean by their proposed core value of "Let everyone be committed".

Zmud & Cox (1979) argues that there are two different ways of operating (change approaches) when implementing new computer-based systems, either the traditional approach or the change approach. When looking at the company's structure implementing this IT-tool, the change approach seems preferable. This is due to the fact that the change process is undefined and many of the interviewees express that LPA & LSW should be implemented into the company with the use of an IT-tool, but

how this should be done is not as clear. Other change programs that the company have tried to implement has failed, this may be due to an undefined change process. The IT-tool that has been tested throughout this thesis must also integrate with other systems, this is mainly due to the poor data visualization that the IT-tool offers. This implementation will also require major organizational change which is the third argument that Zmud & Cox (1979) mentions for selecting the change approach. This is mainly because this IT-tool has not been used before and that the way of working with LPAs and LSW will change many employees way of operating.

### **5.6 Limitations and suggestions for future research**

As mentioned in subchapter 1.5, certain limitations were necessary to achieve this thesis project within the time span of roughly 6 months. Therefore, it was only possible to test the IT-tool in one manufacturing unit of the organization, not to the full-extent and only the IT-tool provided by the company was used.

By only testing the IT-tool in one manufacturing unit, it was not possible to collect company-wide impressions of using the IT-tool. However, the research team did conduct a workshop to collect some impressions from other manufacturing units. Furthermore, the IT-tool was not tested to the full extent within the manufacturing unit, which made it difficult to understand how the IT-tool could be used in the entire manufacturing unit. The IT-tool that was used, was provided by the company which made it impossible to understand whether or not other IT-tools could ease the implementation of LPAs and LSW in a better way.

Another factor that affected the outcome of the thesis, was communication. During some parts of the project, the communication between the research team and the supervisor was poor at times. Also, at one time during the project, a temporary supervisor from the company was assigned, and the communication between the main supervisor and the temporary was also poor. The overall poor communication at times during the project, led to some misunderstandings, which led to some rework and loss of time.

For further research it would be interesting to investigate how well the IT-tool and its software handles data. This would be of interest since data has many benefits if it can be used properly. Data handling was not studied during the project, mostly due to the lack of knowledge in data handling by the research team. It would also

be interesting to try the IT-tool at a larger scale, to fully understand its benefits and potential road blocks.

### 5.7 Discussion about The circle of change

Management engagement is one of the single most significant aspects for successful implementations, according to both Zangiacomi et al. (2020), Zhou (2013) and interviewees. LPAs and LSW are significant parts of this thesis, which is why they are included in the model. When implementing IT-tools within the organization, the goal is not only to produce a successful installation of the specific tool but rather to digitalize and modify the factory's method of operating.

All of the interviewees believed that utilizing an IT-tool to implement LPAs and LSW is preferable to using manual tools. When comparing the theory with the empirical results, it can be determined that using an IT-tool can assist a company in creating a new way of working, such as using LPAs and LSWs. In this scenario, structure includes reminders and emails sent to operators and managers to remind them of their tasks. This is something that supports LPAs and LSW implementation which can be concluded after answering RQ2.

Furthermore, when LPAs and LSW are operating, managers walk out on the production floor to monitor whether or not tasks have been completed. This necessitates management involvement in the execution, which will in turn promotes a sense of management involvement among lower-level operators and managers, increasing the likelihood that they will continue this way of operating.

The implementation will be considered successful if they continue to do so for a longer period of time. As a result, new routines and behaviors will emerge, as well as extensive data collection and strategic decisions.

# 6

## Conclusion

As mentioned in subchapter 1.3, the main purpose of the thesis was as follows:

*The purpose of this thesis is to introduce and to support the implementation of Layered Process Audits and Leader standard work in one manufacturing area at a large Swedish company. Further, the thesis aims to understand how an IT tool can aid the implementation cross multiple levels of the organization.*

Through test-runs, presentations and a workshop, the research team has introduced the organization to LPAs, LSW and the IT-tool. The research team has also identified possible benefits and challenges that might aid or hinder the implementation of these concepts. Moreover, through interviews and test-runs, the research team obtained data to better understand how the proposed IT-tool might aid the implementation of LPAs And LSW.

LPAs and LSW strongly facilitate change initiatives due to the fact that managers are forced to double check one another to ensure compliance with the change. Another benefit of implementing LPAs and LSW is that they aid the organizational structure of work and make it more manageable due to the defined ways of working. Communication between functions has also been identified as being a benefit that the organization can expect as well the the formation of new processes and ways of working.

The analysis showed that the proposed IT-tool can be deemed to enhance the deployment of LPAs and LSW at the manufacturing site. This is mainly due to the immensely positive feedback regarding the tool's functions such as data collection and structuring as well as facilitating ways of working. Additionally, the tool was deemed easy to use which can be considered as easing the deployment of LPAs and LSW in the organization. Implementing LPAs and LSW together with an IT-tool is

also in line with the company's overall strategy, increasing management involvement which in turn enhances the implementation.

Furthermore, one major factor that could hinder the implementation of the LPA and LSW using the new IT-tool is the implementation process itself. Aspects that should not be overlooked have been identified as being: involving everyone that is affected by the change, education, spread of information as well as management engagement. Another factor that could hinder the implementation is resistance to change. Many initiatives have failed in the past at the organization which could be a consequence of cultural aspects being overlooked.



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# A

## Appendix 1

### **Standard Interview Form**

- Would you prefer to use an IT-tool to conduct these audits or would you prefer to conduct them using pen and paper?
- What pros and cons can you identify with using an IT-tool for LPAs and LSW?
- What pros and cons can you identify if you were to conduct LPAs using pen and paper?
- What worked well when you used the IT-tool?
- What difficulties can you identify with implementing a new IT-tool?
- What limitations can you identify with the IT-tool?
- What did you find difficult with the IT-tool?

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