JÖNKÖPING UNIVERSITY
School of Engineering

Managing Successful Change Initiatives

An Investigation of Critical Success Factors for Six Sigma Introduction in Large Manufacturing Enterprises in Sweden

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Abstract

Introduction Six Sigma is one of the most successful improvement strategies of the last 5 decades and has been implemented worldwide by organizations in different sectors and sizes. Despite the popularity, 60% of all Six Sigma initiatives are abandoned or end in failure. Therefore, the purpose of this thesis is to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully.

Methodology The research was conducted as a holistic multiple-case study where qualitative data was collected through semi-structured interviews with three companies. A thematic analysis was made to identify patterns between the companies about critical success factors associated with Six Sigma, Change Management, and Organizational culture.

Findings It was shown that Company 1 has introduced Six Sigma but has no defined plan on how to move forward with the initiative. Company 2 has fully introduced the method and is actively working with it, while Company 3 has failed with the introduction of Six Sigma.

Analysis All identified factors were rated as either a success or a failure factor for each case company. The success factors differentiating Company 2 from the other case companies have been evaluated to be the most critical success factors.

Conclusions Top management commitment, Organizational support, Organizational culture, Communication, and Strategic plan have been identified as the most critical success factors that must be prioritized to introduce Six Sigma successfully. Furthermore, cultural factors such as communication between departments, supportive managers, and committed top management have been identified as important to introduce Six Sigma successfully.

Implications The results of this study can be applied to successfully introduce change initiatives in large manufacturing enterprises in Sweden.

Keywords Large manufacturing enterprises, Six Sigma introduction, critical success factors, change management, organizational culture

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1 Introduction

In this chapter a Background to the problem is presented, followed by the Problem Statement, Purpose and Research questions, Delimitations, and the Outline for the rest of the report.

1.1 Background

The global market is increasingly competitive, and to survive the fast-changing trend, continuous improvement has been more crucial than ever (Solanki & Desai, 2021). Hallin et al. (2021) state that organizations need to improve and develop to ensure that offered products correspond with current demand. Furthermore, Muthukumar (2022) argues that continuous improvement is essential to stay relevant in the market. New technologies and globalization have significantly impacted the competitiveness among manufacturing organizations all over the world (Iyede et al., 2018). Historically, profitability and efficiency have been dominant success factors for organizations (Mohanty & Deshmukh, 1999) but more recently, customer satisfaction, quality, and responsiveness have been just as crucial to consider (Kumar et al., 2017; Mohanty & Deshmukh, 1999). Kumar et al. (2008) state that organizations need to produce products and services with high quality to create satisfaction among customers. Sreedharan V et al. (2020) verify this statement and argue that it has been an increased understanding of the importance of high quality over the past two decades. Moreover, Sembiring et al (2020) state that organizations need to consider environmental issues as well if they want to survive in the global market. Due to environmental regulations, Kumar et al. (2017) state that organizations have been forced to rethink their strategies and how they manage their processes.

Continuous improvement initiatives usually involve the entire organization where the aim is to create a culture of ongoing improvement, (McLean et al., 2017). One established initiative is Six Sigma which has been implemented worldwide by organizations in different sectors and sizes (Antony, 2009). However, Buch and Tolentino (2006) have noted that many quality-based interventions fail and that it is difficult to sustain continuous improvement that will increase business competitiveness.

1.2 Problem statement

Studies show that organizations successfully have implemented Six Sigma, but there are a significant number of organizations that have failed in achieving desired result from their deployment (Albliwi et al., 2015; Kumar et al., 2008). Due to the many different quality initiatives available, organizations discontinue their present initiatives and move on to the next before it is possible to see any improvements (Rogers, 2018). Without giving quality initiatives like Six Sigma the right prerequisites, it will be considered as just another “flavor of the month” program (Peter S et al., 2002). This is confirmed by McLean et al. (2017) who state that 60% of Six Sigma initiatives are abandoned or end in failure. Similarly, Kumar et al. (2008) argue that Six Sigma can become a fad in the eyes of management teams if not introduced properly. There is a risk that individuals in the organization push towards proving that Six Sigma does not work when treating the initiative as a short-term initiative (Sanders & Hild, 2000). Instead

of treating it as a short-term initiative, Kumar et al. (2008) argue that Six Sigma should be considered a "way of life".

A large number of studies have identified critical success factors when introducing Six Sigma (Ebot, 2020; Hudnurkar et al., 2019; Marzagão & Carvalho, 2016; Singh & Singh, 2020), but obstacles and common roadblocks are less explored (Ebot, 2020). Further on, there is a lack of knowledge on why organizations discontinue Six Sigma initiatives (Sony et al., 2019) and there are few studies that have investigated the influence of cultural factors when introducing Six Sigma (Jamshed & Majeed, 2019). Although, Knapp (2015) states that managers who emphasized group culture have a higher potential for a successful quality initiative and that organizational culture has a positive correlation with the introduction of Six Sigma. However, it is difficult to change organizational culture (McLean & Antony, 2014; Miller & Proctor, 2016). According to Miller and Proctor (2016), initiatives requiring cultural change have a failure rate of over 80%.

Six Sigma is suited primarily for large enterprises in terms of financial and manpower resources (Ben Romdhane et al., 2017). Though, there are a significant number of organizations that fail the introduction, independent of the size of the company. With the majority of Six Sigma initiatives ending in failure, it is clear that organizations globally are wasting a substantial quantity of resources in an unsuccessful attempt to improve (McLean et al., 2017). The problem is that organizations do not hold the knowledge of what to focus on and what to avoid when introducing quality initiatives like Six Sigma.

1.3 Purpose and Research Questions

Large enterprises seemingly may have all the resources needed for a successful introduction of Six Sigma. Even though, it is stated that many organizations, independent of size, fail. It was previously stated that organizational culture has a positive correlation with the introduction of Six Sigma, which might indicate it has a greater impact than organizations are aware of. The purpose of this thesis is to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully. With introduction, it is intended to study the initiation of the Six Sigma method and not the complete implementation process.

To identify the difference between continued and discontinued organizations when introducing Six Sigma, the first research question is as follows:

[RQ1]: What factors differentiate companies that succeed with the introduction of Six Sigma from those that fail?

Further, it is identified a need for more research on the impact of organizational culture when introducing Six Sigma. Therefore, the second research question is as follows:

[RQ2]: How can organizational culture be used as a driver when introducing Six Sigma?

1.4 Delimitations

The thesis will not cover the whole implementation of Six Sigma, only the introduction of the method. Though, Six Sigma can have been introduced in other plants within the organization.

The results of this thesis are based on an investigation at three organizations and do not focus on specific departments.

1.5 Outline

The report is divided into the chapters Introduction, Theoretical Background, Methodology, Findings, Analysis, Discussion, and Conclusion.

Chapter 1 – Introduction: The chapter begins by explaining the background related to the chosen topic and is followed by a problem statement. Purpose and two research questions are presented, and the chapter furthermore ends with delimitations.

Chapter 2 – Theoretical background: Theories related to Six Sigma, Change Management, and Organizational culture are presented in this chapter in order to further understand the topic and be able to analyze the findings.

Chapter 3 – Methodology: The chapter explains and describes the methods chosen, and how the work has been carried out to achieve the purpose of the thesis.

Chapter 4 – Findings: The chapter presents the results of the collected data.

Chapter 5 – Analysis: In this chapter, the findings are analyzed based on the theoretical background.

Chapter 6 – Discussion: The chapter begins with a discussion of the choice of method. It is followed by two sub-chapters where each research question is answered.

Chapter 7 – Conclusion: The conclusions made from the thesis based on the purpose and research questions are presented in this chapter. The chapter ends with a discussion of the thesis' implications and suggestions for further research.

References and Appendices can be found at the end of the report.

2 Theoretical background

In this chapter, the Theoretical background is presented that has been used for the analysis.

2.1 Six Sigma

There are various quality initiatives focused on improvement and standardization activities over the years such as Total Quality Management (TQM), Lean, Six Sigma, and Kaizen (Gaikwad et al., 2020). One of the most prominent initiatives is Six Sigma (McLean et al., 2017) which is typically applied to reduce process variability (Hudnurkar et al., 2019). Montgomery (2005) furthermore stated that it might be the most successful improvement strategy of the last 5 decades. The Six Sigma method emerged after disappointments with the results managers received from using TQM. Managers were searching for new philosophies that would improve their processes and systems more drastically, in other words, called Reengineering (Drake et al., 2008). Reengineering is defined as the "fundamental rethinking and redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance" (Hammer & Champy, 1993, p. 32). Reengineering focuses on statistics and quantitative analyses, which adopt a similar approach to Six Sigma (Drake et al., 2008).

Six Sigma was developed by Motorola in the 1980s and has been used successfully by other companies since then (Buch & Tolentino, 2006). Motorola intended to secure a method to reduce manufacturing defects with quality improvement activities (Drake et al., 2008). Six Sigma aims to solve problems to reduce variation in a product- and manufacturing environment (Drake et al., 2008). Six Sigma methodology employs five phases in the problem-solving process, namely define, measure, analyze, improve, and control (DMAIC). Six Sigma was developed by Motorola and therefore has its origin in practice in the manufacturing industry, but today it is widely applied in various industries (Nonthaleerak & Hendry, 2008). Today, Six Sigma is used widely in small- and medium organizations because of the flexibility of Six Sigma methodology and in the variety of tools (Singh & Singh, 2020). Hudnurkar et al. (2019) argue that Six Sigma knowledge and expertise provide organizations a competitive advantage.

Although, it is important to note that not all implementations of Six Sigma have been successful. It was reported by McLean et al. (2017) that 60% of Six Sigma initiatives are abandoned or end in failure. Usually is Six Sigma success a short-term phenomenon due to an organization's failure to recognize factors that impact the methodology long-term (Drake et al., 2008). However, defining and using critical success factors supports the successful implementation of Six Sigma long-term (Singh & Singh, 2020). Implementing Six Sigma can be a successful investment with results such as improved quality, decreased costs, and increased efficiency levels (Del Angel & Froelich, 2008). Singh and Singh (2020) argues that critical success factors encourage organizations to consider different factors when implementing the Six Sigma methodology. To increase the success rate of Six Sigma implementations, critical factors must be identified and taken into consideration. Hudnurkar et al. (2019) similarly stated that Six Sigma knowledge and expertise play an important role during implementation. Many organizations have tried to implement Six Sigma without fully understanding the method and concepts, which most of the time lead to failures (Drake et al., 2008).

2.1.1 Drivers and barriers

One reason for unsatisfactory results is deficiencies in the implementation phase (Hudnurkar et al., 2019). The initial goal of Six Sigma is to increase customer satisfaction by reducing process variation (Hudnurkar et al., 2019). Therefore, having a strong customer focus is one of the most important critical success factors when implementing Six Sigma into the organization (Marzagão & Carvalho, 2016; Singh & Singh, 2020). After customer focus, the authors state that the second most important critical success factor is business strategy. The goal of an organization is to increase profit and by implementing Six Sigma, variations in processes will decrease. Top management commitment is moreover a critical success factor identified by many researchers and passing the responsibility from top management to the employees would result in a failed Six Sigma implementation (Ebot, 2020; Marzagão & Carvalho, 2016; Sajjad et al., 2020; Singh & Singh, 2020).

Due to the misusage of the Six Sigma tools, Six Sigma has received a bad reputation. However, Drake et al. (2008) argue that it is a flaw of the application, not the method itself. Successful Six Sigma implementation can also be affected by the availability of resources (Hudnurkar et al., 2019). Albliwi et al. (2015) moreover state that one of the barriers to deploying the method is the high cost of Six Sigma training. It is also argued by Singh and Singh (2020) that the success of Six Sigma implementation depends on the frequency of training provided for the employees.

Another barrier is the time it takes to both implement Six Sigma and before improvements become visible (Marzagão & Carvalho, 2016; Nonthaleerak & Hendry, 2008). The Six Sigma methodology consists of four different certifications representing different levels of Six Sigma skills and the type of roles an employee can work within, see Table 1. Six Sigma training requires relatively much time to finish whereas Green- and Black Belt take two and four months respectively. Each belt certification requires at least two completed Six Sigma projects, thus it often takes two to three years to complete the process. Moreover, if an organization trains multiple employees in the methodology it will take at least two years to realize the real benefits of Six Sigma (Nonthaleerak & Hendry, 2008).

Table 1

Structure of Six Sigma Certifications

White Belt	Understand structure and goals of Six Sigma. Use basic Six Sigma vocabulary terms.
Yellow Belt	Understand basic Six Sigma concepts. Participates on project teams and receives just-in-time training.
Green Belt	Starts and manage Six Sigma projects. Provides just-in-time training to others.
Black Belt	Has advanced Six Sigma expertise. Functions as a coach, mentor, teacher, and project leader for project teams.

Note. The table was adapted from What is a Six Sigma White Belt? By Six Sigma Development Solutions, Inc, (https://sixsigmadsi.com/what-is-a-six-sigma-white-belt/), Retrieved 2023-03-24.

Furthermore, Singh and Singh (2020) suggests that there is a need for employee involvement when implementing and working with Six Sigma. Organizations must identify employees that contributed to improvements and shall be recognized and rewarded accordingly. Nonthaleerak and Hendry (2008) also discusses barriers in the application of Six Sigma tools. The study shows that employees with engineering backgrounds are confident in applying Six Sigma tools compared to those with other educational backgrounds or work experience. Marzagão and Carvalho (2016) also adds the importance of having project leaders with the right competence. The success of the Six Sigma method and its projects tends to have a strong correlation to the behavior skills of the project leaders. Authors also mention that there is a need to add project management concepts when implementing Six Sigma (Marzagão & Carvalho, 2016; Singh & Singh, 2020). Project management concepts are defined as the balance between the project scope and its ability to finish on time. Six Sigma project typically takes around six months to a year to be completed, therefore the project scope and milestones should be defined clearly.

Other barriers to implementation include the change in organizational culture (Ebot, 2020). A successful implementation is only possible with support from the organization (Ebot, 2020). Most organizations focus on the Six Sigma tools but overlook the efforts required to manage change (Noori & Latifi, 2018). Lack of knowledge and resistance to change are commonly identified as the main causes of failures (Sreedharan V et al., 2020).

2.2 Change management

Organizations need to change quickly, to be competitive in the market (Miller & Proctor, 2016). Therefore, innovation and continuous improvement have become common in modern management. To implement changes successfully a strong context is important as Miller and Proctor (2016) list, among others. It helps people in the organization adapt to change, creates a focus for change programs, makes it easier to implement change initiatives, and exhibits alignment for change leadership. To create a context of change everyone involved needs to

understand and accept the mission, the imperative, and the vision, i.e., why the organization exists, why there is a need for a change, and what the change will achieve.

Nevertheless, studies show that the majority of change programs have a high failure rate (Alvesson & Sveningsson, 2016). It is stated that up to 60% of all Six Sigma initiatives fail to achieve the expected results (Del Angel & Froelich, 2008; McLean et al., 2017) and the same is assigned for change programs in general (Hayes, 2018). Miller and Proctor (2016) state that people are aware of organizational change but they do not support it. Alvesson and Sveningsson (2016) also argue that organizational changes may be extremely difficult and if they are not implemented in a structured way it may even worsen other processes within the organization since they are significant time- and resource-consuming. Moreover, it is more common than uncommon that changes are managed too late, contributing to the seemingly high failure rate (Hallin et al., 2021).

2.2.1 The change process

When a change does not progress as expected, it is common that the change manager blames the situation or other individuals involved (Vos & Rupert, 2018). Hayes (2018) states that those who are responsible for change need to set a direction and monitor the entire process. Accordingly, he states seven important core activities: recognizing the need for change, formulating what needs to be changed, planning how to intervene to achieve expected results, implementing plans and reviewing progress, sustaining the change, leading, and managing people issues, and learning. Leaders sometimes fail to recognize the need for change because they are not aware of the wider environment, such as the retirement of key staff or the development of new products, and even if they are aware they do not consider which implications it might bring. When the need for change is recognized, it needs to be translated into a desire for change, i.e., employees need to be motivated. The next activity is to diagnose what needs to be changed. Problems and opportunities need to be assessed, new perspectives need to be developed, and different alternatives need to be evaluated. Furthermore, the future state and what impact the change will have on the organization need to be identified. The planning stage involves how the goals of the change will be achieved. This is an important activity since poor decisions here might have implications later. Al-Haddad and Kotnour (2015) state that proper planning help organizations identify the gap between where they are today and where they want to be.

When the change and its corresponding activities have been planned, they need to be implemented as intended. In this stage, many organizations fail due to a lack of alignment between managers and employees (Hayes, 2018). The managers may see obvious benefits from the change but there is no benefit for the individual employee which can generate a lack of motivation and resistance to change. Change managers therefore need to support their employees and monitor the processes to not produce an opposite effect of what was intended. They also need to review the implemented processes to see if the change plan is working. When the change has been implemented it needs to be sustained. All too often changes are short-lived, but changes are not simply about reaching a new state. The change needs to be sustained and

the improved outcome should be the new norm. However, some factors might affect the sustainability of changes. Push strategies are more likely to generate issues, such as unmotivated employees, whereas pull strategies generate a higher level of commitment and changes are more likely to be sustained. Another factor is how the change manager acts when intended goals have been achieved. Just because the change has been successful it does not mean it has become the new norm. The change managers need to provide support even after the implementation and show the employees what benefits their efforts have generated. Change managers sometimes consider issues from a technical perspective but miss out on those regarding people issues such as trust, communication, motivation, and different goals and priorities. It is just as important to consider and manage those soft aspects as well and managers need to be aware of it both before and after implementation. However, Miller and Proctor (2016) argue that people's issues should not be predicted, but they need to be dealt with when they arise. The last activity according to Hayes (2018) is learning and he states that effective leaders are those who can learn from experiences, utilize them and adopt their behavior to successfully implement changes within an organization.

2.2.2 Change management perspectives

Change management can take four different perspectives which Hallin et al. (2021) describe as the perspective of the individual, the perspective of the change initiative, the strategic perspective, and the organizational perspective. The perspective of the individual means that changes that take place in organizations affect the behavior of single individuals. Al-Haddad and Kotnour (2015) state this as the personal dimension of change and argue that the deeper the organizational change, the more important it is for individuals' values to be aligned with the organization's values. To generate successful changes, it is crucial to be aware of how individuals will react and develop according to the change. Hallin et al. (2021) state that the ones responsible for the change need to understand this and accordingly support the individuals. Though, at a more comprehensive level the behavioral change of the individual is not as sufficient. From this perspective, the focus is on how the change is planned and implemented to be successful. Organizations need to consider the outcome of the change, which individuals are affected, what activities need to be done, and what support is needed. Further, it is rarely a single ongoing change process at a time, but several. Therefore, organizations need to consider the strategic perspective and adopt a strategic approach. Organizations may need to do correlation analyses to see how the different processes depend on each other. They also need to decide where in the organization the change management expertise is to be located. Lastly, Hallin et al. (2021) state that organizations need to consider the organizational perspective which refers to the ability to change. It is required an understanding of the organization such as its culture and values. This perspective focuses on leadership development, training in change management, and structured methods that will correspond to other management models within the organization.

2.2.3 Resistance to change

It does not matter how welcoming an organization is of new initiatives, there will always be some resistance to change from either employees, suppliers, distributors, stakeholders, or customers (Paton & McCalman, 2008). The main reason is that people are familiar with the known and fear the unknown. Rao (2015) states reasons such as employees not having the right competencies or qualifications, they fear that workload will increase, they will lose out financially, or that their status will be reduced. Furthermore, reasons such as a lack of commitment and motivation are stated in the literature (Hayes, 2018; Vos & Rupert, 2018). Vos and Rupert (2018) argue that organizational change can contribute to increased anxiety or existential fear among employees. However, Paton and McCalman (2008) argue that not all resistance to change needs to be negative. They argue that all changes may not serve the common good and if there is a shared resistance to change, the reason for it needs to be investigated.

2.3 Organizational culture

The awareness of organizational culture has been stated to be important to obtain success in change processes and to stay competitive in the market (Carlström & Ekman, 2012; Jovanoska et al., 2020). However, there is no single definition of what organizational culture actually is (Henrie, 2015; Miller & Proctor, 2016). Miller and Proctor, (2016) see this as surprising and state “If you can’t define it, managing it may be nearly impossible” (p. 145). Though, most definitions include some form of shared meaning, interpretations, values, and norms (Alvesson & Sveningsson, 2016).

Miller and Proctor (2016) state that culture is the center of everything, and argue that organizational culture can make or break organizations' efforts for new change management capabilities. Organizational culture can be very difficult to change whereupon McLean and Antony (2014) argue that the culture of an organization can contribute to the failure of a new initiative. Miller and Proctor (2016) state that the failure rate of new initiatives that require a cultural change can rise to over 80%. To manage change Paton and McCalman (2008) state some cultural attributes. First, there is *A clear and communicated strategic vision*, people need to know where they are going and why. The next one is *Visible senior management involvement*, to achieve sustainable change, top management needs to be involved in the process and the change must be connected from the top to the bottom within the organization. Organizations have it more difficult to find their competitive edge in the increasingly competitive market. According to the attribute *People based competitive edge*, organizations with empowered, autonomous, knowledgeable, and participating workforce are more likely to respond to changes. Furthermore, organizations need to build *Marketing ethos* and focus on the customer’s needs and develop a culture that suits them. A shared perception can be hard to achieve whereupon the attribute *Consensus driven management* focus is to communicate rather than to dictate. Though, creating consensus takes time and commitment. The last attribute stated by Paton and McCalman (2008) is *Awareness and reflection of social responsibility*. To manage cultural change organizations should include society as their stakeholders and reflect upon societal expectations.

2.3.1 Group culture

Employees interact more closely with their workgroups than the entire organization, whereupon individuals' attitudes and behaviors are more affected by the group culture rather than the organizational culture (Shin et al., 2016). Group culture is described as a group's ability to create and share knowledge (Colovic & Williams, 2020), and includes team members' participation, open discussion, empowerment, and commitment (Henri, 2006; Patyal & Koilakuntla, 2018). Previous studies also emphasize social cohesion when discussing group culture (Colovic & Williams, 2020; Henri, 2006; Shin et al., 2016). It is stated that social cohesion reduces the need for fixed monitoring which enables more time for value-added activities (Shin et al., 2016). Furthermore, it generates social benefits since it stimulates innovative capabilities and fosters synergies. Henri (2006) argues that social cohesion and teamwork foster the development, empowerment, and commitment of employees within an organization. Though, it is important to understand that group culture requires interaction between individuals, hence it is nothing we are born with (Henrie, 2015). Group culture will change if the environment changes. However, it is critical to be aware of the values and norms of a group to understand group processes and their outcomes (Shin et al., 2016).

3 Methodology

The methodology chapter shall describe the research design, data collection methods, and the data analysis process. This chapter also includes the reliability and validity of the study followed by ethical considerations.

3.1 Research Design

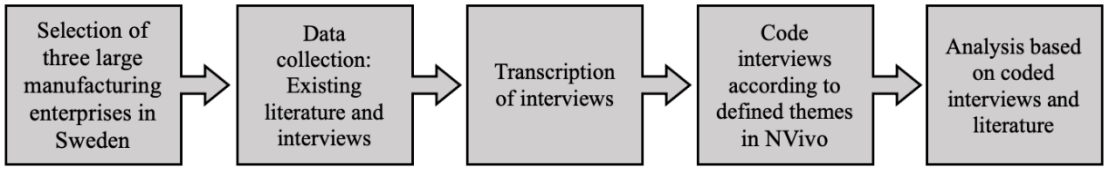
The purpose of this research is to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully. In order to fulfill this purpose the research was conducted as a holistic multiple-case study. Case studies are used when a phenomenon can be studied in its natural setting and when understanding is gained by observing actual practice (Karlsson, 2009). Furthermore, it allows the full understanding and complexity of the phenomenon by answering questions of why, what, and how, and it lends to an early investigation where variables are unknown, or the phenomenon is not at all understood. A holistic multiple-case study means that more than a single case has been investigated and there is one unit of analysis (Yin, 2014). In this research, three companies were investigated whereupon each company has been one unit of analysis. Multiple-case studies are advantageous since the evidence from those is often considered more compelling and the study is seen as more robust (Yin, 2014).

The approach of case studies is to deal with individual cases and get close to the subject of interest (Yin, 2015). Hence, this is qualitative research that is used when a limited number of cases have been selected according to specific criteria (Flick, 2020). Furthermore, the results of case studies are used for theoretical elaboration or analytic generalization (Yin, 2015). By studying the introduction of Six Sigma in large manufacturing enterprises in Sweden, it is possible to generalize the findings to any change initiative in the same context. Moreover, the study has taken a deductive approach due to its starting point in theory, with assumptions of a phenomenon (Säfsten et al., 2020). The data were analyzed to examine the assumptions and arrive at conclusions.

The research process is illustrated in Figure 1. The process began with a selection of three large manufacturing enterprises in Sweden. This was followed by data collection of both existing literature and performed interviews with the case companies. The interviews were transcribed. The data was then coded and analyzed using NVivo software.

Figure 1

Phases of the research process



3.2 Data Collection

There are numerous techniques for data collection, which were selected based on the type of research questions (Säfsten et al., 2020). Data is categorized as primary and secondary data. Primary data can be empirical results from the case, while secondary data can be documents (Flick, 2020). In this case study both primary and secondary data have been used.

When a multiple-case study aims to build on theory, the case selection should use a replication logic (Karlsson, 2009; Yin, 2014). Each case should either be selected to predict similar results or contrary results but for predictable reasons. In this case study, large manufacturing enterprises in Sweden were selected, i.e., manufacturing companies in Sweden with more than 500 employees. In the case selection for this study, contrary results were predicted. Two companies were selected with the authors' prediction to successfully have introduced Six Sigma and one company was selected with the authors' prediction to have failed to introduce Six Sigma. When there is a need to collect information from one or more individuals about a phenomenon, interviews are a suitable method (Säfsten et al., 2020). Therefore, qualitative data collection through interviews has been used. However, a study should include different techniques for collecting data, also called triangulation, to strengthen the validity (Karlsson, 2009). Studies show that case studies using multiple sources of evidence were rated more highly, in terms of quality, compared to those using only single sources (Yin, 2014). Yin (2014) exemplifies sources of evidence as personal experience and extensive field research.

3.2.1 Interviews

In social research, there are three ways to collect data (Flick, 2020). Either asking people through surveys and interviews, observing, or studying documents. Interviews were the most appropriate method to apply in a qualitative study (Flick, 2020). Moreover, interviews are one of the most important sources of evidence in case studies (Yin, 2014). An interview is a professional conversation with a defined purpose and follows a specific structure. Interviews can take different forms and semi-structured interviews were the most suitable for this thesis. Semi-structured interviews are frequently used in engineering science and are usually associated with interview guides (Säfsten et al., 2020). In the interview guide, several questions are prepared which will cover the intended scope of the interview (Flick, 2020). The aim is to initiate a dialogue between the interviewer and respondent to obtain individual views on an issue. The questions should be a variety of open questions and more focused questions to get an in-depth understanding of the problem (Flick, 2020). Säfsten et al. (2020) also mentions that the questions should be formulated carefully in order to prevent wrong interpretations and irrelevant responses. According to Yin (2014), interviews are insightful and provide further

explanations. On the other hand, it could be construed as biased due to poorly formulated questions or inaccuracies due to poor recall.

In this study, three in-depth interviews were performed, one at each company, where both authors were present. The interview questions were formulated based on existing literature about drivers and barriers to introducing Six Sigma, and cultural change. The full interview guide can be found in Appendix 1. The interview guide was the baseline, but the interviews turned out more as dialogues between the authors and the respondents where follow-up questions were asked when necessary. The details of the interviews are shown in Table 2.

Table 2

Structure of interviews

Company	Respondent	Role	Six Sigma Belt	Duration
1	1	Quality Engineer	Black Belt	66 min.
2	2	Site Manager	Black Belt	58 min.
3	3	Customer Quality Manager	Black Belt	69 min.
	4	Production System Manager	Green Belt	

At Company 3 there were two respondents since it was requested from their side, while there was one respondent at Company 1 and 2 respectively. The respondents were managers with a Six Sigma Black Belt, except for respondent 4 from Company 3 who had a Green Belt. All respondents were considered experts in the subject of Six Sigma. Before the interviews, the purpose of the study was communicated. However, no further explanation of the study was given to avoid influence. The interviews were performed in Swedish as everyone involved was a native Swedish speaker. The interview with Company 1 was performed on-site but due to lack of accessibility, the interviews with Company 2 and 3 were performed online, by using Microsoft Teams meetings. Every interview was recorded which made it possible for both authors to take an active part in the interview. The recordings were then used for transcription of the interviews.

3.3 Data Analysis

3.3.1 Transcription of interview data

Transcription is the step where notes written down during the interview and recordings are turned into data that can be analyzed (Flick, 2020). The recordings were transcribed by using the transcription tool in Microsoft Word. Flick (2020) emphasizes the importance of checking the transcripts for their completeness, or the completeness necessary to do the analysis and complete the study. The recordings were listened to thoroughly and errors in the transcription were corrected. The transcripts were then translated into English by the authors. The transcripts were then translated into English by the authors.

3.3.2 Qualitative content analysis

Analysis of qualitative data is defined as the classification and interpretation of material to form structures and statements (Säfsten et al., 2020). After data collection, the direction of the

analysis shall be defined (Flick, 2020). In this study, a thematic analysis was done to identify, analyze, and present emerging patterns (Säfsten et al., 2020). It is fundamental to categorize the contents and meanings into themes in the analysis of qualitative data.

Themes capture contents and patterns in the data that are essential in relation to the study. Themes were generated based on the factors identified in previous studies. To facilitate the analysis of qualitative data there are several computer software available, specifically designed for the purpose (Flick, 2020). Moreover, it is claimed that the use of computer software contributes to a thorough analysis of qualitative data (Bazeley, 2007). All the themes were based on the found factors from the literature and were created as codes in the NVivo program. The interviews were thereafter coded when there was a part that belonged to a specific factor.

3.4 Reliability and validity

The quality of a scientific study is assessed based on the quality criteria of reliability and validity (Säfsten et al., 2020). There are four different aspects to consider regarding the quality of case study research: internal validity, construct validity, external validity, and reliability (Yin, 2014). Internal validity can be strengthened by integrating participants into the research process (Flick, 2020). The respondents from the interviews reviewed and accepted the findings before it was used in the report. Construct validity is an indication of how well a measuring instrument measures what it is supposed to measure (Kumar, 2019). The interviews were semi-structured, and the questions were based on previous research in Six Sigma, change management, and organizational culture. This was done in order to establish a logical link between the theoretical background and the interviews, and to which extent questions represent the issue they are supposed to measure (Kumar, 2019). External validity is the ability to make the results of the study generalizable and whether they are valid for more people in other situations (Säfsten et al., 2020). Generalization is an apparent inability in case studies, but they can be generalizable to theoretical propositions (Yin, 2018). The scope of this study was large enterprises, therefore the results are applicable to other large enterprises to a certain extent. Reliability is the ability to repeat the study and receive the same results. The interview guide attached to this study ensures reliability to some extent.

3.5 Ethics

Research ethics concerns ethical demands in relation to the researcher, the focus of the research, and how it is carried out (Säfsten et al., 2020). It can furthermore be divided into internal and external research ethics and is crucial in the context of scientific studies. Internal research ethics concerns the art of conducting the research and external research ethics concerns the impact the study has on the rest of the world (Säfsten et al., 2020). Flick (2020) mentions non-maleficence, beneficence, autonomy or self-determination, and justice which means researchers should avoid any harm to people from participating in a study, human subjects should not be used for their own sake, participants' values and decisions should be respected and everyone participating in the study should be treated equally. To protect the respondents, anonymity was granted to the case companies. Anonymity has also been used to ensure confidentiality whereupon it is not possible to identify any individual or their workplace. Furthermore, every procedure in the

study such as the purpose and methods used has been transparent to the participants, which eliminates any harm (Flick, 2020).

4 Findings

In this chapter, the results from the interviews with the three case companies are presented. The expectations before the interviews were that Company 1 and Company 2 have successfully introduced Six Sigma while Company 3 has failed their Six Sigma introduction. The interview guide is attached as Appendix 1.

4.1 Interview with Company 1

Company 1 introduced Six Sigma after a discussion between two Black Belt employees where they considered it necessary to increase knowledge in the organization regarding change management and quality management. Respondent 1 explains that there is a need to always improve the organization in order to stay relevant in the market: *"Companies that do not work with continuous improvements will disappear; I truly believe in it."* The goal of introducing Six Sigma was to increase the level of improvement work in the organization and create a common language in the context. Company 1 has defined values in the organization however, Respondent 1 did not know them by heart but believes that both professionalism and customer focus are two of the values. In an additional document, the values were turning technology into opportunity, shaping great experiences, and "it starts with me, what can I do?". Respondent 1 furthermore states that the values are not incorporated enough in the organization.

Respondent 1 states that Company 1 is using other types of improvement methods except for Six Sigma but prefers not to put a label on them. Examples of improvement methods are Lean and TQM. Company 1 is using statistical tools and is collecting data when performing continuous improvement projects. The results of different improvement initiatives are evaluated differently depending on the project and its results. Although, there is always some kind of lessons learned performed in connection with the project. In the case of a Six Sigma project, Respondent 1 implies that evaluation is incorporated in the control phase. Respondent 1 believes that the organization has been successful due to its innovativeness and is in that sense inclined to changes to produce what customers demand. Moreover, when it comes to becoming successful regarding adeptness to changes in ways of working, Respondent 1 clearly points out: *"There is a need to improve company culture"*. Respondent 1 explains that Company 1 has its roots in the old way of managing the organization, making them less likely to be prone to change.

4.1.1 Six Sigma introduction

Company 1 has since the introduction of Six Sigma finished three rounds of Yellow Belt courses for the employees. It has also been courses in Six Sigma White Belt. All Yellow- and White Belt courses have been done internally. Some employees have done a Six Sigma Black Belt course, but these have been done at an external company. Respondent 1 was one of the employees that introduced the Six Sigma methodology and is carrying out the courses internally. The introduction of Six Sigma started by securing competence in the organization by educating employees to receive a Yellow Belt. It is included in the course to perform a Six Sigma project, which Respondent 1 considers crucial in order to master the tools and

methodology entirely: *"This is the challenge, but it is also the key to gaining that type of competence"*. It is furthermore not enough to only teach the Six Sigma method, there is also a need to practice it in a real Six Sigma project. The course extends over four days, and the Six Sigma project is executed after that. The employee receives a Yellow Belt after the finalization of the project and can from now on work as an improvement leader in the organization. Respondent 1 explains that all line managers must sign a contract allowing the employee to take the course and do the Six Sigma project during working hours. Due to the amount of time needed to receive a Yellow Belt, line managers have high expectations of the course. There are also expectations from top management regarding the courses, but there is a lack of knowledge regarding why Six Sigma is important and why there is a need to continue implementing it. Although, when educated Yellow Belts are presenting their Six Sigma project and its results to the top management, the response has been positive. The response from the educated employees has also been positive and there are still people asking when the next course is.

Respondent 1 also raises a concern regarding the available Six Sigma Black Belt courses that are being bought externally. The quality of the courses seems to vary depending on which institution the course takes place at. Due to this reason, Company 1 is trying to find a preferred supplier regarding Black Belt courses and in the long run, even do the courses in-house. The varying quality of courses for Yellow Belt has also been observed by Respondent 1. Only because a person takes a Yellow Belt course it does not mean that they should receive a belt, it should also be required to do a Six Sigma project and practice the different tools: *"The requirements to receive a Yellow Belt or Black Belt are tough."* When discussing the knowledge required to pass the Six Sigma courses Respondent 1 believes that all interested employees can take it, at least Six Sigma Yellow Belt. It is more important to find informal leaders in the organization that are interested in improvement work. But all employees taking the course should be aware of the statistical part that can be difficult for people who are new to the subject. Six Sigma methodology focuses on taking fact-based decisions and taking a Yellow Belt course can be a good start to developing knowledge within statistics and statistical tools. Furthermore, it is more important to find employees with the right personality, rather than employees already mastering statistics. The requirements regarding statistics are considerably higher during a Black Belt course, which is why Respondent 1 recommends employees start with a Yellow Belt.

Even though that Company 1 has done three rounds of Yellow Belt courses, there is currently no strategic plan on how to move forward with the initiative. Respondent 1 explains that there are not many leaders or managers who have taken the course and they are currently lacking knowledge of the method and why it is important to implement it: *"It is crucial to involve top management to succeed. Everything starts with the top management "*. Even if the implementation currently is on pause, Respondent 1 emphasizes that the methods and tools behind Six Sigma still are being used in the organization. But the absence of a strategic orientation on how to move forward is missing. There were no expectations from the organization when the introduction started. Company 1 previously used a continuous improvement team which contained a mix of Six Sigma-educated employees and employees

with a general interest in continuous improvement. Respondent 1 was a part of the team, and they met around 4 times a year to start new continuous improvement initiatives in the organization. The meetings have slipped by over the last few years and the team is currently inactive.

When answering the question if Company 1 sees Six Sigma as a "way of life" or something to work with short-term Respondent 1 explains that one of the hardest obstacles to master is the transformation from being solution-driven to becoming problem-driven. One of the cores of Six Sigma is to find the root cause of a problem and not rush to a solution in the beginning. Moreover, it is important to create time to solve the real problem. Respondent 1 believes that employees currently are being rewarded as long as improvement works are being done, regardless of if the solution works long-term. There is a need for a mind shift where top management stops to reward firefighting and give employees time to find the root cause and not rush into a solution. The lack of commitment from top management can according to Respondent 1 be because there currently are new members in the top management compared to when Six Sigma first was introduced. Moreover, the current top management was not approving the initiation and does probably not know why it was introduced in the first place. Respondent 1 does not want to start working on the implementation again without it being requested by the top management.

4.1.2 Organizational culture

Company 1 has its roots in the old way of managing the organization, making them less likely to be prone to change. It is moreover clear that Company 1 has an old-fashioned leadership style. Respondent 1 thinks that Company 1 is brave in the sense that they dare to invest in new products and new initiatives. Which on the other hand is crucial when being highly competitive. Respondent 1 believes that Company 1 is open to changes in the short term, due to the daily firefighting. But they still must work on being more transparent with problems in the organization and not see it as a defeat to have deviations. Respondent 1 got asked if top management does anything to inspire employees to initiate change and answered that it is different throughout the organization. One initiative took place in a specific part of the organization where the top management was setting specific targets two times a year for the employees to work against. The initiative was successful in the sense that it inspired the employees to consistently work with continuous improvement, but they were not operated as Six Sigma projects. Respondent 1 explains that the team spirit is relatively good in the different work groups but there is still a feeling of us and them in between work groups.

4.2 Interview with Company 2

Company 2 has a lot of global values but those were not known by heart by Respondent 2. In an additional document, the values could be identified as: customer at our core, innovating boldly, powered by inclusion, winning with agility, and unwavering integrity. The company works with continuous improvement and uses tools mainly from Lean and Six Sigma, but also other quality tools such as TPM (Total Productive Maintenance). Respondent 2 says they have

taken the tools *"...put them together in a toolbox and then you use the tools you think fit the best for the task you have"*.

When there is a large improvement, Company 2 measures the results in monetary terms and defines where the cost saving comes from. It can be improved yield, decreased rework, decreased scrap, or decreased design waste. Every improvement project is registered in an intended system to be able to show what has been done. This system is open for every site within the organization and the results are shared with each other. The purpose of this is to replicate the projects and take advantage of each other. Respondent 2 also states that they use PDCA (Plan, Do, Check, Act) for continuous improvement. They want to ensure the improvements have been permanent and that they do not go back to old processes. Respondent 2 means this is quite usual if they do not follow up on the results. A lot of the improvement work comes from deviations in the process and if they identify something wrong. If there is a deviation that can risk the safety of an employee, it will be prioritized before anything else.

In Company 2, they have worked with continuous improvements for at least 30 years, so the employees are used to change initiatives. Though there is some resistance to change, and Respondent 2 means it is understandable, *"it is someone's personal space we are inside and changing"*. Furthermore, Respondent 2 describes, for every change there is one group supporting it, one group that is neutral, and then there are some loudly speaking who are against the change. Respondent 2 believes it looks like this in most organizations but also believes Company 2 is more supportive to change compared to other companies. Change initiatives come from everyone within the company. Larger initiatives come from top management, but a lot of improvement ideas come from the employees in the production.

4.2.1 Six Sigma introduction

Six Sigma was introduced to Company 2 at the beginning of this millennium, and they have had internal Six Sigma courses for the last 10-15 years. The purpose of the introduction was to work systematically with improvements and be able to base decisions on facts. Respondent 2 states that they work with Lean and Six Sigma together where *"Lean is more by testing, test and dare, while Six Sigma is the opposite. Get the facts before moving on."*. When Six Sigma was introduced, Respondent 2 does not believe there were such expectations from either the top management or the employees since they did not know what it was. The employees thought it would create more work for them with all the tools they were supposed to use. Further, it led to continuous improvement got deteriorated since they over-used the tools. Respondent 2 describes this as the greatest obstacle in the implementation and refers to the tools as *"you wanted to use them for everything and then it was not suitable"*. Respondent 2 got the knowledge about why the tools are used when receiving the Black Belt but believes there was a lack of knowledge for the rest of the organization. To solve this problem Company 2 had coaching sessions during their weekly meetings. During those meetings, they discussed the projects, what tools they should use, and how they should move forward to succeed. Accordingly, coaching has been a crucial part, the managers follow up on projects and push to

move forward. They do not want projects to stop just because they do not know how to move forward.

Company 2 had an internal Six Sigma organization with Master Black Belts and Six Sigma coaches when it was introduced to the rest of the company. Hence, they had internal Six Sigma courses to educate the employees. Some of the top managers were educated in Black Belt and there were a lot of employees who were educated in Green Belt. However, Respondent 2 states that most of those employees have never done a Green Belt project. Respondent 2 believes it was more to get knowledge about Six Sigma as a method. In later days, Company 2 had higher requirements, those who took a Green Belt course needed to complete a project and get certified. Those who took the course are almost exclusively white-collar workers, though, blue-collar workers took part in the projects and got knowledge about the tools. Respondent 2 believes anyone can complete a Green Belt course and argues that it is to know the process. However, to understand the statistical part, more competence is needed. Company 2 uses statistical software to analyze, but those who use the program have higher education and academic background. Respondent 2 highlights this as an obstacle since the theoretical part, especially the statistics, can be hard if there is a lack of competence.

From the introduction, it took a couple of years until Six Sigma was up and running. Now the employees use many of the Six Sigma tools in their daily work life and the top management has seen financial benefits from it. Respondent 2 would say that Six Sigma is a "way of life" and state *"it has gone from something you do in projects, to tools you use in the daily operations"*. Since a month back, there has been a reorganization within Company 2, the previous Six Sigma organization will from now on be called continuous improvements. Company 2 has had ongoing Green Belt courses, but due to this reorganization, Respondent 2 is unsure what it will look like in the future. They have a continuous improvement leader, and Respondent 2 speculates if previous Six Sigma courses will be a part of this new concept. Furthermore, Respondent 2 believes there is a will to continue with Six Sigma. Respondent 2 also states that the employees feel pride to work for the company and contributing to continuous improvement. Respondent 2 neither sees any resistance from the employees to quit working with Six Sigma.

4.2.2 Organizational culture

Respondent 2 describes the organizational culture within Company 2 as open and states that the employees are proud of the products and have the will to be better. Company 2 prioritizes safety for the employees, and they ensure a safe working environment. Respondent 2 describes the company as relatively flat with good communication between the departments. They have a top management, line managers, and a production manager which is a part of the top management. However, Respondent 2 believes it is more hierarchical further up in the organization. Since it is a large enterprise there are a lot of levels and decisions are most often made top-down.

At the site where Respondent 2 works, they try to involve the employees as much as possible. Respondent 2 states *"We try to include the employees in improvements and let them impact"*. There will always be some contradictions among the employees, but Company 2 tries to make

decisions which is the best for the majority. They have representatives from every department in the production who take place in daily meetings and the line managers have daily meetings with their managers. In those meetings, they spend time discussing improvements. By involving the employees in the decisions, Respondent 2 believes everyone feels more motivated and inspired for change initiatives. Due to work ergonomics, Company 2 uses a rotation system in the production. This means an individual employee does not work at the same station for more than one hour. Accordingly, the employees work in different groups during the day and might work with several different groups during the week. Respondent 2 states this allows the employees to learn many different things, but at the same time, Respondent 2 believes this affects the team spirit. The employees do not feel fellowship in a single workgroup and Respondent 2 argues this might create insecurity among some. Furthermore, Respondent 2 states that the employees rather work for their own winning than for the company and argues that this is not unusual. Respondent 2 mentions expressions such as *"how does this affect me"* and *"what is in it for me"*, and states that the employees are ready to work for the company's best, but they do not want it to affect them negatively as individuals.

4.3 Interview with Company 3

Company 3 has defined values in their organization, but they are not known by heart by either Respondent 3 or Respondent 4. Respondent 3 mentions the feeling that nothing is impossible within the company and that they have a strong customer focus. Every action in the company is made with the customer in mind. Company 3 is using other quality tools except for the ones from Six Sigma, and they are taught in an internal quality course according to Respondent 4. An example of a quality tool used throughout the whole company is A3 problem-solving. Respondent 4 explains almost all problem-solving starts with doing an A3 and other quality tools linked to that can be found in the standardized A3 template. Respondent 4 adds that most of the employees have mixed up the word A3, the name of the tool, by doing a root cause analysis: *"I do not think you should focus on the tools, like A3, rather the reason why you do it"*. The results are being evaluated differently depending on the type of project and its result. Respondent 3 also adds that they use soft tools, for example, the 5 why's, as often as statistical tools are being used.

Respondent 4 thinks that appreciation and feedback are less common in everyday work. There is a saying in Company 3 that if nobody says something bad about a presented idea, then the idea is good. Respondent 4 states that Company 3 is relatively prone to change, but there are always some employees that are change resistant. Respondent 3 explains that the company is relatively adaptable when the employees are informed of why and how the change will affect them. It is moreover exemplified by a change in their weekly reports where the employees reacted well to the change due to that the top management was clear with why it was changing and what the future report would look like. The respondents both agree that change can be initiated by anyone in Company 3. Respondent 3 believes that small changes are having the greatest impact on the company, and they are more often initiated from the lower levels of the organization. It can although be improved, there is still a feeling that some of the employees are waiting for permission to create changes in the organization, Respondent 3 argues that *"it*

is impossible to wait for permission if nobody knows what you want to do". Respondent 3 got asked why it is like that and the answer is that employees probably are satisfied with all the changes happening around them all the time and it is therefore no need to initiate more changes personally. Another reason could be that top management does not have the time to encourage and give credit to all the initiatives due to the many changes that are in action all the time.

Company 3 is competitive in the market because of its competencies in relation to similar organizations. They have a strong customer focus, according to Respondent 3, and their products include both a physical product and the service around them. Company 3's product development is very close to their customers, and they are very determined to produce exactly what the customers are demanding.

4.3.1 Sig Sigma introduction

Both respondents have Six Sigma belts where Respondent 3 has a Green Belt and Respondent 4 has a Black Belt. The whole initiation started with Respondent 3 hiring an external company to teach Six Sigma in order to increase the knowledge of the various quality tools. Respondent 4 explains that the goal of the course was to give the organization a common language when discussing quality issues and increase the number of continuous improvement initiatives. All employees involved received a Green Belt after the course was done. The aim was not to develop a full-scale Six Sigma organization but rather to give employees the right conditions to perform their work in the best possible way. Respondent 3 also adds that the employees now would make decisions based on facts by using quality tools and not only base decisions on symptoms.

Respondent 4 explained that top management took the same course after the first one was done. The third round of courses was with the rest of the managers in Company 3. There are approximately 100 employees that took the course externally and when the demand increased from the rest of the organization, Company 3 decided to offer the course in-house. The in-house course contains a mix of quality tools from both Lean and Six Sigma. Respondent 3 described that the purpose of continuing with the course in-house with the rest of the organization was to increase product quality in the long run. There were no initial expectations regarding the courses, according to Respondent 4, but there is on the other hand a feeling that some employees avoid taking the course to not receive more work tasks. Respondent 4 continues with an example where Company 3 initiated a continuous improvement project to reduce the number of defects in their products. The aim was to reduce the defects by using the tools from the course. The project eventually came out to nothing when project members stopped coming to the meeting to avoid presenting their results. Respondent 4 believes that employees do not view the course as a tool to improve their working ability and competence, but rather as a burden that will increase their number of work tasks. Respondent 3 adds that the reason for this behavior is the limited time employees are given to understand and apply the different tools during the course.

The course can either be executed for two whole days or four half days. Company 3 is currently only doing half days because it is easier for employees to participate like that. The course is

mixed with both theories about the quality tools and exercises where the employees can practice their knowledge. The employees do not perform a Six Sigma project during the course, just practicing doing root cause analyses and risk analyses. There is currently no plan on when or how often the courses should be taught, but Company 3 starts a new course when there is a need for it. Respondent 4 explains that they received the highest rating when employees rated the finalized course, and the feedback has always been positive. Multiple roles have taken the course except for all managers, including quality leaders, improvement leaders, production leaders, and design engineers. Respondent 4 mentioned that production technicians and logistics technicians have decided not to take the course, due to their previous knowledge of quality tools. But the number of quality initiatives and use of quality tools are used the least of them, according to Respondent 4.

Some employees believe that the quality introduction has failed, but that is not the case according to Respondent 3. It is exemplified with that some employees declined the first invitation to the course and have not received a new invitation after that. Respondent 4 explains that there also are employees who have taken the course more than once. Not because of the content of the course, but to refresh the knowledge. Respondent 4 thinks that the quality tools are used too little in employees' everyday work to remember it: *"It has not become common knowledge because you do it once every year, then you never become good at it"*. When Six Sigma feels like a "way of life" in the organization, Respondent 4 believes that is when you really have succeeded with the introduction. Company 3 does not only use Six Sigma but mixes it with the Lean philosophy. Respondent 3 also adds that it can be hard to have the whole organization on the same page. Some people do not have the personality to learn statistical tools and understand how to use them properly, they have other qualities that are as important in manufacturing organizations.

Since the introduction of Six Sigma, Company 3 has seen financial improvements. Both the number of defective products and problems in production have been decreasing since the introduction. Respondent 4 does not see a reason for Company 3 to stop working with Six Sigma and its quality tools. Company 3 should rather increase its competence and work with it even more. Although, Respondent 4 does not think that working with Six Sigma full scale with its own department is the right way for the company: *"We are not there right now, but I would like to see that every department has one or more Green Belts in the future that uses Six Sigma quality tools regularly"*.

4.3.2 Organizational culture

Respondent 4 states that the culture is open at Company 3. It is exemplified by that all employees greet each other; no matter if it is the CEO or an operator. There is a feeling that all employees' voice matters. Company 3 has grown at a high speed in the past years and Respondent 4 believes that is the reason why continuous improvement has been forgotten sometimes. The focus has been to deliver enough products to the customers. Respondent 4 adds that Company 3 needs to learn to live with it and that it is not an excuse. There is a push from top management to become more effective, but there is no time to do continuous improvement

work when there are too many problems to solve short term. Respondent 4 adds that some production lines have focused more on continuous improvement compared to others and there is a clear difference that those lines are working more efficiently.

Respondent 4 believes that Company 3 is relatively hierarchically, due to the quick expansion. There are many leaders in the organization and many steps hierarchically, but Respondent 4 does not think that the organization is top-managed. Managers are demanding change initiatives from the organization, and it is shown in multiple ways. One way is with the daily control meetings where all continuous improvement work is presented. Respondent 4 underlines that *"it is not the big changes that make the greatest difference, rather the small ones added together"* and explains that Company 3 is very good at presenting and demanding smaller initiatives.

Respondent 4 believes there are always some employees that are resistant to change in an organization. It is important to find employees that are positive about the change initiative and let them lead the group to accept the change. The team spirit is relatively good at Company 3 and Respondent 4 states that it is even stronger within the different work groups. Company 3 could improve their team spirit in the organization, where it is not as strong as within work groups. Respondent 4 gives an example of their own work group where the team spirit is very strong, but it is not as strong between them and the closest group in the same department. Respondent 4 believes it is because the two groups have two different managers which makes the groups work in different directions. It is also shown in-between different work groups at Research & Development where different groups make similar design changes, but they have not worked together to create a common design and reduce costs. Respondent 4 argues that the team spirit is strong within each team but not between teams.

5 Analysis

The expected results when the three case companies were selected were that Company 1 and Company 2 had successfully introduced Six Sigma while Company 3 had failed their introduction. However, based on the results in Findings it is only Company 2 that has continued with Six Sigma while Company 1 and Company 3 have discontinued the initiative. Hence, it can be argued that Company 2 has successfully introduced Six Sigma while Company 1 and Company 3 have failed the Six Sigma introduction. The Findings are therefore analyzed to understand what Company 2 has done differently compared to the other case companies.

5.1 Six Sigma introduction

To understand what Company 2 has done differently compared to the other case companies, success and failure factors from the literature were first identified. The identified factors have been based on the topics of Six Sigma, Change Management, and Organizational Culture, which are explained in the Theoretical background. Since the same factor can be either a success factor or a failure factor for different companies, all identified factors were compiled into one list which can be seen in Table 3. The next step was to identify which of those factors are valid for the Six Sigma introduction. Reward system, Skilled project leaders, Manageable scope, and Follow-up after implementation was argued to not be valid for Six Sigma introduction since those are part of the implementation process and are valid after a Six Sigma implementation. Awareness and reflection of social responsibility were neither argued to be valid for Six Sigma introduction since Six Sigma is a tool to improve internal processes within an organization and does not directly affect external parts such as social responsibility. Factors that were argued to not be valid during the Six Sigma introduction are marked with ”/” in Table 3. The rest of the identified factors were argued to be valid for the Six Sigma introduction and is therefore marked with an “X” in Table 3.

Table 3

Success and failure factors for Six Sigma introduction

Identified Factors	**Valid for Six Sigma introduction**
Customer focus	X
Top management commitment	X
Business strategy	X
Education	X
Employee involvement	X
Reward system	/
Skilled project leaders	/
Manageable scope	/
Organizational support	X
Group culture	X
Usage of tools	X
Capacity	X
Implementation time	X
Competence	X
Organizational culture	X
Communication	X
Alignment between managers and employees	X
Follow-up after implementation	/
Motivation	X
Impact on employee	X
Strategic plan	X
Awareness and reflection of social responsibility	/

Table 4 shows every factor valid for Six Sigma introduction and if the identified factors were evaluated as a success factor or a failure factor for the case companies. The factors marked with "/" has neither been a success factor nor a failure factor for the case companies or were not mentioned by the respondents. 9 success factors and 6 failure factors were identified for Company 1, 10 success factors and 5 failure factors were identified for Company 2, and 6 success factors and 9 failure factors were identified for Company 3. The following text in this subchapter is an analysis of why the case companies either failed or succeeded with identified factors in relation to the literature.

Table 4

Success or failure factors for the case companies

	Success factor (S) or Failure factor (F)		
Identified Factors	**Company 1**	**Company 2**	**Company 3**
Customer focus	S	S	S
Top management commitment	F	S	S
Business strategy	S	S	S
Education	S	S	S
Employee involvement	S	S	S
Organizational support	S	S	F
Group culture	F	F	F
Usage of tools	S	F	F
Capacity	/	/	/
Implementation time	F	/	/
Competence	S	F	F
Organizational culture	F	S	F
Communication	F	S	F
Alignment between managers and employees	S	S	S
Motivation	S	F	F
Impact on employee	/	F	F
Strategic plan	F	S	F

The initial goal of Six Sigma is to increase customer satisfaction by reducing process variation (Hudnurkar et al., 2019). Therefore, linking Six Sigma to the customer and having a **customer focus** is one of the most important critical success factors when implementing the method into the organization (Marzagão & Carvalho, 2016; Singh & Singh, 2020). Company 1 has been successful because of its ability to produce what customer wants, according to Respondent 1. One of Company 2's values are "customer at our core" which also shows a strong customer focus. Respondent 3 at Company 3 describes that there is a strong customer focus and that every action in the company is made with the customer in mind. It is also added that Company 3 is very determined to produce exactly what the customers are demanding. Due to these statements, it can be argued that all three companies have succeeded in having a strong customer focus.

Top management commitment is another important critical success factor when introducing Six Sigma, and passing the responsibility from top management to the employees would result in a failed introduction (Ebot, 2020; Marzagão & Carvalho, 2016; Sajjad et al., 2020; Singh & Singh, 2020). The initiation of Six Sigma in Company 1 did not come from the top management and there were no expectations from their side. Respondent 1 believed it was because the top management lack knowledge regarding why Six Sigma is important and added that *"it is crucial*

to involve top management to succeed. Everything starts with the top management ". Not many leaders have taken the course at Company 1 which can be a reason why they do not understand the importance of the method. That is validated by Hayes (2018) who describes that leaders sometimes fail to recognize the need for change because they are not aware of the wider environment. It is moreover necessary to involve top management in the process to achieve sustainable change and there must be a connection from the top to the bottom in the organization (Paton & McCalman, 2008). Although, Respondent 1 explains that top management is committed to continuous improvements in general due to its initiative in setting specific targets two times a year for employees to work against. Company 2 educated some top managers to receive a Black Belt during the Six Sigma introduction, but they did not have any expectations according to Respondent 2. Company 2 is described to have a flat organization with good communication both horizontal and vertical in the organization. Company 3 shares the same story where top management also took the Six Sigma course at the beginning of the introduction. Respondents 3 and 4 also explain that managers are demanding change initiatives from the organization by for example demanding them during the daily control meetings. It can be concluded that top management is committed in general regarding continuous improvements in Company 1, but not in the Six Sigma introduction, which is why top management commitment is a failure factor. Company 2 and Company 3 have on the other hand had top management involved in the Six Sigma introduction and are therefore a success factor for both.

Another important critical success factor is **business strategy** (Marzagão & Carvalho, 2016; Singh & Singh, 2020). The goal of an organization is to earn money and by applying Six Sigma, the profit should increase, and variations decrease. The goal of implementing Six Sigma was to increase the level of improvement work and create a common language in Company 1. Company 2 had the same goal where the goal was to give the organization a common language when discussing quality issues and increase the number of continuous improvement initiatives. The goal was similar for Company 3 as well where the initiative would make the organization work systematically with continuous improvement and base decisions on facts. It can therefore be argued that business strategy was a success factor for all case companies.

Singh and Singh (2020) state that the success of the Six Sigma introduction depends on the frequency of **education** provided for the employees. A successful initiative can also be affected by the number of available resources (Hudnurkar et al., 2019). Company 1 has since the introduction of Six Sigma finished three rounds of Yellow Belt courses and some White Belt courses. Some employees have done a Black Belt course at an external company. Company 2 has done internal Six Sigma courses for the last 10-15 years to educate the employees. Some of the top managers were educated in Black Belt and a lot of employees were educated in Green Belt. Company 3 started the introduction by hiring an external company to teach Six Sigma, where all the educated employees received a Green Belt. Company 3 started to offer the course in-house when the demand for it increased and some employees have taken the course more than once. It can therefore be argued that all the case companies have succeeded with Six Sigma education.

When implementing and working with Six Sigma there is a need for **employee involvement** (Singh & Singh, 2020). All the companies have involved the employees in the introduction of Six Sigma by educating them to receive a Six Sigma belt and be able to be a part of the initiative. All companies are therefore argued to have been successful with employee involvement when introducing Six Sigma.

A successful implementation can only be achieved with the right **organizational support** (Ebot, 2020). Company 1 has had support from the organization regarding Six Sigma implementation since the response from educated employees has been positive and there are still people asking when the next course is. Most organizations focus on Six Sigma tools when introducing the method (Noori & Latifi, 2018) but miss out on the lack of knowledge and change resistance, which are the main causes of failure (Sreedharan V et al., 2020). The demand for executing new courses shows that the organization supports the introduction of Six Sigma and wants to be a part of it. Company 2 is more supportive to change compared to other companies according to Respondent 2. Some employees in Company 2 had a hard time understanding when to use each Six Sigma tool at the beginning which was solved with coaching when needed. The action of coaching shows that the organization supported the employees to fully understand the tools and eventually increase their knowledge. Company 3 has had positive responses from employees taking the course, but there is still some resistance from parts of the organizations where some roles for example, production technicians and logistics technicians, have decided to take the course due to previous knowledge. But the number of quality initiatives and use of quality tools are used the least of them even though they should use them the most, according to Respondent 4. This results in organizational support being a failure factor for Company 3 and a success factor for Company 1 and Company 2.

Employees interact more closely with their respective workgroups than the entire organization, which leads to individuals' attitudes and behaviors being more affected by an emphasized **group culture** rather than the organizational culture (Shin et al., 2016). Group culture is described as a group's ability to create and share knowledge (Colovic & Williams, 2020). Company 1 has relatively good team spirit in the organization, but Respondent 1 explains that there still is a feeling of "us" and "them" in between the workgroups. There is also a need in Company 1 to work on being more transparent with problems in the organization. Company 2 rotates the working roles in the production which can decrease the level of group culture. Respondent 2 also states that employees rather work for their own winning than for the company and argues that this is not unusual in other companies as well. Employees are moreover ready to work for the company's best, but they do not want it to affect them negatively as individuals. The team spirit is relatively good within workgroups in Company 3, but not as strong across workgroups in the same departments. Respondent 4 gives an example at the department of Research & Development where different groups make similar design changes, but they have not shared knowledge between the workgroups to create a common design and reduce costs. Examples from the case companies above show that emphasizing group culture is a failure factor for Company 1, Company 2, and Company 3.

Six Sigma has received a bad reputation among some people due to the misusage of the method. This should although not be blamed on the method but rather on the organization's application of it (Drake et al., 2008). Nonthaleerak and Hendry (2008) highlight the potential barrier to **using Six Sigma tools.** The confidence in using Six Sigma tools depends on the user's background and their study showed that people having an engineering background had no difficulty in using Six Sigma tools, in contrast with those of a different background who lack mathematical skills. It is included in Company 1's course to perform a Six Sigma project, which the interviewee believes is crucial to master the tools and methodology completely: *"This is the challenge, but it is also the key to gaining that type of competence".* The interviewee thinks that all employees can take the course regardless of their background and skills, as long as they are interested. But all employees taking the course should be aware of the statistical part that can be hard for people who are new to the subject. The interviewee explains that there have not been any difficulties to use the Six Sigma tools after the course which can be because of Company 1's ability to apply the Six Sigma method correctly and they are therefore considered to have succeeded with the factor. Company 2 had problems in correctly using the Six Sigma tools. The continuous improvement initiatives got deteriorated since they overused the tools: *"You wanted to use them for everything and then it was not suitable".* Employees thought it would create more work for them with all the tools they were supposed to use, which is why Company 2 is considered to have failed with the factor. The interviewee got the knowledge about why the tools are used when receiving the Black Belt but believes there was a lack of knowledge for the rest of the organization. Company 2 solved this difficulty by having coaching sessions during their weekly meetings. During the meetings, they discussed the projects, what tools they should use, and how they should move forward to succeed. Coaching was a crucial part where the managers followed up on the projects and pushed them forward. The managers did not want projects to stop just because the employees did not know how to move forward. The interviewee also mentioned that most of the employees executing the course did not have to do a Green Belt project, which can be the reason why they were not educated enough to use the Six Sigma tools properly. A Six Sigma project was not included in the course at Company 3 either. The interviewees described a situation where project members stopped to come to project meetings to avoid presenting their results, where the reason could be that the employees did not understand how to use the tools to reach the expected results in the project. Respondent 4 believes that the employees need to practice the tools more in the course in order to understand them fully. Due to that Company 3 had problems using the tools correctly, they are considered to have failed the factor.

Successful Six Sigma implementation can be affected by the number of resources available (Hudnurkar et al., 2019), in other words, the company's **capacity**. None of the companies discussed the factor of having enough capacity while introducing Six Sigma. One of the reasons for this can be that all case companies are large enterprises and Six Sigma is more easily implemented in these companies due to financial and manpower resources (Ben Romdhane et al., 2017).

Another obstacle when introducing Six Sigma is the relatively long **implementation time**, both to introducing the method and before results become visible (Marzagão & Carvalho, 2016; Nonthaleerak & Hendry, 2008). Six Sigma training takes relatively much time to finish whereas Green- and Black Belt take two and four months respectively. Each belt certification requires at least two completed Six Sigma projects, thus it often takes two to three years to complete the process. Moreover, if an organization trains multiple employees in the methodology it will take at least two years to realize the real benefits of Six Sigma (Nonthaleerak & Hendry, 2008). This problem was shown in Company 1 where Respondent 1 believed that the lack of top management commitment was due to the long implementation time. The members of the top management are not the same as when Six Sigma was introduced in the first place, which can be the reason why top management is not as committed today. They were not the ones approving the initiative and do probably not understand why it was initiated in the first place. Implementation time was mentioned neither as a failure- nor a success factor for Company 2 or Company 3. It was although validated by Company 2 that it took a couple of years before Six Sigma was up and running in the organization.

There is also a risk that organizations need to deal with a lack of **competence** during the Six Sigma introduction. The confidence in using Six Sigma tools can depend on the user's background, according to Nonthaleerak and Hendry (2008). Their study showed that employees who had an engineering background had no difficulty in using the Six Sigma tools in contrast with people who had different backgrounds and lack mathematical skills. This was discussed with Company 1 where Respondent 1 believed that anyone could complete their Yellow Belt course, no matter the employee's background. But all employees should be aware of the statistical part which can be difficult for people who are new to the subject, but it is more important to find employees with the right personality rather than employees already mastering statistics. Respondent 1 also adds that receiving a Yellow Belt can be a good start to developing skills within statistics and statistical tools. Company 1 has tried to find a "preferred supplier" regarding Black Belt courses externally and the Respondent 1 raised a concern about varying quality levels for both Black- and Yellow Belt courses externally. Only because a person takes a Yellow Belt course, it does not mean that they should receive a belt, it should also be required to do a Six Sigma project and practice the different tools. This is also validated by Nonthaleerak and Hendry (2008) who state that each belt certification requires at least two Six Sigma projects. Company 1 did not mention any problems regarding competence using Six Sigma tools and is requiring one Six Sigma project when employees are taking the Yellow Belt course, which is why competence is argued to be a success factor. Company 2 had some problems at the beginning of the introduction where employees thought it would create more work for them with all the Six Sigma tools they were supposed to use. The employees taking a Green Belt course at that time were not required to do a Six Sigma project, which can be the reason why they did not understand the purpose of the tools completely. Company 3 shared the feeling that employees thought that taking the course would create more work for them in the long run. They did not view that course as a tool to improve their working ability and competence, but rather as a burden that would increase their number of work tasks. Respondent 4 adds that the reason for this is the limited time employees are given to understand and apply the different

tools during the course, due to that they for example did not perform a Six Sigma project. The quality tools are also used too little in employees' everyday work to remember it, where Respondent 2 says: *"It has not become common knowledge because you do it once every year, then you never become good at it"*. This can also be the reason why some employees have taken the course more than once. Due to the lack of understanding of the tools and the purpose of using them, both Company 2 and Company 3 are considered to have failed in this factor.

The awareness of **organizational culture** has been stated to be important to obtain success in change processes (Carlström & Ekman, 2012; Jovanoska et al., 2020) where most definitions include some form of shared meaning, interpretations, values, and norms (Alvesson & Sveningsson, 2016). Still, none of the respondents in the three case companies did know their organizational values by heart. However, Respondent 1 in Company 1 believed that professionalism and customer focus are two of their values. This corresponds well with Six Sigma since it is a quality tool used to achieve customer satisfaction (Hudnurkar et al., 2019). Though, as Respondent 1 stated, the values need to be more incorporated within the organization. Organizational culture can be very difficult to change whereupon the culture can contribute to failure when implementing a new change initiative (McLean & Antony, 2014; Miller & Proctor, 2016). Company 1 has its roots in the old way of managing which makes them less likely to be prone to change and Respondent 1 pointed out *"There is a need to improve company culture"*. Company 1 uses other improvement methods such as Lean and TQM which prove they are used to work with continuous improvement. Though, they have some issues when introducing new change initiatives. Respondent 1 explained that the hardest obstacle is the transformation from being solution-driven to becoming problem-driven. Furthermore, Respondent 1 explained that the top management needs to shift its mindset and stop rewarding firefighting. It can be argued that Company 1 misses out on some cultural attributes which are crucial to managing change. Paton and McCalman (2008) state that top management needs to be involved in the process and that change must be connected from the top to the bottom within the organization, which has not been the case for Company 1. Neither have they had consensus-driven management since the top management has not been involved in the Six Sigma introduction. Lastly, the group culture within Company 1 can be improved. Group culture includes team members' participation, open discussion, empowerment, and communication whereas Respondent 1 states that Company 1 needs to be more transparent with organizational problems. Hence, organizational culture was evaluated as a failure factor during the Six Sigma introduction. Company 2's global values could be identified as a customer at our core, innovating boldly, powered by inclusion, winning with agility, and unwavering integrity. This corresponds to how Respondent 2 in Company 2 described the organizational culture but also how the employees reacted when Six Sigma was introduced. Company 2 has worked with change initiatives for at least 30 years, so the employees are used to change initiatives. Paton and McCalman (2008) describe People based competitive edge as a cultural attribute to manage change successfully which means organizations with empowered, autonomous, knowledgeable, and participating workforce are more likely to respond to changes. Changes initiatives come from everyone within Company 2 which indicate the employees are participating. Larger change initiatives come from top management and they have been supporting the Six Sigma

introduction which means Company 2 corresponds to the cultural attributes of Visible senior management involvement and Consensus driven management (Paton & McCalman, 2008). Furthermore, the employees in Company 2 register every improvement project in an intended system with the purpose to share knowledge and to be able to replicate projects. Hence, Company 2 has a group culture with the ability to create and share knowledge (Colovic & Williams, 2020). The employees feel the pride to work for the company and contribute to continuous improvement whereupon it can be argued that organizational culture has been a success factor for Company 2 in the Six Sigma introduction. As stated, the respondents in Company 3 did not know their values by heart. However, they had the feeling that nothing is impossible, and they have a strong customer focus. Company 3 uses different quality tools, but Respondent 4 believed the employees sometimes mix the tools up and do not know what they are doing. Successful group culture involves open discussion (Henri, 2006; Patyal & Koilakuntla, 2018) and it can be argued if Company 3 is lacking in this aspect. Respondent 3 in Company 3 stated that feedback is less common in the company and there is a saying that if nobody says anything about an idea, the idea is good. Group culture requires interaction between individuals (Henrie, 2015), and based on the previous statement, Company 3 can improve this part. Respondent 3 believes it looks like this because the employees are satisfied with the changes or that the top management does not have the time to encourage new change initiatives. Respondent 4 still describes the organizational culture as open within Company 3 and that every employee's voice matter. Since this is perceived as contradictory to what has earlier been described the organizational culture is seen as a failure factor for Company 3.

Top management commitment has previously been stated as one of the most critical success factors in business strategy (Marzagão & Carvalho, 2016; Singh & Singh, 2020), where **communication** takes a crucial part. There are not many leaders or managers in Company 1 who have taken the Six Sigma course which causes a lack of knowledge about the method and why it is important. Respondent 1 in Company 1 stated, *"It is crucial to involve top management to succeed. Everything starts with the top management"*. Further, it is confirmed in the literature that passing responsibility from top management to the employees results in a failed Six Sigma implementation (Ebot, 2020). To create a successful change initiative everyone involved needs to understand and accept there is a need for change and what the change will achieve (Miller & Proctor, 2016). In Company 1 there has not been an alignment between top management and employees which Hayes (2018) states is one cause of failure. According to Respondent 2 in Company 2, they have good communication between departments where the top management has supported the Six Sigma initiative. This indicates they have consensus-driven management where the focus is to communicate rather than to dictate (Paton & McCalman, 2008). In Company 3 multiple roles have taken the Six Sigma course, top managers included, which implies the knowledge of the initiative has been throughout the organization. Nevertheless, many employees in Company 3 believe they have failed the Six Sigma introduction which does not correspond to the respondents' perception. Respondent 4 exemplified that some employees declined the first invitation to the Six Sigma course and have not received a new one after that. When a change initiative has been planned it needs to be implemented as intended (Hayes, 2018). It can be argued that the managers had a clear vision of the Six Sigma introduction but

it was not communicated to the rest of the employees which Hayes (2018) describes as a lack of alignment between management and employees. It can be concluded that communication has been a success factor for Company 2 while it has been a failure factor for Company 1 and Company 3.

When a change initiative has been planned it needs to be implemented as intended. Many organizations fail to achieve this part due to a lack of **alignment between managers and employees** (Hayes, 2018). In Company 1, the managers need to sign a contract allowing the employee to take the course and the Six Sigma project during working hours. It is therefore an alignment where both parties have agreed on giving the employee time to receive the Green Belt without feeling obligated to do it after ordinary working hours. Company 2 also shows a succeeding example where they try to involve the employees as much as possible. They have representatives from every department in the production who take place in the daily meetings and the line managers have daily meetings with their managers. In Company 3, alignment is shown that employees are ready for change if they are informed of why and how the change will affect them from the top management. This was exemplified by a change in their weekly reports where the employees reacted well to the change due to that top management was clear with why it was changing and what the future report would look like.

When Six Sigma was introduced in Company 1 the response was positive and there are still people asking when the next course is. However, it is common that only the managers see the benefits of a change initiative such as Six Sigma but not the individual employees which can lead to a lack of **motivation** (Hayes, 2018). This has never been the case for Company 1 whereupon this factor has been evaluated as a success factor. Though, a lack of commitment and motivation are common in change initiatives (Hayes, 2018; Vos & Rupert, 2018). Company 2 experienced a lack of motivation from the employees when introducing Six Sigma since they thought it would create more work for them with all tools they were supposed to use. Company 2 solved this problem with coaching sessions where they educated the employees on how they should advantageously use the tools. Thereafter, the managers supported the employees and helped them to move forward. Company 3 has also experienced a lack of motivation from their employees because they believed Six Sigma would create an increased workload for them. This resulted in some projects coming out to nothing because employees stopped showing up at meetings. Both Company 2 and Company 3 had a lack of motivation as a failure factor when Six Sigma was introduced. The difference is that Company 2 overmastered this while Company 3 did not.

Managers often consider issues from a technical perspective during change initiatives but miss out on people issues such as trust, communication, motivation, and different goals and priorities (Hayes, 2018). It is crucial to be aware of the **impact on employees**, and how they will react and develop according to the change (Al-Haddad & Kotnour, 2015). Company 1 mentioned they have their roots in the old way of managing which makes them less likely to be prone to change. However, Respondent 1 in Company 1 did not see either resistance or motivation for their Six Sigma introduction. Therefore, the factor Impact on employees has neither been evaluated as a success factor nor a failure factor in Table 5. Company 2 has worked with

continuous improvement for at least 30 years and the employees are used to changes. However, Company 2 believes there will always be some resistance to change and described there is always one group supporting it, one group that is neutral, and one group that is against the change. The literature confirms there will always be some resistance to change since people are familiar with the known and fear the unknown (Paton & McCalman, 2008). Company 2 has considered people's issues and understands that problems can occur which is emphasized by the statement *"It is someone's personal space we are inside and changing"*. Miller and Proctor (2016) argue that people´s issues should not be predicted but dealt with when they arise, which Company 2 did. The employees feared that Six Sigma would create more work for them, which Rao (2015) states are one common reason for resistance to change. As well as Company 2 solved the lack of motivation through coaching sessions, those sessions made the employees no longer feel fear of the change. Thus, the Impact on employees was a failure factor for Company 2 when Six Sigma was introduced but they managed to overmaster it. Company 3 confirms there will always be some resistance to change but believes they are relatively prone to change. Respondent 3 from Company 3 stated that employees are adaptable when they get informed of how the change will affect them. Contradictory, Company 3 stated that many employees did not see the Six Sigma introduction as a way of improving their work, but rather as a burden that would increase their workload. Moreover, they have a feeling that some employees avoid taking the courses due to the same reason. Company 3 has not done anything to overmaster this failure factor.

Six Sigma is a change initiative and to manage change there is a need for a clear and communicated **strategic plan** (Paton & McCalman, 2008). Company 1 introduced Six Sigma since there was a need to increase the knowledge regarding change management and quality management within the organization. Their goal was to increase the level of improvement work and they started by securing competence among the employees. However, there was no strategic plan for how to move forward with the introduction. Hayes (2018) states that the planning stage is important since poor decisions there might have implications later, which has been the case for Company 1. There were no expectations from the organization when the introduction started and the team for continuous improvement is currently inactive. According to Al-Haddad and Kotnour (2015), proper planning helps organizations identify the gap between where they are today and where they want to be. Company 2 indicates to have managed this successfully. Their purpose with the Six Sigma introduction was to work systematically with improvements and to be able to base decisions on facts. The introduction has developed into an organization of continuous improvement where there is a will to be more effective and grow as a company. Company 3 had similar goals as the other companies with their introduction of Six Sigma. They wanted to increase their knowledge of various quality tools and give the organization a common language when discussing quality issues. However, Paton and McCalman (2008) argue that people need to know where they are going and why. It can be discussed how this was communicated in Company 3 since the aim of the Six Sigma introduction was never to use Six Sigma at full scale. Their aim with the Six Sigma courses was to give the employees the right conditions to be able to make decisions based on facts by using quality tools. Nevertheless, Company 3 has no plan for how often the courses should be taught, which indicates they might

not have considered the strategic perspective (Hallin et al., 2021). Furthermore, the statement *"We are not there right now, but I would like to see that every department has one or more Green Belts in the future that uses Six Sigma quality tools regularly"* indicates that a strategic plan has been missing. Accordingly, the factor Strategic plan has been a success factor for Company 2, while it has been a failure factor for Company 1 and Company 3.

5.2 Organizational culture

It is stated by Knapp (2015) that organizational culture has a positive correlation with the introduction of Six Sigma and it is furthermore argued by McLean and Anthony (2014) that the culture of an organization can contribute to the failure of a new initiative. Organizational culture was previously stated to be a failure factor for both Company 1 and Company 3, while it was a success factor for Company 2. However, it was not validated if any of the case companies needed to change their organizational culture or not due to the Six Sigma introduction. Nevertheless, to obtain success in change processes the awareness of organizational culture has been stated to be important (Carlström & Ekman, 2012; Jovanoska et al., 2020). The failure rate of new initiatives that require a cultural change can rise to over 80% (Miller & Proctor, 2016), whereupon it needs to be considered in Six Sigma initiatives.

Hayes (2018) states seven important core activities to manage change successfully, whereupon organizational culture should be included in those activities. The first activity is recognizing the need for change, where companies need to consider if there is a need for cultural change to achieve the expected results with the Six Sigma initiative. The global values in Company 1 correspond to the goal they had with the Six Sigma initiative. Though, Respondent 1 stated the values are not incorporated enough in the organization. It can therefore be argued that all employees did not know or were aligned with the values. The next core activity explained by Hayes (2018) is formulating what needs to be changed, where communication has a crucial part. The change needs to be translated into a desire for change where the employees feel motivated. All three case companies experienced unmotivated employees because they feared the Six Sigma initiative would create an increased workload. Company 2 overmastered this issue since communication within the company was a success factor. In Company 1 and Company 3 communication was stated as a failure factor which indicates they failed to formulate what needed to be changed. The next two activities explained by Hayes (2018) are planning how to intervene to achieve expected results and implementing plans and reviewing progress where Al-Haddad and Kotnour (2015) state that proper planning helps organizations to identify the gap between where they are today and where they want to be. Company 1 did not have a plan for how to move forward with the Six Sigma initiative and Company 3 did not implement the Six Sigma initiative full scale. It can be argued this has caused unmotivated employees since they did not see the purpose of the initiative. Contradictory, the employees in Company 2 got support from the managers to achieve the expected results. The managers review projects and ensure the employees do not turn back to old habits. The fifth activity explained by Hayes (2018) is sustaining the change, which means the change needs to be the new norm. Company 2 works continually with improvements which imply they have set the norm to constantly develop. Company 1 and Company 3 have not moved forward with the

initiative which implies they have not sustained the change. The next core activity explained by Hayes (2018) is leading and managing people issues, that involve trust, communication, and motivation. From a cultural perspective, it is therefore crucial to prioritize those factors. The main reason people are resistant to change is that they fear the unknown (Rao, 2015). It was validated from the case companies that lack knowledge and bad communication led to insecurity among the employees since they did not know how the Six Sigma initiative would affect them as individuals. The seventh and last core activity explained by Hayes (2018) is learning which focuses on the leaders' ability to learn from experiences, utilize them and adopt their behavior to successfully implement changes in an organization. Accordingly, not only the employees need to change their behavior but also the managers. In Company 2 and Company 3 the top management was involved in the Six Sigma introduction while they did not take part in the initiative in Company 1.

As previously stated, it is not validated if Company 2 needed to change its organizational culture, but it is stated that its organizational culture has generated a successful Six Sigma introduction. Organizational culture was a failure factor for both Company 1 and Company 3. This implies it would have been a need for cultural change when Six Sigma was introduced, to achieve a successful introduction. It is stated that cultural change is hard to achieve (McLean & Antony, 2014), but from a group culture perspective, it is not impossible. Henri (2015) points out that group culture requires interaction between individuals, hence it is nothing we are born with. Employees interact more closely with their workgroups, whereupon individuals' attitudes and behaviors are more affected by the group culture rather than the organizational culture (Shin et al., 2016). Furthermore, social cohesion in workgroups generates development, empowerment, and commitment from employees (Henri, 2006). It can be argued that group culture set the baseline for organizational culture. However, successful group culture does not automatically generate successful organizational culture. Both Company 1 and Company 3 described the team spirit as strong within workgroups. Still, organizational culture was a failure factor for them, whereupon one reason can be they do not have strong team spirit between work groups. The respondents in both Company 1 and Company 3 experienced a "we and them" feeling. The respondent in Company 2 has not experienced the same team spirit within work groups as the respondents from Company 1 and 3 since the employees in Company 2 work in different work groups every day. Nevertheless, Company 2 was described as a flat organization with good communication between departments, where the employees feel involved and work for the company's good. Hence, this generated organizational culture to be a success factor during the introduction of Six Sigma, even though the group culture is not optimal.

6 Discussion

In this chapter, the choice of method is discussed followed by a discussion of the analyzed findings and answers to each research question.

6.1 Discussion of method

The choice to conduct a holistic multiple-case study allowed a broader investigation and the possibility to compare findings from the case companies with each other, if compared to conducting a single case study. However, multiple-case studies require more resources than single-case studies and there might be less depth per case (Yin, 2014). The purpose of the study was to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully, where the authors decided to use factors found in the existing literature and evaluate them against the case companies. This was done both to validate if the found factors were relevant for large manufacturing enterprises in Sweden and if some factors were more important than others. It can be questioned why the thesis consists of interviews with three companies instead of sending out a survey to a larger number of participants. The authors wanted to investigate the case companies' relation to the identified factors in-depth and receive a deeper understanding of how that affected the Six Sigma introduction. This is why interviews and qualitative research were a better choice and suited the study's purpose better. A reflection after the interviews is also that the findings would not have been the same if a survey would have been sent out to the same participants. The interviews were semi-structured and executed according to an interview guide. The guide contained a mix of open questions and more focused ones to get a deeper understanding of the companies' relation to the factors. The use of an interview guide made sure that the authors covered the intended scope and asked follow-up questions when there was a need to explain something further. Construct validity of the study was strengthened due to that an interview guide was used, which ensured that the interviews covered all aspects that were meant to be measured. The reliability was strengthened with the use of an interview guide by ensuring that the interviews were based on the same questions. The content of findings can slightly vary due to that the interviews were semi-structured and additional questions were asked when there was a need.

The authors performed one interview at each case company with one respondent present at Company 1 and Company 2, and two respondents at Company 3. Every respondent is some kind of manager and has a Six Sigma Black Belt, except for one of the respondents at Company 3 who has a Green Belt. All interviewees were in some way involved in the introduction of Six Sigma hence, they were well-versed in the field of the study. The interview with Company 1 was performed on-site but due to inconvenience in accessibility, the interviews with Company 2 and Company 3 were performed online. Due to this distinction, there is a possibility that the content of findings is slightly different between the case companies. The internal validity would have been strengthened if all interviews either were performed online or on-site. The study did not include observing the introduction of Six Sigma at the case companies, which could have added another dimension of data triangulation and strengthened the study's internal validity. Findings were only based on the respondents' perceptions of the introduction, which can

conflict with reality. The internal validity could although have been strengthened by interviewing more employees from each case company to make sure that the respondents' points of view were shared by the rest of the company. Since both parts of every interview have Swedish as their native language the interviews were performed in Swedish. This reduced the risk of the interviewees not being able to express themselves fully due to the language barrier when switching to English. All interviews were transcribed by using a transcription tool in Microsoft Word. The record was thereafter listened through and corrected where errors had appeared. Since the interviews were performed in Swedish the used data has been translated into English by the authors. Hence, all text in the findings is translated and all quotes throughout the report are directly translated based on the authors' knowledge of English. There is a risk of losing the meaning of a quote when deciding whether to directly translate it or edit it to express the same meaning.

6.2 Discussion of findings

The purpose of this thesis was to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully. To fulfill this purpose critical success and failure factors were identified in the literature, both for Six Sigma initiatives and for change initiatives in general. The findings are a result of the interviews with questions based on the factors identified in the literature. Hence, the findings describe how the case companies have acted in their Six Sigma introduction according to the critical success and failure factors. Findings will further be discussed, and the research questions will be answered in the two subchapters.

6.2.1 What factors differentiate companies that succeed with the introduction of Six Sigma from those that fail?

From the Background it is stated that the global market is increasingly competitive and that continuous improvement has been more crucial than ever (Solanki & Desai, 2021). Six Sigma is an established initiative that has been proven to generate great success for organizations in different sectors and sizes (Antony, 2009). Even though, up to 60% of all Six Sigma initiatives end in failure (McLean et al., 2017). It can be argued that there is a lack of shared meaning among the employees within an organization of what the purpose of Six Sigma is, which is highlighted in Problem statement. Six Sigma should be considered a "way of life" and not treated as a short-term initiative (Kumar et al., 2008). Everyone involved needs to know that Six Sigma takes time before there are visible results, but as problematized if Six Sigma does not get the right prerequisites it can become just another "flavor of the month" (Peter S et al., 2002). Numerically, Company 2 had the most success factors, compared to Company 1 and Company 3. It can be argued already there that the more success factors, the more conditions to be successful. However, it was also described how Company 2 overmastered some of the failure factors, which was not experienced in the other two case companies. Arguably this can be an additional reason for their success with the Six Sigma introduction.

From the analysis that was done in the previous chapter, factors were filtered out that were either a failure or success for all companies, since it can be argued those are not critical and do

not affect the outcome of the Six Sigma introduction. Some literature highlights top management commitment and business strategy as the most important critical success factors when introducing Six Sigma (Marzagão & Carvalho, 2016; Singh & Singh, 2020). Top management commitment has been validated in this research to be a critical factor since it was a success factor for Company 2 and Company 3, while being a failure factor for Company 1. However, business strategy was evaluated as a success factor for all three case companies and has accordingly not been a crucial factor. Furthermore, customer focus, education, employee involvement, alignment between managers and employees, and social cohesion have been stated as critical success factors in Six Sigma initiatives, or change initiatives in general, but neither of them has been crucial for the case companies. The three case companies were successful with those factors but still, Company 1 and Company 3 failed their introduction. Neither have the factors that were failure factors for Company 2 been argued to be critical since Company 2 succeeded anyways and have therefore been filtered out. Capacity was not argued to be either a success factor or a failure factor for any of the case companies. It can be argued this factor does not affect large enterprises since they have the capacity in terms of financial and manpower resources (Ben Romdhane et al., 2017). However, this validates that capacity does not generate success since large enterprises still have a high failure rate of Six Sigma initiatives. The remaining drivers and barriers can arguably be critical when introducing Six Sigma and are presented in Table 5. The factors that differentiate companies that succeed with the introduction of Six Sigma from those that fail are therefore Top management commitment, Organizational support, Organizational culture, Communication, and Strategic plan.

Table 5

Critical success factors for Six Sigma introduction

	Success factor (S) or Failure factor (F)		
Identified Factors	**Company 1**	**Company 2**	**Company 3**
Top management commitment	F	S	S
Organizational support	S	S	F
Organizational culture	F	S	F
Communication	F	S	F
Strategic plan	F	S	F

6.2.2 How can organizational culture be used as a driver when introducing Six Sigma?

In the Problem statement, it is stated that there is a lack of knowledge about why organizations discontinue Six Sigma initiatives (Sony et al., 2019) and there are few studies that have investigated the influence of cultural factors (Jamshed & Majeed, 2019). Nevertheless, it is stated that organizational culture has a positive correlation with the introduction of Six Sigma (Knapp, 2015), whereupon it can be questioned why it is not discussed more in the literature. Six Sigma has a high failure rate itself and change initiatives requiring cultural change have an

even higher failure rate. Hence, if a Six Sigma initiative within an organization requires cultural change the probability of success is low. It is argued that Six Sigma can be implemented in every organization and every sector independent of the size of the company (Antony, 2009), but maybe that is not the case if the organizational culture is not suited for a Six Sigma initiative. On the other hand, it is not impossible to change organizational culture since culture requires interaction between individuals, and individuals can change their behavior if the environment changes (Henrie, 2015).

Six Sigma is suited for large enterprises in terms of financial and manpower resources (Ben Romdhane et al., 2017), but it might be harder to implement in large enterprises in terms of organizational culture. Group culture is an important part of a group's ability to create and share knowledge (Colovic & Williams, 2020). Though, team spirit in the entire company might be even more important, based on Company 2's success. The larger the company, the more work groups exist that can have different group culture that is not aligned with each other. There might also be a greater distance between the top management and the employees since large enterprises often have more hierarchical levels than small- and medium-sized enterprises. It was not stated if any of the case companies needed to change their organizational culture due to the Six Sigma introduction. However, since organizational culture was a failure factor for Company 1 and Company 3 it can be argued that a change in organizational culture would have increased the probability of success. The first step might be to evaluate the organizational culture within the company and be aware of how it will correspond to the goal of the Six Sigma initiative. If an organization tries to introduce Six Sigma when the culture is not suited for it, it is set up for failure. To use organizational culture as a driver when introducing Six Sigma organizations need to create a culture where the individuals' values are aligned with the organizational values, where there is open communication, and where both top management and employees are committed. When this is achieved, the risk of resistance to change will decrease, and the probability of success with a change initiative such as Six Sigma will increase.

7 Conclusions

The purpose of the study was to investigate what factors large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully. It was fulfilled by first investigating the initiative to introduce Six Sigma in three large enterprises in Sweden. Second, organizational culture was further investigated to understand its impact related to the Six Sigma introduction. The study confirms if identified factors from the literature have an impact when large enterprises in Sweden introduce Six Sigma and if those factors are critical or not. It contributes to knowledge for companies to be more successful when introducing Six Sigma, but also change initiatives in general.

The first research question was *What factors differentiate companies that succeed with the introduction of Six Sigma from those that fail?* By analyzing how identified success and failure factors from literature affect organizations when introducing Six Sigma it was possible to conclude what factors have been different. It was argued that the critical success factors have been the difference that has generated success, where the factors of Top management commitment, Organizational support, Organizational culture, Communication, and Strategic plan have been identified. Hence, those need to be prioritized to introduce Six Sigma successfully.

The second research question was *How can organizational culture be used as a driver when introducing Six Sigma?* It was not validated in the study if the case companies needed to change their organizational culture or not due to the Six Sigma introduction. However, based on the company that has succeeded with the Six Sigma introduction, communication between departments, supportive managers, and committed top management are cultural factors that need to be considered. Organizations need to create a culture where those factors are successful before introducing any change initiative, then organizational culture will be a driver when introducing Six Sigma.

7.1 Implications and further research

This study strived to investigate what large manufacturing enterprises in Sweden need to prioritize to introduce Six Sigma successfully. There are today various stated factors that affect organizations when introducing a quality initiative like Six Sigma, but there is a need to understand what factors to focus on and prioritize. This study found that the critical success factors for Six Sigma introduction are Top management commitment, Organizational support, Organizational culture, Communication, and Strategic plan. It is also emphasized that an organizational culture with open communication between departments, supportive managers, and committed top management can be used as a driver when introducing Six Sigma.

While previous research has focused on defining a wide range of factors that affects organizations when introducing Six Sigma, this thesis' results show that some factors are more important than others during the introduction. Few studies have investigated the influence of cultural factors when introducing Six Sigma despite its stated positive correlation. This study has contributed to shed light on the correlation, including how organizational culture can be

used as a driver during the Six Sigma introduction. This allows organizations to know what factors to prioritize higher during the introduction of Six Sigma to reduce the risks of discontinuing the initiative. It also emphasizes the importance of addressing the organization's culture before initiating the initiative. By increasing organizations' chances to implement Six Sigma successfully, more resources would be saved globally and can thus be used more efficiently. The factors mentioned in this study are not only based on literature regarding the Six Sigma introduction but also change initiatives in general. Hence, the results can also be applied to other change initiatives except the Six Sigma introduction to increase the number of successful change initiatives in general.

This study has been done on large manufacturing enterprises and can therefore not be directly applied to small- and medium enterprises in Sweden. The result can although be generalizable to other large manufacturing enterprises in Sweden to some extent. The same factors should be investigated in small- and medium enterprises to increase the utilization of the study. This research continued investigating the correlation between organizational culture and the Six Sigma introduction, but there is a need to further develop this in order to reach any legitimate conclusions.

8 References

Al-Haddad, S., & Kotnour, T. (2015). Integrating the organizational change literature: a model for successful change. *Journal of organizational change management*, *28*(2), 234-262. https://doi.org/10.1108/JOCM-11-2013-0215

Albliwi, S. A., Antony, J., & Lim, S. A. h. (2015). A systematic review of Lean Six Sigma for the manufacturing industry. *Business process management journal*, *21*(3), 665-691. https://doi.org/10.1108/BPMJ-03-2014-0019

Alvesson, M., & Sveningsson, S. (2016). *Changing organizational culture : cultural change work in progress* (2. ed.). Routledge.

Antony, J. (2009). Six Sigma vs TQM: some perspectives from leading practitioners and academics. *International journal of productivity and performance management*, *58*(3), 274-279. https://doi.org/10.1108/17410400910938869

Bazeley, P. (2007). *Qualitative data analysis with NVivo*. SAGE.

Ben Romdhane, T., Badreddine, A., & Sansa, M. (2017). A new model to implement Six Sigma in small- and medium-sized enterprises. *International journal of production research*, *55*(15), 4319-4340. https://doi.org/10.1080/00207543.2016.1249430

Buch, K., & Tolentino, A. (2006). Employee perceptions of the rewards associated with six sigma. *Journal of organizational change management*, *19*(3), 356-364. https://doi.org/10.1108/09534810610668355

Carlström, E. D., & Ekman, I. (2012). Organisational culture and change: implementing person-centred care. *Journal of health organization and management*, *26*(2), 175-191. https://doi.org/10.1108/14777261211230763

Colovic, A., & Williams, C. (2020). Group culture, gender diversity and organizational innovativeness: Evidence from Serbia. *Journal of business research*, *110*, 282-291. https://doi.org/10.1016/j.jbusres.2019.12.046

Del Angel, C., & Froelich, J. (2008). Six Sigma: What Went Wrong? *Customer relationship management (Malibu, Calif.)*, *12*(11), 14-14.

Drake, D., Sutterfield, J. S., & Ngassam, C. (2008). The revolution of six-sigma: an analysis of its theory and application. *Academy of Information and Management Sciences journal*, *11*(1), 29.

Ebot, E. E. (2020). Determining Six Sigma Critical Failure Factors. https://doi.org/info:doi/

Flick, U. (2020). *Introducing Research Methodology*. Sage.

Gaikwad, S. K., Paul, A., Moktadir, M. A., Paul, S. K., & Chowdhury, P. (2020). Analyzing barriers and strategies for implementing Lean Six Sigma in the context of Indian SMEs. *Benchmarking : an international journal*, *27*(8), 2365-2399. https://doi.org/10.1108/BIJ-11-2019-0484

Hallin, A., Olsson, A., Widström, M., & Ehnsiö, R. (2021). *Change Management* (First edition ed.). Studentlitteratur.

Hammer, M., & Champy, J. (1993). *Reengineering the corporation : a manifesto for business revolution* (1 ed.). HarperBusiness.

Harry, M., & Schroeder, R. (2000). *Six sigma : the breakthrough management strategy revolutionizing the world's top corporations*. Currency.

Hayes, J. (2018). *The theory and practice of change management* (Fifth edition ed.). Palgrave.

Henri, J.-F. (2006). Organizational culture and performance measurement systems. *Accounting, organizations and society*, *31*(1), 77-103. https://doi.org/10.1016/j.aos.2004.10.003 (Accounting, Organizations and Society)

Henrie, M. E. (2015). *Cultural influences in engineering projects*. Momentum Press.

Hudnurkar, M., Ambekar, S., & Bhattacharya, S. (2019). Empirical analysis of Six Sigma project capability deficiency and its impact on project success. *TQM journal*, *31*(3), 340-358. https://doi.org/10.1108/TQM-06-2018-0078

Iyede, R., Fallon, E. F., & Donnellan, P. (2018). An exploration of the extent of Lean Six Sigma implementation in the West of Ireland. *International journal of lean six sigma*, *9*(3), 444-462. https://doi.org/10.1108/IJLSS-02-2017-0018

Jamshed, S., & Majeed, N. (2019). Relationship between team culture and team performance through lens of knowledge sharing and team emotional intelligence. *Journal of knowledge management*, *23*(1), 90-109. https://doi.org/10.1108/JKM-04-2018-0265

Jovanoska, A., Drakulevski, L., & Debarliev, S. (2020). CHANGING ORGANIZATIONAL CULTURE BY PROMOTING VALUES THAT ENCOURAGE TEAMWORK. *Eurasian journal of business and management*, *8*(2), 94-105. https://doi.org/10.15604/ejbm.2020.08.02.004

Karlsson, C. (2009). *Researching operations management*. Routledge.

Knapp, S. (2015). Lean Six Sigma implementation and organizational culture. *International journal of health care quality assurance*, *28*(8), 855-863. https://doi.org/10.1108/IJHCQA-06-2015-0079

Kumar, M., Antony, J., Madu, C. N., Montgomery, D. C., & Park, S. H. (2008). Common myths of Six Sigma demystified. *The International journal of quality & reliability management*, *25*(8), 878-895. https://doi.org/10.1108/02656710810898658

Kumar, R. (2019). *Research methodology : a step-by-step guide for beginners* (5. ed.). SAGE.

Kumar, V., Garza-Reyes, J. A., & Chen, F. F. (2017). *Seeing Green: Achieving Environmental Sustainability through Lean and Six Sigma*. Emerald Publishing Limited.

Linderman, K., Schroeder, R. G., & Choo, A. S. (2006). Six Sigma: The role of goals in improvement teams. *Journal of operations management*, *24*(6), 779-790. https://doi.org/10.1016/j.jom.2005.08.005

Marzagão, D. S. L., & Carvalho, M. M. (2016). Critical success factors for Six Sigma projects. *International journal of project management*, *34*(8), 1505-1518. https://doi.org/10.1016/j.ijproman.2016.08.005

McLean, R., & Antony, J. (2014). Why continuous improvement initiatives fail in manufacturing environments? A systematic review of the evidence. *International journal of productivity and performance management*, *63*(3), 370-376. https://doi.org/10.1108/IJPPM-07-2013-0124

McLean, R. S., Antony, J., & Dahlgaard, J. J. (2017). Failure of Continuous Improvement initiatives in manufacturing environments: a systematic review of the evidence. *Total quality management & business excellence*, *28*(3-4), 219-237. https://doi.org/10.1080/14783363.2015.1063414

Miller, D., & Proctor, A. (2016). *Enterprise change management : how to prepare your organization for continuous change*. Kogan Page.

Mohanty, R. P., & Deshmukh, S. G. (1999). Managing green productivity: a case study. *Work Study*, *48*(5), 165-169. https://doi.org/10.1108/00438029910279402

Montgomery, D. C. (2005). Generation III Six Sigma. *Quality and reliability engineering international*, *21*(6), iii-iv. https://doi.org/10.1002/qre.751

Muthukumar, N. (2022). *Organizational culture and its impact on continuous improvement in manufacturing*. Emerald Publishing Limited.

Nonthaleerak, P., & Hendry, L. (2008). Exploring the six sigma phenomenon using multiple case study evidence. *International journal of operations & production management*, *28*(3), 279-303. https://doi.org/10.1108/01443570810856198

Noori, B., & Latifi, M. (2018). Development of Six Sigma methodology to improve grinding processes: A change management approach. *International journal of lean six sigma*, *9*(1), 50-63. https://doi.org/10.1108/IJLSS-11-2016-0074

Pande, P. S., Neuman, R. P., & Cavanagh, R. R. (2000). *The Six Sigma way : how GE, Motorola, and other top companies are honing their performance*. McGraw-Hill.

Paton, R., & McCalman, J. (2008). *Change management : a guide to effective implementation* (3. ed.). Sage Publications.

Patyal, V. S., & Koilakuntla, M. (2018). Impact of organizational culture on quality management practices: an empirical investigation. *Benchmarking : an international journal*, *25*(5), 1406-1428. https://doi.org/10.1108/BIJ-12-2016-0191

Peter S, P., Robert P, N., & Roland R, C. (2002). *The Six Sigma Way Team Fieldbook: An Implementation Guide for Process Improvement*. McGraw-Hill.

Rao, M. S. (2015). The tools and techniques of effective change management: Why some reformers succeed while others fail. *Human resource management international digest*, *23*(1), 35-37. https://doi.org/10.1108/HRMID-12-2014-0163

Rogers, D. (2018). *The Future of Lean Sigma Thinking in a Changing Business Environment* (First edition. ed.). Productivity Press.

Sajjad, A., Eweje, G., & Tappin, D. (2020). Managerial perspectives on drivers for and barriers to sustainable supply chain management implementation: Evidence from New Zealand. *Business strategy and the environment*, *29*(2), 592-604. https://doi.org/10.1002/bse.2389

Sanders, D., & Hild, C. (2000). A DISCUSSION OF STRATEGIES FOR SIX SIGMA IMPLEMENTATION. *Quality engineering*, *12*(3), 303-309. https://doi.org/10.1080/08982110008962593

Schroeder, R. G., Linderman, K., Liedtke, C., & Choo, A. S. (2008). Six Sigma: Definition and underlying theory. *Journal of operations management*, *26*(4), 536-554. https://doi.org/10.1016/j.jom.2007.06.007

Sembiring, N., Yurisditira, R., & Devany, J. (2020). Analysis of Drivers and Barriers The Implementation of Sustainability Supply Chain Management (SSCM) in PT. ABC. *IOP conference series. Materials Science and Engineering*, *851*(1), 12047. https://doi.org/10.1088/1757-899X/851/1/012047

Shin, Y., Kim, M., Choi, J. N., & Lee, S.-H. (2016). Does Team Culture Matter? Roles of Team Culture and Collective Regulatory Focus in Team Task and Creative Performance. *Group & organization management.*, *41*(2), 232-265. https://doi.org/10.1177/1059601115584998

Singh, G., & Singh, D. (2020). CSFs for Six Sigma implementation: a systematic literature review. *Journal of Asia business studies*, *14*(5), 795-818. https://doi.org/10.1108/JABS-03-2020-0119

Solanki, M., & Desai, D. (2021). Competitive advantage through Six Sigma in sand casting industry to improve overall first-pass yield: a case study of SSE. *International journal of lean six sigma*, *12*(3), 477-502. https://doi.org/10.1108/IJLSS-03-2020-0032

Sony, M., Naik, S., & Therisa, K. K. (2019). Why do organizations discontinue Lean Six Sigma initiatives? *The International journal of quality & reliability management*, *36*(3), 420-436. https://doi.org/10.1108/IJQRM-03-2018-0066

Sreedharan V, R., Sunder M, V., Madhavan, V., & Gurumurthy, A. (2020). Development of Lean Six Sigma training module: evidence from an emerging economy. *The International journal of quality & reliability management*, *37*(5), 689-710. https://doi.org/10.1108/IJQRM-08-2018-0209

SSDI. *What is a Six Sigma White Belt?* Six Sigma Development Solutions, Inc. Retrieved 2023-03-24 from https://sixsigmadsi.com/what-is-a-six-sigma-white-belt/

Säfsten, K., Gustavsson, M., & Ehnsiö, R. (2020). *Research methodology : for engineers and other problem-solvers*. Studentlitteratur AB.

Vos, J. F. J., & Rupert, J. (2018). Change agent's contribution to recipients' resistance to change: A two-sided story. *European management journal*, *36*(4), 453-462. https://doi.org/10.1016/j.emj.2017.11.004

Yin, R. K. (2014). *Case study research : design and methods* (5. ed.). SAGE.

Yin, R. K. (2015). *Qualitative research from start to finish* (Second Edition ed.). Guilford Press.

Yin, R. K. (2018). *Case study research and applications : design and methods* (Sixth edition. ed.). SAGE.

9 Appendices

Appendix 1 – Interview guide

General

1. What are the values of the company?
2. Except for Six Sigma, do you use other quality initiatives or methods for improvement?
3. When you do improvements, how do you evaluate the results?
4. How do you make decisions regarding improvements?
5. Do you use statistical tools?
6. How do you celebrate success?
7. How do your employees react to change initiatives?
8. Who pushes for change initiatives?
9. What do you do to be competitive in the market?
10. If you consider quality, flexibility, speed, dependability, and cost, how do you, as a company, prioritize those?

Six Sigma

1. Do you have a Six Sigma belt?
2. When did you introduce Six Sigma in your company?
3. Can you tell us about how it was introduced?
4. Did you have a long-term plan?
5. What was the purpose of the introduction?
6. What was the goal of the introduction?
7. What expectations were from employees and top management?
8. How did other people within the company react to the introduction?
9. Did you face any hindrances?
10. Can you tell us about the education of the employees?
11. Were you a part of the introduction? What was your role?
12. What background did the involved employees have? Previous education, work position, etc.
13. Did you face any hindrances due to a lack of competence?
14. Do you have ongoing education?
15. Did you have a structured way of working when introducing Six Sigma?
16. How did the top management react after the introduction?
17. What resources have you had?
18. What was the time plan for the introduction?
19. Have you continuously continued with Six Sigma since the introduction?

If yes:

1. How long did it take until you were up and running?
2. Have you seen financial improvements from Six Sigma?
3. What drives you to continue with Six Sigma?
4. Do you see any resistance from the employees to continue?
5. To what extent do you work with Six Sigma?
6. Do you see any reason to quit Six Sigma?

If no:

1. Why did you not continue the process?
2. Did you have clear instructions?
3. Why do you believe you did not continue?
4. Have you tried to introduce Six Sigma again?

Culture

1. Can you tell us about your organizational culture?
2. How do you manage resistance to change within the company?
3. What do the line managers and top managers do to inspire change?
4. Can you tell us about the team spirit within the work groups?

Is it anything more you want to add?