Jarno Tapani Pottonen

UTILIZATION OF THE 8D QUALITY TOOL IN SOLVING THE QUALITY PROBLEMS IN JOHN CRANE NORDIC UNITS

Master’s thesis

Master's Degree Programme in International Business Management

2023

Kaakkois-Suomen ammattikorkeakoulu

Kaakkois-Suomen ammattikorkeakoulu

Degree title	Master of Business Administration
Author	Jarno Tapani Pottonen
Thesis title	Utilization of the 8 D quality tool in Solving the quality problem in John Crane Nordic Units
Commissioned by	John Crane Safematic
Time	2023
Pages	76
Supervisors	Mikhail Nemilentsev

ABSTRACT

In industrialised countries, competition is fierce in every market in the world. The future will be shaped by companies determined to invest and deliver high quality. Quality is one of the essential success factors, but the ability to solve manufacturing problems can also be seen as necessary.

Companies and organisations with an effective quality management process and use it effectively daily face fewer problems. The company's strategy should include a significant investment in the management and development of problem-solving. These factors should be an intrinsic value of a successful business. For this thesis, a qualitative research method was chosen. In addition, elements of a case study were included. The study consists of a development project implemented for the target company.

It explored the basic concepts of problem-solving, lean methods and quality management and how they could be used effectively and intelligently in the daily operations of the case company in the Nordic countries.

This study aimed to describe problem-solving processes and models. The aim was to identify and offer solutions on how problem-solving is most effectively used and utilised in John Crane's Nordic operations. The material for the thesis was collected through interviews with the company's Nordic quality engineers and a literature review on the topic. The data from the survey provided information on the current state of problem-solving and how it is perceived in the client company. After analysis, this study answers the research questions and develops suggestions for future problem-solving. This study provided the case company with helpful information that it can use to design and implement new quality processes.

Keywords: Problem-solving, Lean methodology, quality, 8D, Nordic, documentation

CONTENTS

1 INTRODUCTION 5

1.1 Research background.....6

1.2 Objective and research questions.....7

1.3 Structure of the study.....8

1.4 Research Methodology.....9

1.5 Commissioning company John Crane Safematic 10

1.6 Limitations of the research.....11

1.7 Lean Methodology 12

2 GENERAL PROBLEM-SOLVING METHODS 14

2.1 DMAIC 14

2.2 PDCA.....15

2.3 FMEA.....16

2.4 8D Eight Disciplines.....17

3 STRUCTURE OF 8 D PROBLEM-SOLVING METHOD 19

3.1 D0 Plan.....20

3.2 D1 Creating a Team 21

3.3 D2 Define and Describe the Problem 23

3.4 D3 Contain the Problem 24

3.5 D4 Identify, Describe, and Verify the Root Causes.....26

3.5.1 Root Cause Analysis Tools.....27

3.5.2 Flowchart 27

3.5.3 Ishikawa diagram (Fishbone).....28

3.5.4 Five Whys 29

3.6 D5 Choose Corrective Actions.....30

3.7 D6 Implement and Validate the Corrective Actions.....31

3.8 D7 Preventive Actions 33

3.9 D8 Closing 34
4 PROBLEM-SOLVING IN JOHN CRANE'S NORDIC 34
4.1 Notifications 35
5 RESEARCH 37
5.1 Goals of the research 38
5.2 Data collection 39
5.3 Survey for Participants 41
5.4 Questions Asked in the Survey 42
5.4.1 Survey Questions 1-3 43
5.4.2 Survey Questions 4-14 43
5.4.3 Survey Questions 14-26 44
5.4.4 Survey Questions 27-32 44
5.4.5 Interview Of Quality Professionals 44
6 RESEARCH RESULTS 46
6.1 Results for Survey Questions 1-3 46
6.2 Results for Survey Questions 4-13 48
6.3 Results of Survey Questions 14-26 53
6.4 Results of Survey Questions 27-32 58
7 CONCLUSIONS 61
7.1 Responses to Research Questions. 62
7.2 Findings of the study 63
7.3 The Validity of the Research 66
7.4 Administrative development ideas 67
REFERENCES 70
LIST OF FIGURES 74
APPENDIX LIST: 76

1 INTRODUCTION

“Quality is more important than quantity. One home run is much better than two doubles.” –Steve Jobs.

The things mentioned above by Steve Jobs are significant words for all those who produce something or dream of creating something. In those words, the importance of building quality has been understood. Quality is more crucial than amount.

In every organisation occurs, problems, problems can be considered necessary and, at the same time, inevitable. Problems develop organisations, and at the same time, they also help us to understand what has been done differently in the past. In organisations, solving problems is often concentrated on the task of the same people.

Continuous improvement is crucial to create better and more reliable processes. In many cases, success and survival require continuous improvement. Organisations and companies that fail to apply continuous improvement methods to their functions will be left behind by those that succeed in continuous improvement. (Nicholas 2018, 22.)

The people who solve the problems that arise are among the most essential resources of companies. Their job is to look at situations and prevent the causes of problems. All levels of the organisation need to understand that problem solvers remove obstacles to continuous improvement. (Zarghami & Benbow 2017, 4.)
In the modern industrial world, problem-solving favours group problem solving. Employees must understand how a group can solve their problems effectively. (Zarghami & Benbow 2017, 4.)

Problem solving has become a vital part of business in challenging times. Organisations must maintain their ability to deal with complex situations and factors impacting different areas. (Marquat & Yeo 2012, 10.)

This thesis analyses and seeks to uncover the current state of problem solving in a collaborative enterprise. The research will explore the state of problem solving in the Nordic entities, their competencies and public opinion through surveys and interviews.

1.1 Research background

The researcher needs to reflect and think about the ultimate purpose of the research. Before embarking on a study, the author must fully understand the subject and meaning of the study. As a result of this reflection, the research objectives should be clearly defined, and the direction in which the investigation will proceed should also be decided. (Moore 2006, 3-4.)

There is the possibility that a phenomenon can be studied from many different angles. The research subject can be considered a broad concept that allows the phenomenon under study to be linked to a discipline. (Kananen 2017, 51.)

This study combines experimental and qualitative research methods. This combination of research methods directly results from the research topic and the desire to provide the client with helpful information on how problem-solving techniques can be used in the future.

The researcher should choose a relevant topic that is satisfactory to study. They should also be passionate about the subject to translate their passion into creative and rigorous research. (Sumerson 2013, 13.)

A researcher considering integrating different research fields into their study should search for the subject matter widely across disciplines. A research fusionist can be viewed as a pioneer in their field of research. (Puusa et al. 2020, 256.)

In a survey, several people are asked the same information to understand what people think, feel, and experience. Surveys can be carried out efficiently and quickly at low cost. The participants in a study do not have to be restricted to a specific group but can be almost anyone. In general, it is unnecessary to resource external professionals to conduct a survey. (Walle 2015, 50.)

Action research is mainly associated with qualitative research. A specific feature of action research is that research and practice are carried out simultaneously and combined. The creation and implementation of new things are often linked to the performance of practice. Action research has proven to be an undeniably practical tool if scientific methods accompany it. (Puusa et al. 2020, 256.)

The author of this study has been working at the commissioning company within the quality and service departments. In that role, there has been a wide-scoped view of every quality aspect of what the company has offered.
The role of research in an evolving organisation can be seen as one of the critical tasks. Therefore, all organisation members must know the opportunities that research can offer to address problems.

The author of this thesis is the QEHS manager of the target company and, through his role, has been involved in quality management and problem-solving in the target company. During his career, the study author has observed the intractability of problem solving in several projects.

Problem solving is not a panacea for all situations but only a tool. Like any other process, problem-solving creates problems elsewhere in the organisation to which others must respond. It can therefore be said that problem-solving creates situations within the organisation that require problem-solving.

This research topic has been chosen because of its importance. The study author initiated the topic choice and involved other levels of the Nordic organisation.

1.2 Objective and research questions

This study aims to find a practical approach to solving the problem of problem-solving methods in a collaborative enterprise in Nordic countries. The study's main objective is to find ways to use existing tools and processes. The study favours the development and how problem-solving methods can be uniform in all locations. The study aims to strengthen these processes and guide users to deepen their problem-solving techniques through better knowledge. Based on the above, the main research question is.

- *How can existing problem solving tools be used more efficiently in the Nordic profit units?*

The sub research questions are:

- *How can the parent company contribute to achieving a better level of problem solving?*
- *What kind of actions do those working on problem-solving hope for?*

In a company-sized organisation, cooperation is a significant factor in the direction and common approaches chosen for activities. The organisation also imposes specific control measures on the selected sites. A problem-solving activity in an enterprise is among the pre-selected activities and has been assigned a control measure for the overall quality development in the organisation.
Problem solving within the organisation can always be carried out by a qualified person. The professionalism of the person ensures the smooth running of the process. These persons must be able to use the tools provided effectively in their day-to-day work.

Finding the best people for the relevant tasks is critical for the global quality management organisation. Staff availability and accessibility of experts are a concern, as finding suitable experts for quality and problem-solving environments is challenging.

1.3 Structure of the study

During this study, a problem was identified with the availability of literature. Literature directly related to the research topic was difficult to find or access. Due to the literature problems, the study author added interviews to the project to broaden the perspective. Electronic literature sources were also accepted for the study, but the content was critically reviewed. The research framework is firmly grounded in theory and provides a reasonable basis for validating the research. Figure 1 below shows the study's structure, progression, and research questions.

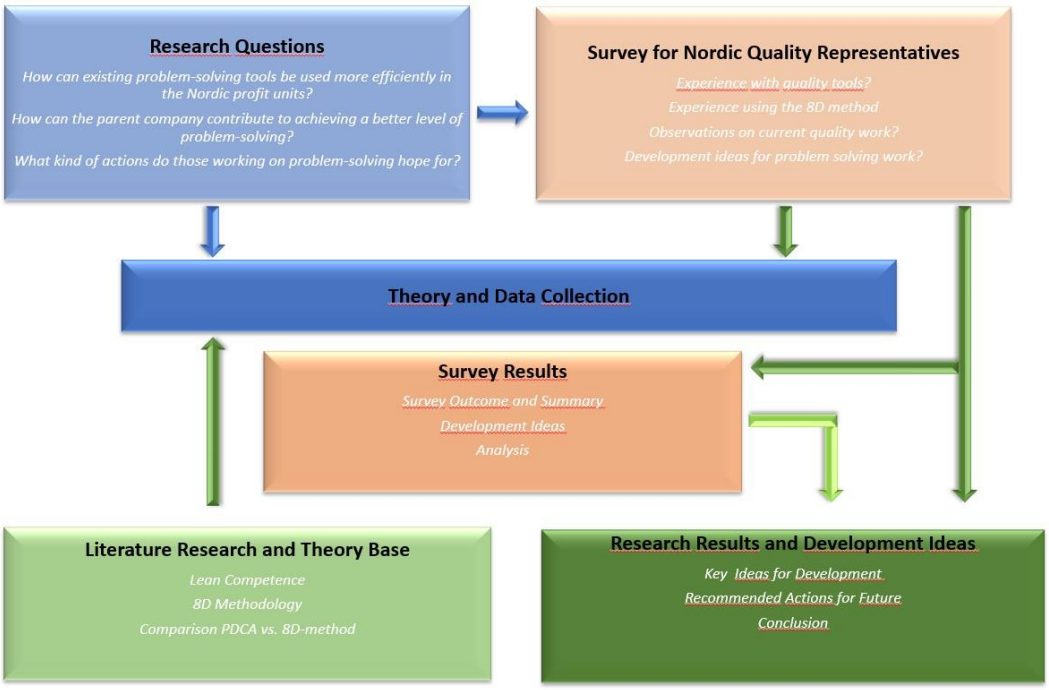

Figure 1. Structure of the studies

The diagram in Figure 1 can be seen as a study author's guideline and guide, presenting a plan for analytically exploring the theoretical basis of their thesis.

The thesis's necessary analytical tools and procedures can be found in the theoretical framework. At the same time, the final approach to the theory can be chosen. (Dickson et al. 2018.)

An essential part of this research is also the organisation of a survey for quality professionals. Interviews with professionals from outside the organisation were also included to broaden the scope of this study. These interviews are not shown in Figure 1 due to their late completion date.

1.4 Research Methodology

When looking at the concept of methodology, it focuses on how we do research - our own interests, purposes, and assumptions influence the methodology we choose. Regarding methodology, discussions tend to be reduced to a debate about beliefs, perspectives and theory. (Taylor 2015,14.)

1.5 Commissioning company John Crane Safematic

In 1972, a company was established in the Muurame area of Jyväskylä, Finland, which began manufacturing various lubrication and shaft sealing systems for multiple industries. Initially, the business was a maintenance and manufacturing operation run by two entrepreneurs. However, soon after the start of operations, the workforce was increased to meet the demands of a growing market. During the first years of operation, turnover growth was steady and stable. The constant and continuous growth attracted the interest of investors. In the late 1970s, the entire business was sold to Partek Oy in a takeover. (John Crane 2022.)

Safematic's merger with Partek Business began the company's internationalisation. In the 1980s, the business started manufacturing its first products in Atlanta, USA. Revenues grew steadily throughout the decade, and Safematic made its first acquisition with the purchase of Tyton Seal Inc. of Canada. The internationalisation process led to significant developments, particularly regarding technologies and operating principles. These developments confirmed Safematic's position on the market as an emerging and attractive growth company. (John Crane 2022.)

In the 1990s, mechanical production activity for seals and lubrication systems was set up. In the 1990s, Safematic was awarded ISO 9001 quality and ISO 14 001 environmental certifications. Obtaining these certifications shows the company's positive attitude towards development and its desire to manufacture quality-certified products. Later, in the 2000s, ISO 45001 personnel and safety certification was added. In the late 1990s, Safematic merged with the John Crane family to form a global centre of excellence for the paper and pulp industry. (John Crane 2022.)

In the early 2000s, Smiths Co. merged its business with the TI Group, which owns Safematic Ltd, and Safematic Ltd changed its name to John Crane Safematic Ltd. In the 2000s, John Crane achieved the OHSAS 18001 Occupational Health and Safety Standard, which was soon changed to ISO 45001. The company has repeatedly won the Best Environmental Initiative and Working Environment awards. (John Crane 2022.)

2022 John Crane Safematic will operate in Muurame, part of John Crane. The company currently has 45 employees in Muurame in various specialist and maintenance positions. The turnover in 2021 was 17.4 million euros.

Figure 2. John Crane Locations Worldwide (John Crane 2023)

In Figure 2, John Crane's locations worldwide are marked with blue dots on the map. John Crane Safematic has ensured its operation, e.g., With ISO 9001, ISO 14001, and ISO 45001 certificates, and is intensely involved in various Lean activities at the global level. John Crane Safematic is also responsible for maintaining Nordic management systems and their quality functions. (John Crane 2022.)

1.6 Limitations of the research

Although the theoretical framework deals with quality and how to improve it through various methods, the extensive studies and interviews naturally present only some of the features of the discipline. This case study is limited in scope to cover only the best-known areas and tools of the profession. The results of this study can be used in the future to design quality management and, thus, develop a solution to the problem. The target group for which the study results are most naturally applicable is all quality managers and quality workers in the Nordics.

In this thesis, the theoretical basis presented will be limited so that the study will only offer topics that are considered to be the most general. Quality and quality

management are broad concepts, and for the sake of clarity and time management, this delimitation was chosen.

The second delimitation exercise carried out during the study concerned the collection of source literature. Unfortunately, literature on quality management and development is often expensive and requires considerable money from the author. For this reason, the source literature is limited to a few significant works in the field. However, most general reference works are available in public libraries and on the open part of the Internet.

1.7 Lean Methodology

Lean has become the leading quality management and problem-solving method in modern industry. Many different techniques and tools have been built around problem-solving. The Toyota Production System (TPS), developed and maintained by Toyota, is a process management system consisting of LEAN best practices and other effective development methods. Among the most prominent features of Toyota's philosophy are the seven production wastes to improve customer satisfaction. According to Toyota's philosophy, any activity that does not bring the process closer to the finish line or does not add value is a waste. (Wang 2011, 1.)

Six Sigma is a method that focuses on reducing variations in a process. The concept of Lean is quite often associated with Six Sigma and is used simultaneously. Lean manufacturing usually focuses on eliminating and reducing manufacturing costs, while Six Sigma tries to find the items that cause defects. By using both together, improvements in quality and productivity can be achieved (Wang 2011, 3.)

In organisations focusing on continuous improvement and identifying bottlenecks, Lean manufacturing is a valuable management method (Nicholas 2018, 3.)

Six Sigma has provided the best solutions and alternatives for companies that have been forced by the pressures of the business environment in the 20th century, with increasing expectations and product complexity. Because of Six

Sigma's efficiency and flexibility, many leading companies quickly adopted Six Sigma. Over the past decades, small and medium-sized companies have also adopted Sig Sigma. (Coskun 2010, 6.)

Friedrich Gauss (1777-1855) introduced the now widely known normal curve. This moment can be considered the birth of the Six Sigma measurement standard method. In the 1920s, Walter Shewhart showed that a three-sigma deviation from the mean was critical to correcting the process. Six Sigma was coined by an engineer who worked for Motorola. Since the invention of Six Sigma, many other measurement standards have appeared on the market. (Isixsigma.com 2022.)

The problem can be defined as the difference between the current and target states. Problem-solving becomes one of the most important aspects of Lean operations. (Chevallier 2016, 6.)

What kind of socks we choose or how we cure cancer is helped by problem-solving. Problem-solving is everywhere in our lives. Problem-solving supports decisions in small insignificant matters and challenging long-term projects. (Chevallier 2016, 6.)

As noted earlier in the text, Lean and Six Sigma involve several problem-solving methods. The next section of the study presents the most commonly used methods. In this thesis, the problem-solving method outside the list is discussed. The study's author wanted to use the list to highlight the broad scope of problem-solving. The method under investigation is called 8D problem-solving. It is also called the eight disciplines method. If a company wants to get to the point where it can start developing a solution to a problem as part of its process, it must first become familiar with the procedures and know how to use them. This thesis focuses on the current state of the client's problem-solving and how to develop it in the future.

2 GENERAL PROBLEM-SOLVING METHODS

There is now a perception that problem-solving is the responsibility of everyone in the organisation. In the past, problem-solving was seen as primarily the responsibility of management. Problem-solving is considered one of the most essential tasks of organisations. Recognition of the importance of problem-solving has become more accessible in an organisation when it is realised that those closest to the problem are best placed to fix it. All organisation members should be seen as part of the problem-solving machinery in their work. (Zarghami & Benbow 2017,15.)

2.1 DMAIC

Companies that want to lead their organisation to a competitive position can approach the opportunity using the DMAIC method. The essence of the method is to use tools and techniques logically to find solutions to a problem. The solutions resulting from a successful process minimise or eliminate the scope of the problem. (Shankar 2008,16.)

The DMAIC method should also be considered a Six Sigma process improvement tool. All steps should be followed if the DMAIC method is implemented in cooperation with different personnel groups. The solution reflects the problem's root cause. (Shankar 2008, 17.)

If the solution to a problem is considered a process, its input is the defined problem. The output of the process is the solution. The DMAIC method can be divided into Define, Measure, Analyse, Improve, and Control. (Shankar 2008, 17.) Figure 3 shows the steps of the DMAIC method.

Figure 3. DMAIC Process (Visual Knowledge Share 2022)

In more detail, DMAIC can be broken down into the following meanings. The list below of the steps in the DMAIC process explains the importance of each step in the process itself. The initial letter of each step explains its primary purpose in the DMAIC process.

- Define: Identify the core of the problem, consider who is affected by the situation, and identify the objectives and how the achieved goals will be implemented.
- Measure: Select the parameters to be studied, find the best measurement methods, collect the necessary data and carry out the measurements carefully before starting work
- Analyse: Identify gaps between actual and target, see how increases in activity affect outputs, and identify potential opportunities for improvement.
- Improve: Identify the methods you can use, plan and identify solutions, also familiarise yourself with non-essential solutions. Do not implement improvements that are not genuine improvements for your organisation.
- Control: Don't let the plans you create get lost in your organisation, but make a plan to monitor the solutions achieved.

2.2 PDCA

The four-step Deming cycle can also be used to solve the problem. It is also known as the PDCA method. The PDCA method can solve problems and improve organisational processes. (Isixsigma, 2023.)

Characteristic features of the PDCA are the Deminig wheel introduced by W.E. Deming in 1951. The cycle is based on the scientific method, where a change is proposed, the change is implemented, the results achieved are measured, and the necessary action is initiated. A cycle variation is also known, where the definition is PDSA. Definition S stands for research. (Lean Institute 2023.)

There are significant companies with a PDCA circle in their toolbox. This four-step method has proven its effectiveness in these companies. PDCA is also known by its alternative name, the Shewhart cycle. (Creative Safety Supply 2023.)

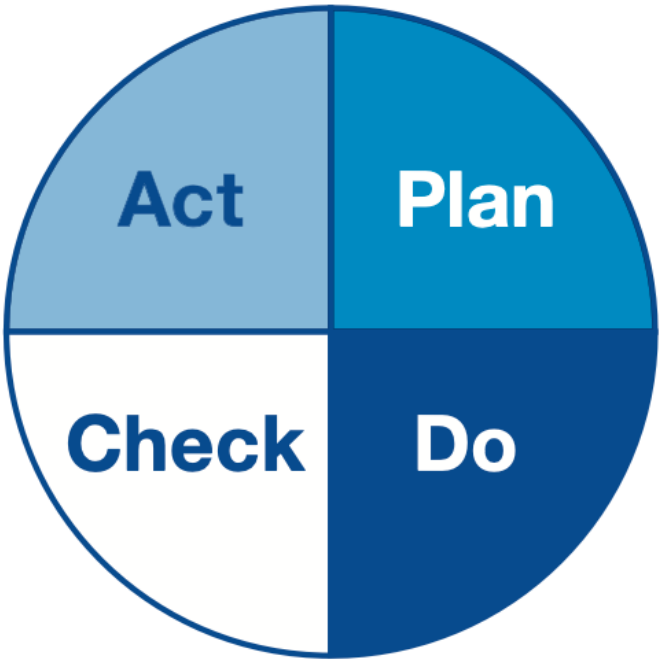

Figure 4. The Plan-Do-Check-Act circle (Lean Enterprise Institute, Inc 2023)

Figure 4 shows the progression and steps of the four-step PDCA method, a circle divided into four equal sectors.

A simple and practical way exists to solve the problem and manage change. It is known as the PDCA cycle. It allows companies to search for information on the elements that must be changed. PDCA will enable you to look at items in many different ways. Before making any decisions, it is worth exploring the possibilities offered by PDCA. (LeanWay 2023.)

2.3 FMEA

An excellent way to collect process data is FMEA. Data is collected in four separately defined steps. The basic idea behind FMEA is to anticipate potential failures and process damage that may occur. (Techtarget 2023.)

The global market is in a constant state of significant challenges. One of the most effective methods to address challenges such as cost reduction, faster development and high customer demands is FMEA. FMEA creates a recency-

based means to address process problems. Three significant challenges can be identified in the supply sector. (Carlson et al. 2012, 2.)

Failure Mode and Effects Analysis, commonly known as FMEA, is a powerful tool that can be used to assess the failure of different items.
FMEA is a tool for assessing processes and their impact on people and other stakeholders. (Weeden 2015, 4.)

Figure 5. FMEA Process (Capvidia 2023)

Figure 5. above shows the multi-step workflow of the FMEA method. The figure identifies the main steps of the whole process, divided into three categories.

Failure mode and effect analysis is not a substitute for a good design but an improvement. FMEA is a step-by-step process of assessing process failures. The FMEA process is initiated when there is a need to identify problems or threats at different levels of the organisation. FMEA is closely linked to problem-solving team tools, so it is desirable to go through the process with the team (Development Studios 2023.)

2.4 8D Eight Disciplines

The US military wanted efficiency and problem-solving capability in its operations. The Army developed its own solution and created the first eight-point system. The method was called Military Standard 1520. Ford, the US car manufacturer, saw the method's potential and developed it further while simultaneously popularising it. The primary use of the method is to solve and eliminate recurring

problems. The hard core of the method lies in the team setup to solve the problem and follow the instructions given step by step. An improved version of the method was created in the 1990s, and at the same time, it was standardised for industrial use. The method is now known as 8 Disciplines or 8 D. (Operational Excellence Consulting 2023.)

8 D is a team-based problem-solving method for solving complex and large-scale problems. In February 1995, Ford Motor Company set up a cross-organisational team to further develop the 8 D method of the 1980s. Ford wanted to incorporate modern computer systems into the process.
The characteristic of the 8D method is that a single entity or person cannot solve the problem at hand. In those situations, the 8 D team shows its strengths. It focuses only on why something or a process is not working correctly. The method does not look for a culprit. (Visser 2018, 22.)

This study focuses on and examines the commonly known 8 D problem-solving method. The method is not new. Visser C.S.P 2018 mentions in his book that the Ford Motor Company introduced the 8 D method in the 1950s. Ford has done significant development work on the 8 D method, as already in the 1960s, it regularly trained its management in the use of different problem-solving techniques. (Visser 2018, 21.)

Figure 6. List of Eight Disciplines (American Society for Quality 2023)

For the markable industrial audience, the 8D process was introduced by the Ford Motor Company, although the process initially had its roots in the US military. At this stage, the method was known as the Eight Disciplines, as the name originally given by the army differed from the prevailing convention. Ford Motor Company was not entirely happy with the name and, in the late 1990s, created the revised 8D method. This revision added step D0, which is considered to be the gateway to the process itself. The D0 step determines, before the actual process, whether the solution requires the help of a team. This step is essential because it saves unnecessary resources during the definition phase. Therefore, it is wise to define the criteria for starting the method, based on which the 8 D team should be formed in the D 0 phase. (Cheok 2022, 8-9.)

Written sources testify clearly that the 8 D has changed over the decades. Among these changes, the problem-solving method has moved from the military to the civilian industry. This shift has naturally led to changes in the approach in different industries to suit them better.

In the late 1990s, Ford Motor Company updated the method to include a new step. This step is called D 0-preparation. At the same time, the technique was renamed the G8 D method. The letter G, which comes from the word Global, was added to the method's name. (Cheok 2022, 8.)

The 8D method favours a combination approach, combining different techniques and their best features. 8 D is a problem-solving tool that promotes system change so that the existing problem can even be avoided. The strength of the 8D method is its structure and rigour. (Quality One 2023.)

3 STRUCTURE OF 8 D PROBLEM-SOLVING METHOD

The main subject area of the study and its structure are presented in stages below. The reader needs to get a clear picture of the subject because of its complexity. The recommended methods and significance of each of the nine steps are presented through observations, photographs, illustrations and literature sources. The process covers a wide range of different areas. However, each element has a single objective: to solve the problem presented.

Many different methods are used to solve root-cause problems. 8 D is one of them. The 8 D method allows you to solve a problem systematically and standardised. An 8 D method is a tool that uses other parts of the quality management system. It can be used to solve both internal and external problems. The effectiveness of the 8 D method is based on eight analytical steps. (Rambaud 2006, 11.)

3.1 D0 Plan

When starting the 8 D process, the project manager should consider whether the problem is ready for the 8 D method. Before beginning the task, the project manager should go through a few basic research questions that must be met. The preparation phase ensures no unnecessary work is done, and that the identified problem correctly meets the project requirements. The project manager may sometimes have to choose the most helpful solution to the problem for the organisation from several existing issues. The project manager should exercise judgement in selecting problems and choose only those that are wise to take the project forward. The problem should be carefully considered before setting up a team or starting a project.

The team leader of the 8 D process should have previous experience running the process, and the management team should appoint an experienced person to lead the team. The appointment of the team leader is the most crucial task for the management. The person selected should have sufficient authority and the ability to mobilise the resources needed to run the team. (Schade 2013, 13.)

Two different versions of the 8 D method have been mentioned in the literature. One, the older method, does not recognise the D0 stage at all and starts the process from stage D1. Ford updates the second version in the 1990s, which mentions the D0 stage. Nowadays, the procedure generally begins from step D0.

According to Matejcek & Jadrný (2019, 6.), the presentation of the 8 D process begins from phase D1 in their book.

According to Zargham and Benbow (2017, 2.), the D0 phase is called the initiation phase. This phase aims to identify the problems identified and their importance for resolution. The step is started if the problem identified by the subject is considered to meet the criteria of the 8 D process. The organisation's management has assigned the issue to the solver and, at the same time, has defined the scope of the solution. This step is called D 0.

When setting up a team, it is essential to consider what resources are available during the process. At the same time, the structure and purpose of the group should be considered. Rantanen (2023.) said it is essential to ascertain whether the problem is emerging or previously unknown in the preparatory phase.

It is fair to say that the essential task of the D0 phase is identifying the problem and drawing up a plan for a possible project. If the problem is to be solved competently, all the steps of the 8D method are needed. The initial problem should not be solved in the preparation phase.

3.2 D1 Creating a Team

After the preparation phase, when preparing to move to the D1 phase of the 8 D method, the process leader gathers the team around them. The group should consist of 3-7 people from different staff groups. All participants in the group should be familiar with the problematic process or product that the group is investigating. The assembled group should not consist of experts from the quality department but should include participants from production, design or logistics. (Matejcek & Jadrný 2019, 6.)

Unfortunately, the influence of good friendships in the work community impacts the structure of the assembled group. Only people who can contribute significantly to the group should be recruited. The qualities required of the group members are an attitude towards the issue to be solved and sufficient knowledge. (Visser 2017, 37.)

Mistakes in choosing the group's composition can affect the whole process. This choice is based on the belief that the team's composition is critical in solving the root cause. (Carter 2015,102.)

In many different projects, reporting is an essential part of the output of the process. 8 D team leaders should ensure regular and thorough reporting by the team. Reporting should be done at all stages of the process. There are ready-made documentation documents for reporting the 8 D process in various sources. (Asana 2023.)

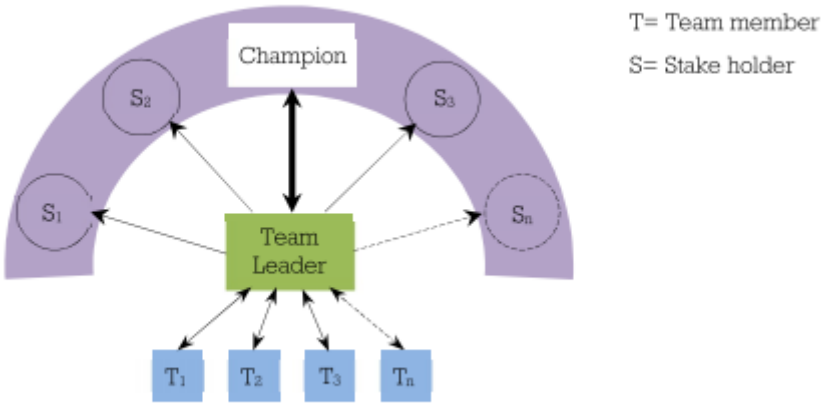

Figure 7. Communication model (Visser 2017)

In addition to documenting the problem, the group leader should discuss it with all the group members. All participants in the 8 D group need to understand how the process works. The group leader should ensure and maintain adequate communication throughout the process.

There are a few critical roles in creating the 8 D problem-solving process. The team leader should confirm these roles before the process is started. These include defining the champion, selecting the team leader, recruiting qualified members and defining the stakeholders. The champion is not an active team member but is the owner and driver. (Visser 2017, 38.)

In addition to documentation, the group leader must communicate with all parties about the problem. His task is to maintain a discussion and information line with the parties so that all parties clearly understand how the project is progressing. The structure of the 8 D process can be interpreted so that there are three parties between whom communication must occur. Figure 7 above shows

the communication model according to Visser (2017, 38-39.) In the diagram, the team leader communicates to all parties involved in the case.

3.3 D2 Define and Describe the Problem

In step D1, the team leader gathered the team around him and assigned them appropriate roles for the project duration. The team leader moves on to the next stage of the process, D2, and starts to define the problem with the team's help. It is generally agreed in the literature that phase D2 is essential for the project's success.

In phase, D2, data collection and problem description must be carried out precisely, as the whole process can depend on the data. All relevant information about the problem should be extracted in phase D2. Relevant information can be obtained from anywhere. The team leader can ask the organisation for help in gathering information. All stakeholders are available for whatever additional information is needed. Figure 8. shows the occurrence of the questions of the auxiliary instrument used in the definition according to Matejcek & Jadrný. (2019, 7.)

Figure 8. 5W & 2 H tool for defining the problem. (Matejcek & Jadrný 2019)

The 5Why&2How method will effectively define the problem in the D2 phase. It is considered one of the most effective methods for describing and understanding the problem. (Cheok 2022, 15.)

The problem description does not always provide enough information for the team to start working on the problem. The information may be missing critical information for the group's work. Therefore, the group leader should determine the direction of the investigation and gather more information about the problem. (Visser 2017, 54.)

If the team needs more detailed information to solve the problem more effectively, Visser (2017, 56) recommends the 5W2H method. Below is a list of the fundamental questions that the group should be able to answer.

- Who? Who is complaining?
- What? What are they complaining about?
- When? When did this problem start?
- Where? Where is the problem occurring?
- Why? Why is this problem occurring?
- How? How did this problem occur?
- How? How many problems?

The problem of an internal or external customer should be solved as precisely as possible, for example, by utilizing a problem analysis. The internal customer is the actor inside your company, and the external customer is the entity that receives your goods as a customer. (Schade 2013, 20.)

3.4 D3 Contain the Problem

Protective measures are initiated to protect the customer from further damage before corrective actions have been decided or assessed. A risk analysis shall be carried out for containment to limit and identify the problem. Measures are never 100% effective, and their benefit will be measured if the customer faces a significant additional bill for defective products. (Matejcek & Jadrný 2019, 9-10.)

Sometimes defective products must be inspected with 100% accuracy if faulty products are to be prevented from reaching the customer. Communication must be sincere between the parties. As a result of the inspection, processes may

need to be corrected to maintain the integrity of the products. (Zarghami & Benbow 2017, 4.)

The 8D team carries out containment operations to stop the flow of goods. If the team suspects defective goods are being generated, it tries to protect the customer's operations by imposing restrictions. The group may even stop the flow of goods as a limitation action. (Visser 2017, 65.)

Figure 9. shows the three main areas of interruption activities according to Visser (2017). In the figure, the yellow arrow points to the supplier, the orange one leads to the process and the red one to the customer.

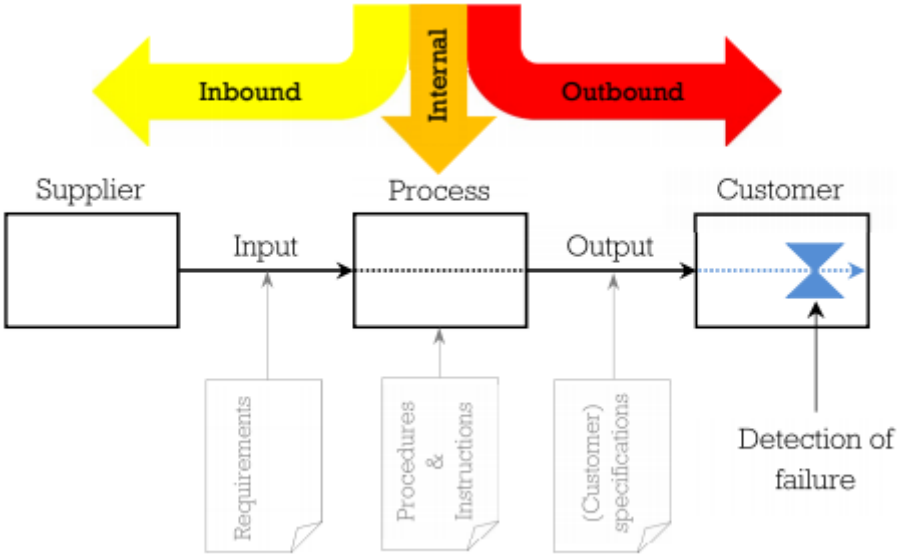

Figure 9. Three directions of the containment actions. (Visser 2017)

The orange arrow in Figure 9 points to internal activities that require more attention than usual in an organisation. These activities are often referred to as 'work in progress'. A group can create constraint actions to save as much as possible or processes in progress. (Visser 2017, 68.)

Outward restriction activities focus on removing defective products so they do not end up in the customer's possession. At the same time, the aim is also to remove the product from the process—the red arrow in Figure 9 points to the customer or the end of the supply chain. The most undesirable containment actions are those directed at the customer, as they provide customers with important performance information. (Visser 2017, 69.)

Restrictive measures should be documented on the 8 D form and reviewed regularly. Restrictive actions are not permanent and are not a substitute for permanent operations. In most cases, constraints are temporary and tend to impose costs on the firm's operations. (Zarghamhi & Benbow 2017, 5.)

If a company wants to keep its customers, the restriction measures must be a joint effort between the supplier and the customers. Isolation measures focus on preventing defective products from entering the production line or even the customer. When the parties know what to expect soon, they have time to prepare for the different options. In the interest of both parties, the search for alternatives should be successful. (Visser 2017, 65.)

3.5 D4 Identify, Describe, and Verify the Root Causes

Organised research, known as root cause analysis, aims to identify the origin of the problem and the appropriate course of action to solve it. Although different techniques and tools are used, root cause analysis appears to be a simple task. There is no universally accepted model or definition of root cause analysis. (Andersen & Fagerhaug 2006, 21.)

Proper root cause analysis is vital; any action taken after D 4 will be futile. Poorly conducted root cause analyses create costs later in the D 4 process and can be considered unnecessary. Other problems may also be found. (Matejcek & Jadrný 2019, 12.)

Instead of using all the tools at our disposal, root cause analysis looks at the tools we already have and chooses the best one to fix the problem. While some problem-solving methods focus more on finding root causes, others can support the essential analysis tasks. As there are simple and complex approaches, there are structural variations between them. (Andersen & Fagerhaug 2006, 22.)

In stage D4, the team assembled for the process will set out to find the root cause of the problem at hand. The literature recognises this is the process's most demanding and time-consuming stage. According to Matejcek and Jardný (2017 12.), it is also the most critical stage of the process.

3.5.1 Root Cause Analysis Tools.

Finding the root cause can be done using various techniques and resources. The 8 D approach is thought to be the only one that fits because there isn't a single, accurate tool for it. The many tools and strategies available make finding the best solution for the group's challenge possible. Commonly used solution techniques are presented in the following chapters.

3.5.2 Flowchart

The team may sometimes find itself in a situation where it needs detailed information on the steps and methods involved in a challenge. The use of flowcharts has been effective in identifying undesirable conditions. The use of flowcharts can help to demonstrate process competence. The group should consider including a two-way flow diagram in their response. (Zarghami & Benbow 2017, 7.)

In a flowchart, boxes of different shapes are used to denote different types of operations. Lines then connect these boxes with arrows pointing to the flow or direction to which one should proceed to know the next step. Figure 10 on the next page shows an example of a basic flowchart. (Chaudhuri 2020, 2-3.)

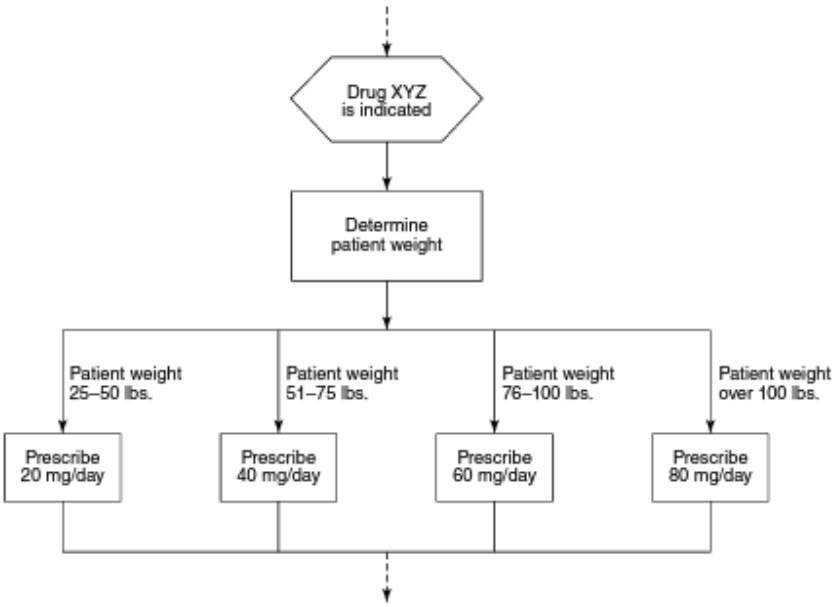

Figure 10. Example of a basic flowchart (Zarghami & Benbow 2017)

One of the vital quality tools is often used to illustrate the process. A flow diagram is one of the most commonly used tools for observing descriptions of a multi-step process (Matejcek & Jadrný 2019, 12.)

3.5.3 Ishikawa diagram (Fishbone)

Ishikawa Kaoru developed the fishbone diagram as a tool for problem-solving. Its primary purpose is identifying a problem's causes, also known as the cause-and-effect diagram. The name Ishikawa is derived from its creator's name. The problem is positioned on the right-hand side and labelled in the chart with an accurate description. The next step involves drawing a horizontal line on the left side, known as the main line. Diagonal lines extend from the main line to identify the potential causes of the problem. There are several techniques for determining the root causes of a problem. Figure 11 illustrates an Ishikawa diagram with descriptive labels. (Ionos 2020.)

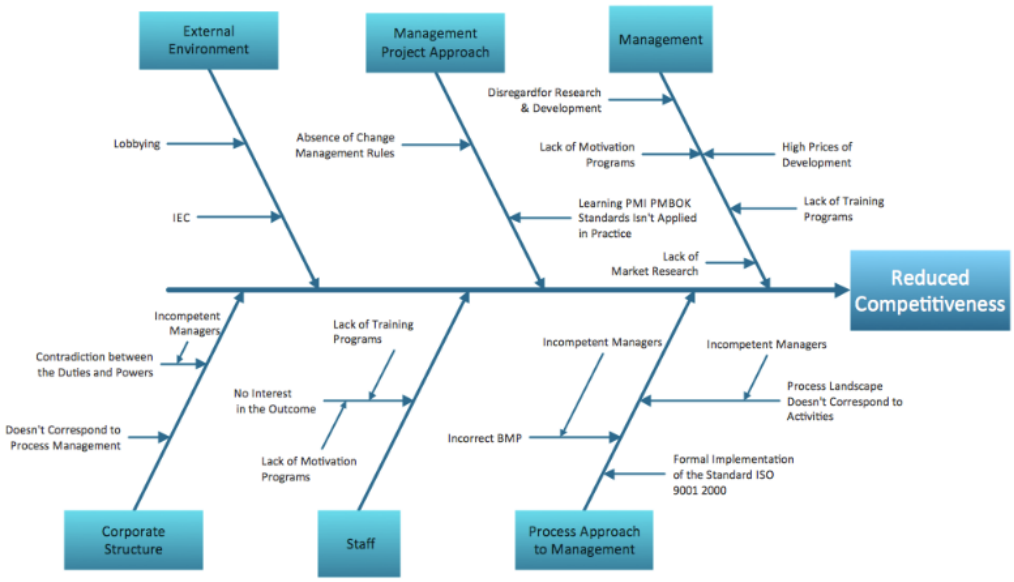

Figure 11. Example of Ishikawa diagram. (Concept Draw Solutions 2023)

The Ishikawa chart is a simple tool to comprehend and utilize as part of the 8 D approach. The fishbone chart is a superb resource for initiating a conversation when a team deliberates a problem. The objective of the discussion is to recognize and determine the reasons for the problem. The fundamental principle for

documenting discoveries restricts the censure of the topics raised. If an informed group suits the fishbone chart, the problem's underlying origin is probably revealed in the finished chart. (Zarghami & Benbow 2017, 8.)

3.5.4 Five Whys

The technique of asking "Why" five times, known as the 5 Whys method, is a powerful tool in Lean management for identifying the underlying cause of a problem. This approach to root cause analysis relies on a series of five interrogative steps. (Kanbanize 2023.)

One of the hazards of team collaborative problem-solving is the possibility of prematurely halting problem investigation. It might be alluring for a group to discontinue their search for fundamental causes after discovering an immediate cause. The 5WHY technique can aid the team in delving deeper into their analysis. This technique prompts the team to scrutinize the identified cause by questioning why the issue arose. After the group has pinpointed the underlying cause of the predicament through the inquiries posed, they must formulate strategies to avert the problem from reoccurring. (Zarghami & Benbow 2017, 11.)

Figure 12. Example of 5WHY method. (The West of England AHSN 2023.)

Figure 12 above shows a basic 5WHY diagram with sample questions. The graph is not related to the 8 D case.

3.6 D5 Choose Corrective Actions

At stage D5, the team has reached the stage where it needs to start taking decisions on remedial action. At this stage, the group must clarify that it can complete the process. If the group doubts completing the process, acquiring additional skills and expertise for its structures remain manageable. The process should not be forced to the end but asking for help in difficult situations is acceptable. Asking for help is an exceptional situation for the group and must be decided by the group as a whole.

The D5 stage in the procedure efficiently constructs causal connections among the underlying reasons, and the team should come up with methods to eradicate these reasons. (Visser 2017, 96.)

The fifth step in the 8 D process is presenting the proposals to fix the problem. This stage is sometimes called the remedy selection and verification stage. (Matejcek & Jadrný 2019, 19.)

During stage D5, the group contemplates the issue and endeavours to resolve it utilizing remedial measures. Following the assessment, the management team conducts a gathering and conducts a cost-benefit examination before reaching conclusions at a reasonable expense. There may be circumstances where corrective measures are necessary at this juncture. The decision is crucial considering cost and timing as they are fundamental and unavoidable.

After pinpointing the root cause of the issue, talks regarding rectifying actions can commence. Any solution must be feasible, functional, economical, and adaptable to process fluctuations. In case of unintentional outcomes, the team should address them and guarantee their non-recurrence. At this phase, long-lasting solutions are recorded, and their efficacy is verified after a trial run. (Zarghami & Benbow 2017, 5.)

“It is vital that the identified action that will eliminate the cause of the problem is verified. Will this problem disappear and re-occur if you remove the cause and re-introduce the cause?”. (Schade 2013, 34.)

Once the process has progressed, it is time to check whether the planned corrective measures are adequate and correctly identified by the team. The group should also internalise a few things before moving on with the process.

By Schade's (2013) publication, the team must review the following items before proceeding. Is the group still suitable for the task, or should additional proficiency be acquired? Have all remedial actions been accurately identified? Has a conclusion evaluation been executed? Have the corrective measures been assessed? Have substitutes to the chosen standards been examined? Has a hazard appraisal of the actions been conducted? Is there a strategy outlining the measures' implementation steps? Is appropriate supervision established or scheduled? (Schade 2013, 35.)

After the 8 D team has selected the remedial actions and accurately documented them in the 8 D report, it is crucial to guarantee all stakeholders that the enduring corrective action will not harm or hinder production. It is imprudent for the team to propose measures that negatively impact operations. Before advancing to stage D6, the team must secure a pledge to proceed to the subsequent step. When permanent solutions are attainable, the team will notify the advocate and other stakeholders. (Visser 2017, 104.)

3.7 D6 Implement and Validate the Corrective Actions

After the team has finished designing Phase D6 and created the implementation strategy, the launch of Phase D6 can occur. This indicates the commencement of the validation phase for the current issue. Phase D6 guarantees that a permanent solution to the problem has been identified. The team should take measures to prevent and rectify any potential issues. All documentation must be revised with new answers, and stakeholders should be notified of the modifications and their implications. The team's implementation plan will introduce enduring solutions while closely monitoring their efficacy. (Visser 2017, 108.)

Referring to Schade (2013), the team must follow the following steps to complete the stage successfully. The team should revisit the following checklist to ensure that everything possible has been done to ensure the success of this step D6. The team should review the FMEAs: and reassess the severity, frequency and new control levels of these items in the FMEA report. The measurements can be relied upon if the team performs validation measures using validation tools. (Schade 2013, 38.)

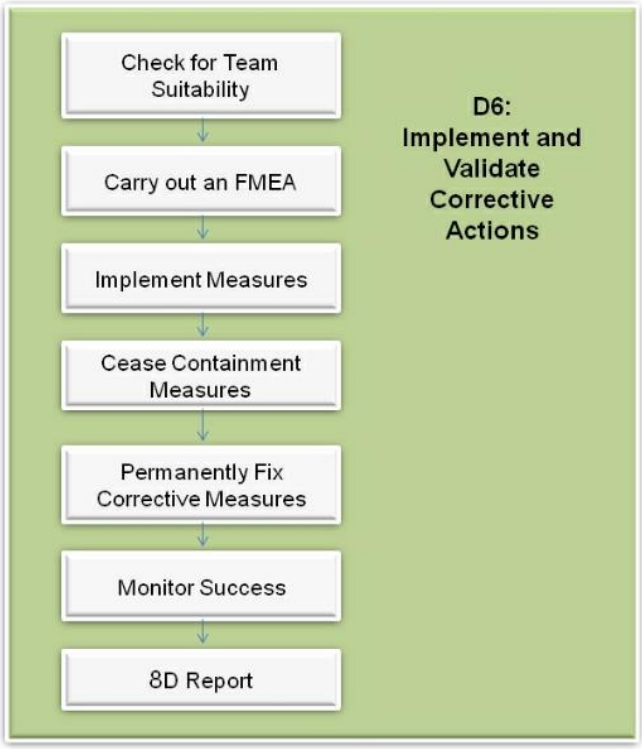

Figure 13. D6 Corrective and Validation Actions. (Schade 2013)

The figure above shows the validation measures recommended by Schade in 2013 for phase D6. Conducted are the activities that should be implemented and validated.

At this stage, all documentation must be together, and each item must be identified and linked to the central document, the 8 D report. (Schade 2013, 39.)

3.8 D7 Preventive Actions

In step D6, the selected remedial measures are implemented. The group should also draw attention to the fact that if the corrective actions are not fully implemented, the restrictive measures will remain in force. (Matejcek & Jadrný 2019, 22.)

What is done in step D7 can be helpful. The knowledge gained is stored for the future, and the group's improvements are replicated elsewhere. Maximising the benefits of the 8D process prevents problems from occurring in other functions. (Schade 2013, 43.)

“Step D7 looks at the problem so that there is no risk of the same problem recurring in the organisation.” (Schade 2013, 42.)

Step D7 aims to prevent the problem by looking again at the systemic causes. It is essential to find the circumstances that caused the situation to occur. (Visser 2017,118.)

“The intention of D7 is to document and share the Lessons Learned to prevent the recurrence of the same or similar issue on similar products, processes, or at sister plants.” (Cheok 2022, 86.)

For the group, stage D7 is an important message. This is the moment where all the lessons learned are put into practice. This implementation ensures that the new models are more sustainable and that the 8D process is of maximum benefit to the community. (Schade 2013, 46.)

During phase D7, it is feasible to implement a methodology that enables the attainment of a scenario where the outcomes of the process can be educated within the problematic establishment. The team can disseminate the conclusive 8D record to the company for instructional purposes. Instruction is believed to influence the frequency of issues in the organization. If the matter is not confidential, the ultimate data can be communicated to customers. (Visser 2017, 119.)

Even if the team has now carefully identified and validated the causes of the problem, there may still be questions for the group arising from the tasks carried out in the previous stages. As the team's work progresses, it is natural that the anatomy of the team will give rise to new questions that cannot be fully resolved at any stage. This phenomenon is natural because the problem is alive and well. As a result, the questions will manifest themselves in different ways at different stages of the 8D process.

3.9 D8 Closing

Now that the process has reached the final stage of the 8D method, it is time to congratulate the team for going through the whole process and doing a good job. During the group work, some participants were more dedicated than others, which can naturally lead to debate. The final stage of the 8D process is a time to forgive differences, as the completed 8 D process is a success story and, of course, always the result of the whole group. The group is all its participants. (Schade 2013, 47-48.)

A team leader must consider all the hassle and neglect the work for the 8 D process. Most group members are not problem-solving professionals; now is the time to reward them for their contribution. However, the most essential task is to treat the participants with respect and dignity. (Visser 2017, 128.)

Concluding the 8D report marks the last phase of the process. This is an opportune moment to convene with the team and give a synopsis of the issue and the corresponding measures to resolve it. The summary ought to be accompanied by the necessary documentation and scrutinized. Upon review, the ultimate report should be endorsed. The 8 D champion inspects the final report and affixes its signature. The master's signature denotes the end of the 8 D process, paving the way for an evaluation of the project's success. (Matejcek & Jadrný 2019, 24.)

4 PROBLEM-SOLVING IN JOHN CRANE’S NORDIC

In all John Crane units worldwide, problem-solving is centralised in a single software and database. All quality issues and customer complaints are recorded in the Salesforce database. The data is collected site-by-site, so auditing and

reporting can be done anywhere worldwide. This freely available data provides a transparent and trustworthy picture of quality performance. Because of its availability, this data can be checked by those affected by any problems. This method of recording quality deviations was introduced in the organisation in March 2023, so the process is still relatively new for everyone. Statistics on the number of notifications, defective parts and the overall John Crane quality rate are collected from the reports according to the cases entered at the head office level. Through this Salesforce database, quality deviations are also managed and defined, which will end up in the main topic of this study, the 8 D method. At the time of the study, February 2023, the organization had accumulated little experience in the environment that activates the 8 D process. This fact above contributes to the survey conducted in the study context.

In 2022, 2,034 notifications were made and recorded at John Crane. It should be noted that the figure also includes companies within the Smiths organisation that use the same system. Of the notifications, 124 were initiated in 8 D processes at John Crane units worldwide. It should be noted that no case has ended up in an 8D procedure in the Nordic countries during the study period. The current 8D processes were mainly initiated in North America and Latin America. This study explores opinions, experiences and willingness to use 8 D in Nordic countries. According to the company's archives, there are several cases in the Nordic countries where reporting is so severe, however, that an 8 D process should have been initiated. However, for whatever reason, the above has not been started. The previous provides a good starting point for conducting this investigation in the Nordic countries.

4.1 Notifications

When one of the stakeholders is not fully satisfied with the performance or customers want to discuss our products' quality, they will report or complain. The subject of the complaint is forwarded to the sales organisation in the region concerned. The sales manager in the area(s) concerned will carefully record the details of the matter for a formal complaint. The record is immediately sent for information to the region's Quality Manager and the manufacturing unit to which the complaint belongs. Once the customer or stakeholder notification is

forwarded to the responsible team, it is recorded as a quality issue in the Salesforce database.

The responsible unit will investigate the customer's complaint immediately after the matter has been brought to its attention. As a first step, the Quality Manager of the team explores the case and takes the necessary decisions to handle the complaint further. At this stage, all the notifications to be recorded can be divided into five levels according to different categorical criteria. The level of seriousness is categorised using additional information. These include the impact on the customer, the financial damage to the company, the production process results and, of course, the impact on the security of supply.

The complainant will be carefully informed of all stages of the procedure, from initiation to completion. The investigation itself is an internal process. The final case report of the investigation is sent to the customer for consultation and retention, provided that the case does not contain any material sensitive to the organisation.

The 8D investigation under investigation is automatically triggered in Salesforce if specific criteria are met. The severity categories have already been described earlier in the text. The Salesforce database is structured so that for an 8D process to be triggered, several high-severity events are required for the process to start. One significant event is rarely enough to begin an 8 D process.
As mentioned above, based on the information entered into the system during registration, Salesforce software classifies the notification into five severity levels. These notification categories are:

1. **Neglible** = No significant impact on customer or supplier operations. The economic effects are minor. No tracking is required.

2. **Minor** = Effects noticeable due to error. Little impact on the customer's or supplier's operations. No effects on operational activities. Financial damages of less than €1,000. A follow-up is to be arranged upon request.

3. **Severe** = The effects due to the error are considerable. The results can be seen in one process or the supply chain as a weakened performance. Financial consequences over €3,000. Requires follow-up after corrective actions.

4. **Major** = The effects on the customer's or supplier's operations are significant. Multiple functions in disturbance mode. Business interruptions. Financial consequences €5,000-€20,000. Follow-up is inevitable. Requires reporting through the 8D method.

5. **Catastrophic** = The effects on operations are disastrous. Operation suspended in several processes. Functions cannot continue until corrective measures are taken. Economic impacts are unknown. Requires monitoring, 8D reporting, and the participation of the Global Quality Team. The permission of the company's management is required to continue operations.

While the above list provides strong measures for notifications, it should be recognised that the majority of notifications recorded are minor or of negligible seriousness and no further action is required.

The organisation has a specific rule: no customer complaint is so tiny that it is not recorded and dealt with. Doing so ensures that the organisation constantly improves quality, even in small matters. This approach aims to improve overall quality. Overall quality is an important indicator closely monitored by management and requires continuous improvement.

5 RESEARCH

The data for the study was collected through questionnaire interviews with Nordic quality actors. The survey material was sent by e-mail to each participant. Respondents had ten days to complete the survey before it closed. The full survey was conducted in March 2023 and consisted of a total of 32 problem-solving questions and a free-word question. Some questions collected only basic information relevant to the study, such as position in the company and length of service. The survey was completely anonymous if the respondent wished to do so. The answers to the questions were analysed, and an overall picture was drawn. The responses were mirrored against the complex research questions and then organised and interpreted.

The final step in this operational research process was to summarise the results, assess the credibility and validity of the research and draw conclusions. Based on the interviews and the study's findings, the author will present his

views and suggestions for improvement to the management. The recommendations appear as a separate section in the conclusions section. Naturally, the results and tips for development may be subjective, as the research was carried out as an individual project. The author's position in the target company may influence the conclusions.

This development work focuses on mapping the use of the 8D problem-solving tool in John Crane's Nordic units. The study's starting point is to interview and conduct a survey on the current problem-solving state. The study is limited to the Nordic units, as European-wide research would have been impossible to carry out as a master’s thesis study. 8 D is the parent company's problem-solving method and is widely used on all continents. As part of the research work, the steps of the 8 D method are briefly outlined in the report to facilitate the reader's understanding.

The first stage of this study was to outline and decide on the research topic. The theoretical basis for the study was gathered from literature, articles and electronic sources.

The next stage of the study was to examine the theory and select the relevant issues for the study itself. Drafting the survey questions and sending them to the chosen participants initiated the actual recording of the research. The survey questionnaire sample was slightly lower than expected, as the organisation did not have more potential candidates for the survey.
After recording the theory, conclusions and suggestions for improvement, the study was ready for the author.
The study author experienced some exciting challenges during the research process when significant work disappeared.

5.1 Goals of the research

This case study aims to present the problem-solving method chosen in the John Crane organisation in a way that does not leave doubt about its purpose and effectiveness. The results of this study can be used in any John Crane industrial unit that uses problem-solving as part of its quality work. The study is helpful to the organisation, and no similar studies on development and problem solving

could be found in the company's internal archives. Globally, John Crane has decided to adopt the 8 D method studied and make it known to its staff, especially its quality managers.

The main methods used in the study are a mapping of the current state of problem solving and a written presentation of the chosen topic. As part of the survey, respondents will be asked for suggestions on improving problem solving in the John Crane organisation.

5.2 Data collection

Conducting qualitative research is a complex process that cannot be easily defined when attempting to decipher its essence. In an optimal scenario, we would compile a list of distinctive attributes that are unique to qualitative research and do not exist in other research methodologies. (Hammersley & Campbell 2012, 2.)

Social research is deemed qualitative, delving into how individuals internalize their encounters and surroundings. Researchers utilize the qualitative method to investigate emotions, experiences, and perceptions. On the other hand, the qualitative approach is more fitting when examining conflict or transformation. (Holloway & Galvin 2016, 3.)

Qualitative research has been used as a scientific tool since the 1960s, even though quantitative research was dominant at the time. Qualitative research was driven by a desire to displace non-quantitative data. These efforts introduced questionnaires and tests as a more effective and reliable approach. Quantitative statistics alone were considered inadequate at the time. (Hammersley & Campbell 2012, 10.)

The origin of qualitative research is relatively recent; however, during the 1700s, its pioneering investigators were already familiar with the concepts of quality and quantity. This era marks the inception of qualitative research. (Leavy 2014, 18.)

“Qualitative research aims to comprehend that relevance is socially built by individual people who interact with their world, where occurrences are not single, fixed, measurable, or agreed upon.” (Merriam & Grenier 2019, 21.)

Instead of gathering information from different sources to make judgements and insights, researchers create their wisdom based on the data they collect. A characteristic process of qualitative research is to interpret and theorise concepts on which to build a theory. It is good to be aware that theory building is a creative rather than a mechanical process. (Taylor 2015, 19-20.)

When gathering data in qualitative research, the primary instrument for data collection is typically the researcher. Typically, qualitative research depends on conducting interviews with participants. The information obtained through interviews is an effective method for recording and bringing individuals' opinions, perspectives, principles, convictions, and emotions relating to their personal experiences and factual information about their lives. (Saldaña 2011, 32-33.)

As per Leavy (2014), a qualitative investigation is relatively unfamiliar. It is deemed to be a laborious and demanding process to carry out. Qualitative research highlights intention and origin. It can amass an extensive array of information regarding issues. (Leavy 2014, 458.)

A case analysis centres on examining a solitary occurrence or succession of happenings. The crucial initial step for this research technique is gathering a broad spectrum of information explicated accurately. A vital inquiry of a case analysis is, "Is it possible to gain knowledge from the case?". (Laine et al. 2015, 9.)

According to Leavy (2014), a case study involves recording information about an individual, a group, an organization, or an entity. This recording takes place within a socio-political framework. (Leavy 2014, 455.)

Like various other types of qualitative research, case studies have similar underlying principles and investigative techniques. Nonetheless, qualitative re-

search cannot be entirely synonymous with case studies. While other approaches may be employed, some qualitative research may not be associated with a case study. (Simons 2009, 14.)

Conducting a case study can vary in pace, contingent on the duration and resources accessible. It is plausible to conduct a case study spanning several years, enabling the investigator to scrutinize the causation of events. Conversely, a case study can also be executed within a few days, weeks, or months. (Leavy 2014, 455.)

Numerous versions of the case study can be found in the literature. This research does not explicitly concentrate on any particular methodology but relies on the widespread understanding of case studies. Here is a concise account of the information on the categories of case studies referred to in the literature. A case study that relies on a theoretical framework is meticulous in its research approach. Examining a concept begins with a specific theory, which is then tested using a case study. An assessment-based case study necessitates more detail due to the real-world setting.

Case investigations concentrate on intricate and prolonged occurrences. Augmenting familiarity with the topic or situation being scrutinized is one of the objectives of case studies. A case study centres on a particular subject or demographic. Case studies are deemed to be an exceptional mode of exploration. (Laine et al. 2015, 11.)

A case study was chosen for this study because the starting point of the research was to find ways to develop quality management and to problem-solve in Nordic communities.

5.3 Survey for Participants

The investigator proceeds to inquire about the participants and records their answers. The rate of replies is generally more significant than mail surveys, as the investigator can persuade a potential participant. Conducting in-person interviews is more expensive and time-consuming than sending questionnaires by mail. (Kelley et al. 2013, 262-263)

5.4 Questions Asked in the Survey

As previously stated in the research, an inquiry was carried out among quality supervisors within the John Crane corporation, and interested parties closely engaged in quality improvement and troubleshooting. The questionnaire was dispatched to 11 individuals, all of whom replied in their manner. As a result, the questionnaire obtained a 100% response rate, which is a positive outcome considering the limited time frame and the restricted number of appropriate respondents in the Nordic countries.

Nonetheless, it must be acknowledged that several inquiries remained unanswered, while some garnered a more significant number of replies than respondents. This implies that the overall response rate can only be deemed moderately dependable. The survey instrument comprised 32 items and was fashioned using the complimentary Google Forms software. The items were categorized into three distinct sections. Moreover, two individual interviews were conducted with seasoned 8 D users during the survey. Both interviewees occupy quality development positions in their respective organizations. One interviewee is employed by a subcontractor of the target firm, while the other works at John Crane's main office in a quality management capacity. Both interviewees were asked the same fundamental questions as the other study participants. The employment of the 8 D tool and its appropriateness for the study domain were also deliberated with them.

“The complexity of a survey is based on what information is needed, whom we need to get that information from, and how we’re going to get that information”. (Cowles & Edward 2015, 75.)

The queries presented in the investigation have been classified into different sections based on their nature. In the preliminary stage of the study, a conscious attempt was made to divide the queries into three primary themes. However, some questions in the questionnaire could not be appropriately sorted during the layout phase, so they were dealt with separately. The questionnaire was designed to be user-friendly, allowing respondents to answer anonymously. Most of the questions are in the format of multiple-choice, where the respondent

is provided with answer options as part of the survey. Additionally, open-ended questions require respondents to provide their answers verbally.

Kelley (2003) argues that open-ended questions are time-consuming and challenging to analyse, but at the same time, they can provide helpful information on the topic. (Kelley 2003, 263.)

5.4.1 Survey Questions 1-3

The investigation for this research was dispatched to a relatively limited audience recognized to be engaged in the topic of 8 D. As earlier stated, the queries are categorized based on their distinguishing characteristics. In the initial queries 1-3 of the investigation, the respondents were presented with the only questions that encompass personal details. The research objective of the queries was to determine the age bracket, the role of the survey respondent, and the duration of employment in the aimed organization. The queries provided were intended to differentiate by gender, position, and proficiency. We can identify who is engaged in 8 D by posing these crucial questions.

5.4.2 Survey Questions 4-14

Questions 4-14 of the survey aimed to establish the respondents' comprehension of the Lean methodology. Lean significantly impacts various aspects of manufacturing organizations across diverse industries, particularly in addressing problems. The survey commenced by gathering information on the current problem-solving status and the level of proficiency in the target company. The respondents were queried about the names of the most widely recognized Lean tools and their familiarity with the topics presented. Generally, the responses were obtained by selecting the options familiar to the respondents.
Additionally, respondents were allowed to provide verbal responses to share their previous experiences with the presented tools. This segment features the client's initial inquiry regarding the company's problem-solving status. The questions aimed to obtain information and a point of reference for comparing the competence level of the Nordic entities.

5.4.3 Survey Questions 14-26

The second part of the study focused on the state and frequency of problem-solving in the partner company. It also asked whether the respondent had any experience with 8 D and, if so, in what role the respondent had been involved. This section's second essential research objective was to identify, through questions, whether the 8 D process was successful and whether assistance was needed. If the process was unsuccessful, respondents were asked to explain in their own words the reasons for the failure and the factors that led to it. In total, there are 13 questions in this section. The questions were presented in a prepared format where respondents could select one or more answer options. The number of answers depended on the respondent. Respondents were also allowed to submit their written responses to questions for which the study author wanted clarification or additional information from respondents. This section presents the questions relevant to the survey and contains the highest number of questions.

5.4.4 Survey Questions 27-32

The third and final part of the survey contains only six questions. These questions were used to gather information from participants on how they would develop a solution to the 8 D problem in their organisation. In addition, respondents were asked about their willingness to participate in the group if an 8 D process were to be launched in their domain. The study author collected future development ideas and topics from the questions asked for the Nordic entities.

5.4.5 Interview Of Quality Professionals

The study's author had the opportunity to interview quality professionals from outside his organisation. Two interviews were included in this study. The interviewees were asked the same questions as the respondents. In addition, they freely discussed quality work, mainly using the 8 D problem-solving method. The study's author already knew that both had extensively used 8 D in their work. This fact influenced their inclusion in this study. The interviewees are permitted for limited use of personally identifiable material in the report, so their names are not mentioned in the archival copy. To make identification more difficult, interviewees' names are only mentioned using their surnames.

Interviewee Rantanen actively cooperates with the study author. He works as a quality manager and has actively used the 8 D method during his career. Rantanen mentions that 8 D is an excellent tool for more significant anomalies. In particular, the structure and clarity of the process make it a good reporting tool. However, Rantanen believes 8 D should not be used for minor deviations. Interviewed Rantanen also mentions that the 8 D feedback he receives from his clients is often poorly reported at the end-user level. The 8 D process has not been carried out professionally. Rantanen recommends the use of support tools in the 8 D process. For example, he says that the Ichikawa diagram is a great help in solving a problem. It emerged from the interview that Rantanen hopes the study will help the Nordic organisations under investigation improve their process further by using 8 D. The results of the survey of the interviewee Rantanen are not included in the results of the study, as he is not part of the target organisation. Rantanen's answers were well in line with the other respondents, although more extended than the others. The interview lasted one and a half hours in January 2023.

The other interviewee in this study belongs to the target company. His office is located in Morton Grove, Illinois, USA. The interviewee is a member of the client company's quality organisation staff and an indirect supervisor of the study author. The interviewee, Mr Smith A., deals with severe or complex quality problems that have occurred worldwide.

As mentioned earlier in this study, all serious quality incidents involve an 8 D process. Interviewee Smith A. is an expert in the use of 8 D.

The interview was conducted via the Teams service. Coordinating schedules was challenging due to the significant time difference between sites.

Unfortunately, answering the questionnaire played a minor role in this interview, as Smith A. wanted to discuss quality management more broadly. Mr Smith said the 8 D method proved effective in many complex cases, provided staff were committed to it.

Smith A. hoped that the study would provide the Nordic services with good points for development, and, above all, he hoped that the method would be actively used. The Teams interview lasted 45 minutes on the first day of March 2023.

6 RESEARCH RESULTS

This case study aimed to gather information on the state of 8 D competence and its development in Nordic units. Organising an international survey across several countries is challenging, and the design of the survey that was carried out was, at times, complex. This study sought ways to build on existing experiences, processes and models. The study was conducted by interviewing employees of companies in different locations. The study provided the author with important information on the current state of problem-solving and the usability of the 8 D method. The survey gave a good insight into the level of knowledge of the company's employees at the time of the study. This chapter interprets the questionnaire interview results and highlights the participants' most common experiences and perceptions. The response data have been included so that the answer to each question is not presented, but the responses are grouped. The questions do not necessarily appear in numerical order in the reactions but are grouped according to their relevance to the topic. In interpreting the responses, the author found that not all the questions presented met the required level of significance, so some of the questions have been removed from the interpretations as being of minor importance.

The results also indicate that respondents have used the option not to comment or not to answer the question at all. As a reflection of the above, there is some variation in the responses, so there may be a different number of responses to individual questions. The survey's author has made an interpretation based only on the answers given.

6.1 Results for Survey Questions 1-3

Survey questions 1-3 asked for basic information about the participants. This information was used to identify the gender of the participants, their position in the company and the length of their career in the target company. All participants answered the first identification questions. Figure 1 of the question below shows that the position in the company varies widely among the participants. The largest group of respondents was 'Other', with four indicating that they belonged to this category. The results also show the anomaly that there was one more response than the number of respondents. The above confirms that one

respondent answered this question with two options. The QEHS manager, production manager, and engineer received two responses.

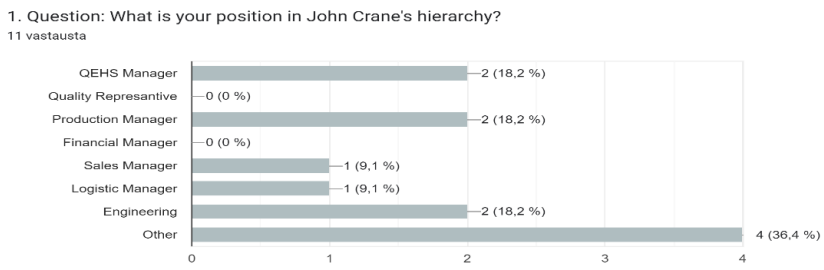

Figure 14. Responses to Question 1.

The second question asked about the gender of the respondents. All 11 respondents answered the question. Figure 15 below shows that the gender distribution of respondents is strongly male-dominated. Of all respondents, 81.8% were male and 18.8% female.

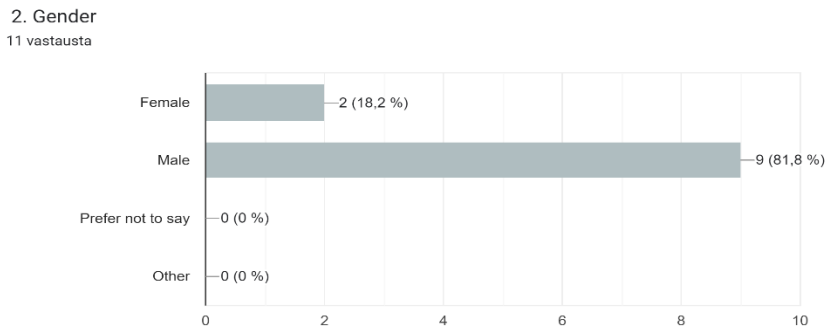

Figure 15. Responses to Question 2.

The third question asked respondents about the length of their employment in the target company. The response rate for both groups rose to 27.3%. The groups 11-15 and 16-25 years attracted three respondents each. The responses indicate that the length of employment in the target company is relatively long and reliable. Reactions from the bottom two groups were relatively few and are considered reasonably insignificant. The pie chart in Figure 16 shows the distribution of the responses and their distribution between reactions.

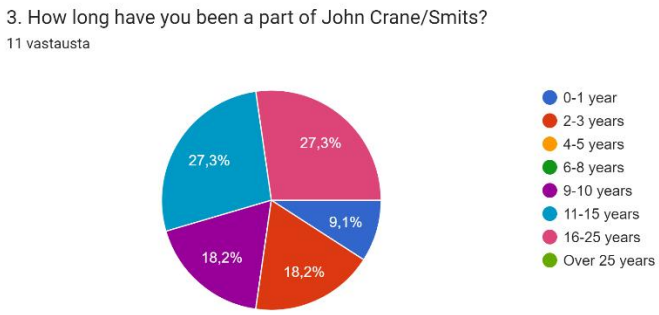

Figure 16. Responses to Question 3.

6.2 Results for Survey Questions 4-13

Questions 4-15 of the survey collected information from respondents about problem-solving, their knowledge of the Lean approach and what problem-solving instruments they were familiar with or used to using. The author considers the information relevant to the nature of the study, as the terms and concepts identified in the questionnaire are well-known and widely used in the industrial world. The answers provided can be used to interpret the use and knowledge of problem-solving tools and methods among the staff of the target company. Figure 16 of the fourth question shows that 90.9% of respondents indicated familiarity with quality management and problem-solving concepts.

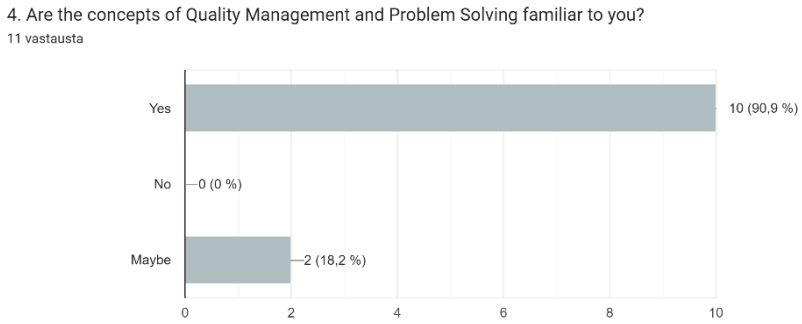

Figure 16. Responses to Question 4.

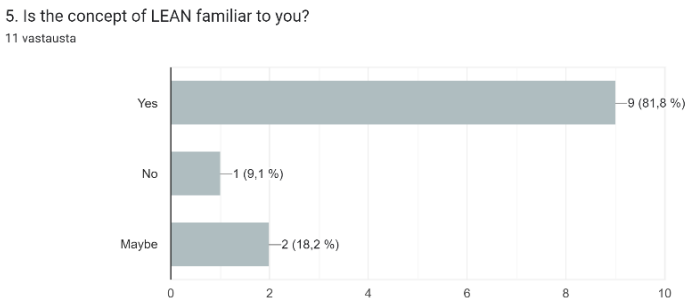

Figure 17. Responses to Question 5.

The fifth question asked respondents how well they understood the concept of Lean. The results have already shown a phenomenon where there are more answers than respondents, as seen in the responses in Figure 17, which suggests that one respondent probably chose more than one of the options. The statistical reactions show that Lean is a standard method for Nordic respondents. More than 81% of respondents indicated that they were familiar with the concept of Lean. Only one respondent was familiar with the Lean concept. In percentage terms, 9.1% of the respondents were unfamiliar with the Lean concept. 18.2% of respondents said they needed clarification to understand the idea. All other respondents were familiar with the concept.

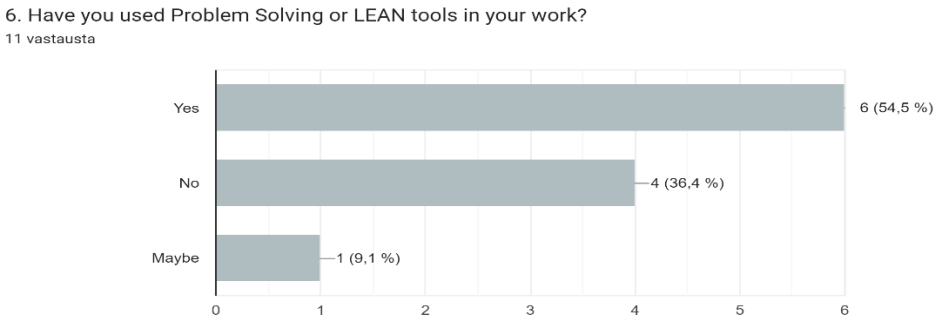

Figure 18. Responses to Question 6.

In the sixth question, interviewees were asked whether they had used Lean or problem-solving methods and tools. Figure 18 shows that 54.5% of the respondents are familiar with and have used the concepts in their work. 36.4% of the respondents indicated that they did not know enough about the methods asked. One respondent could not give a clear answer to the question. This single response accounted for 9.1 % of the results.

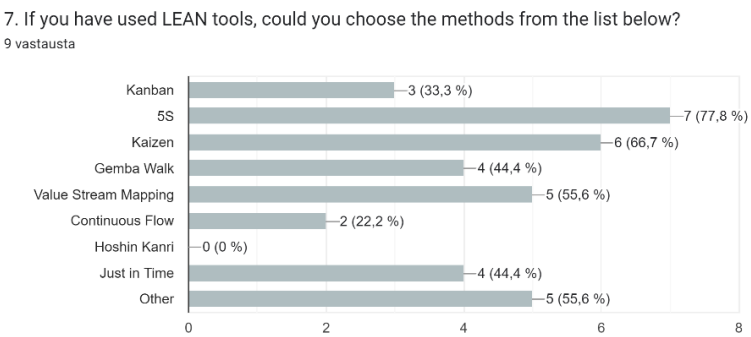

Figure 19. Responses to Question 7.

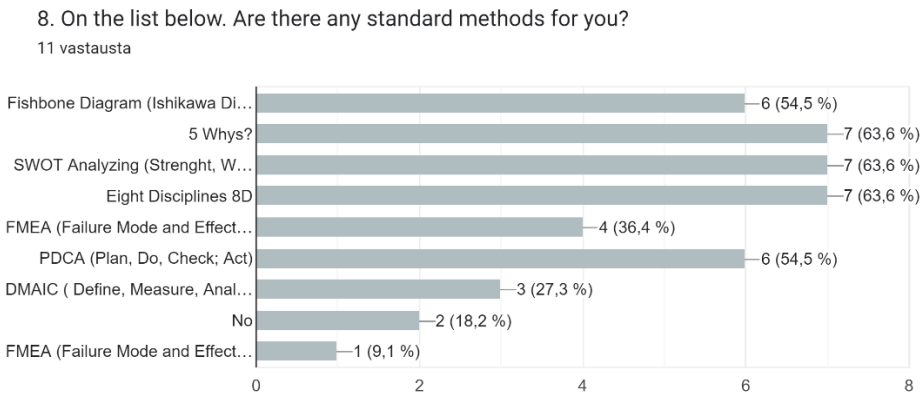

Figure 20. Responses to Question 8.

Questions seven and eight surveyed respondents' knowledge of problem solving and Lean tools. In the responses to question seven, the two methods were the most familiar and therefore attracted the most responses. Of the methods used in question seven, 5S was the most widely used in the workplace, with a 77.8% share. Kaizen was the next most used, with 66.8% of the responses. The distribution of reactions can be seen in Figure 19. The question structure allowed respondents to select multiple answers, so it should be remembered that the responses do not represent the overall percentage but how many respondents were familiar with the method or tool. Respondents provided fewer responses in terms of importance for the other response options in question 7. However, it should be mentioned that even if there were more answer options, the familiarity rate is still around 50% for these answers. Only the option Hoshin Kanri was unknown to respondents, with zero per cent of responses.

The following observations can be made from Figure 20 of question 8 on page 51. The three available tools received the same percentage of recognition. 66.3% of the respondents recognise the 5WHY, 8 D and SWOT methods. Based on the literature, the methods mentioned earlier are widely used in the manufacturing industry. PDCA and Fishbone diagrams were the next most popular among respondents. They accounted for 54.5% of respondents. Two respondents said they were unfamiliar with some or any of the presented methods. The percentage of no responses was 18.2%, which seems high in percentage terms, but the reasonably small sample size affects the magnitude of the figures even for a single reply.

The answers to the ninth question show that quite well-known methods are presented. Some verbal responses use the same techniques as in the original survey. The value of the oral comments in this context is mainly illustrative and data collection. The question response table can be found in the appendix.

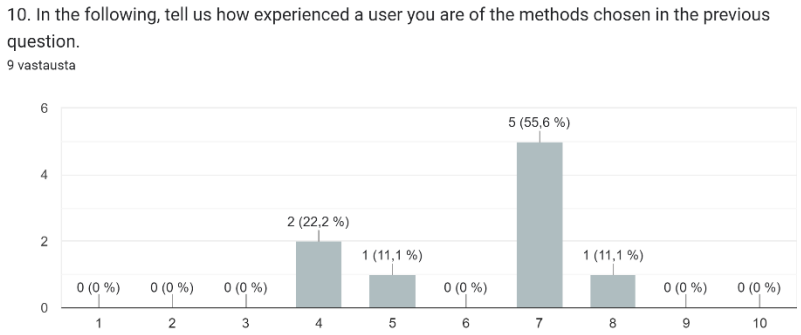

Figure 21. Responses to Question 10.

Question 10 is classified as general, as it asked respondents to rate their own experience of the methods and tools that the respondent had provided in questions eight and nine. The answers in Figure 21 show that the solutions are concentrated on answer seven, and it can be concluded that the respondents do not consider themselves true professionals in the field or beginners. For the target organisation, the result is promising, as the answers can be interpreted as indicating that a little additional training on the subject can raise awareness in the organisation.

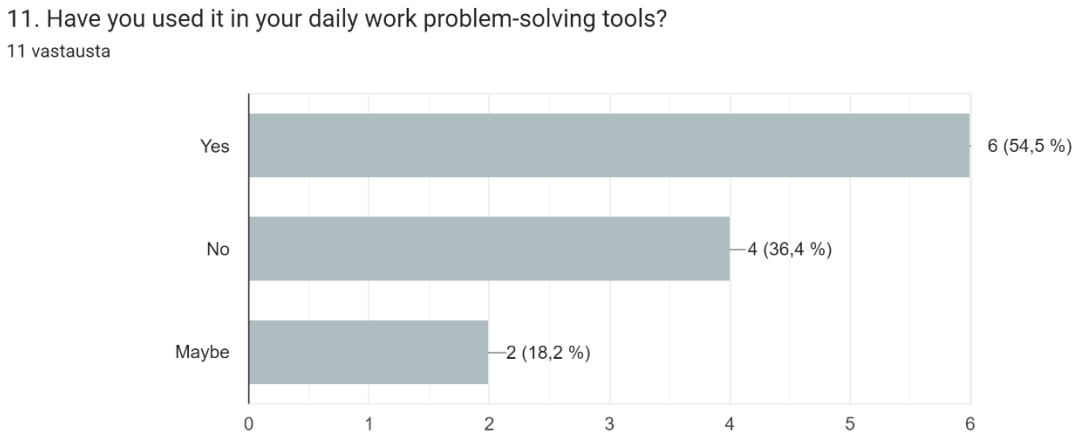

Figure 22. Responses to Question 11.

Question 11 targeted respondents to determine whether they had used problem-solving methods in their daily work. From the responses in Figure 22,

54.6% of the respondents use the techniques in their work, while 36.4% do not. The answer "maybe" given by two respondents leaves the interpretation open.

Question 12 was the survey's first question, addressed to the Commission member company under investigation. The question asked how practical the respondent considered using problem-solving tools in the target company. Figure 23 shows an even distribution of responses across the response scale. However, 90% of respondents ranked their position above the middle of the scale. Only one respondent answered the above. Responses to options 8 and 6 both received 30% of the answers. No responses above 30% were observed for any question.

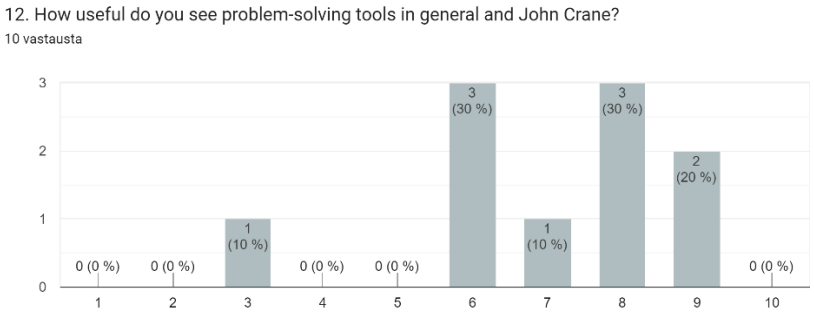

Figure 23. Responses to Question 12.

Question 13 asked respondents whether they felt that the problem-solving method gave them answers to the problems they had solved. Figure 24 clearly shows that respondents consider problem-solving techniques to be helpful to them in solving problems. 70% of respondents said that they get help from problem-solving methods. Three respondents did not share the majority opinion, and neither option was selected for two.

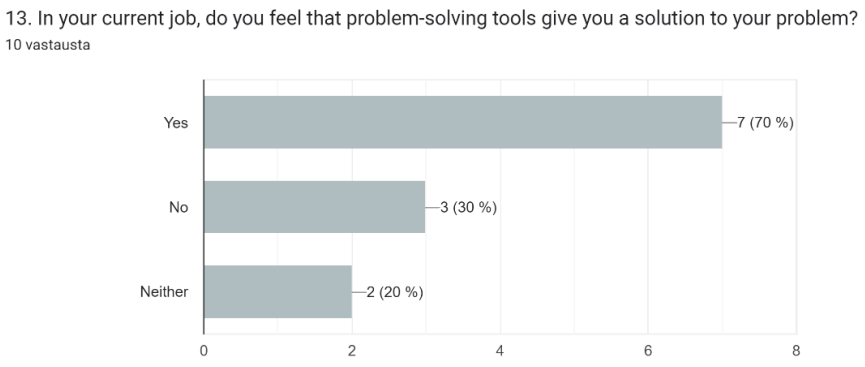

Figure 24. Responses to Question 13.

6.3 Results of Survey Questions 14-26

The second part of the study will provide different perspectives on the 8 D problem. The survey questions focused more on efficiency and the current state of problem solving at John Crane Nordics. The questions in the second part asked respondents about their preferences and views on the form of the 8 D process, successes and potential failures.

The first question, 14 in the second part of the survey, asked respondents to give their opinion on whether the problem-solving method 8 D chosen by the target company was a process or term with which they were familiar. The responses in Figure 25 show that 63.6% of the respondents are familiar with the 8D process. Two respondents say they are unfamiliar with the 8 D process, and two are uncertain. Both options garnered 18.2% of respondents' opinions. For the author, this strong distribution of responses was a slight surprise.

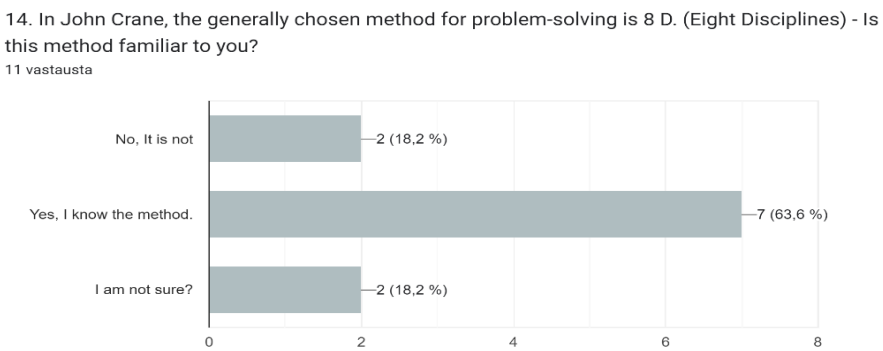

Figure 25. Responses to Question 14.

In question 15, respondents were asked a direct question about whether they had ever owned an 8 D process. The breakdown of responses was that three indicated they had been an owner, while eight stated they had not played that role. The author found the result very similar to what he expected from his experience. Figure 26 on page 55 shows the percentage distribution of responses to the question. It had been easy for all respondents to answer, as the option "maybe" had not been selected.

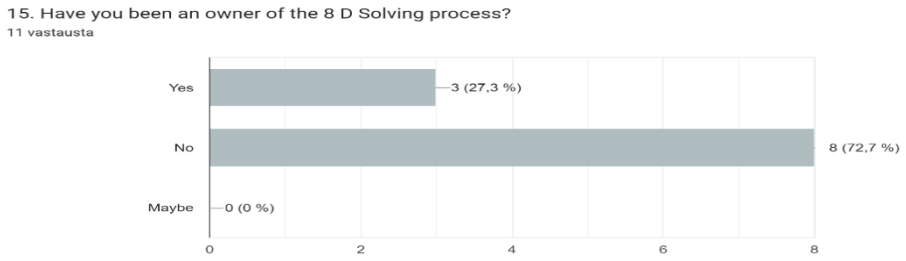

Figure 26. Responses to Question 15.

Question 16 asked about respondents' willingness to participate in the 8 D process as its proprietor. Nine responses were given, with an equal number of respondents for each option. The proportion of all options was 33.3%. The attached pie chart for question 16 in Figure 27 shows the spread of results. Based on the answers given, it can be concluded that three respondents to question 15 answered yes to question 16. However, this is only an indication, as the answers cannot prove it.

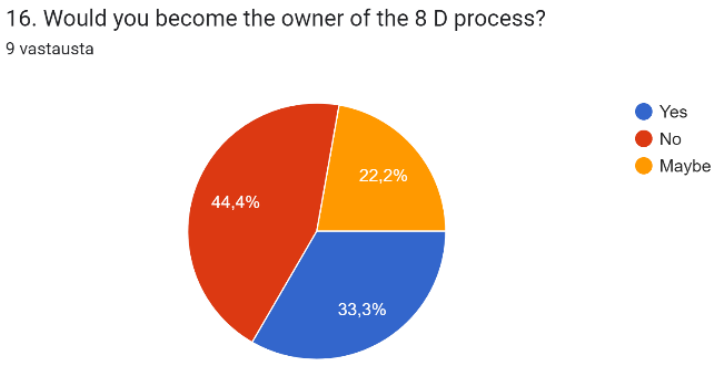

Figure 27. Responses to Question 16.

Question 17 asked respondents to give their opinion on how effective the 8 D process has been if they have used it at any time. The answers to this question 17 are linked to question 15. Although the sample size of the solutions is small,

it is vital to raise this question because the answers tell us how successful people think the 8 D process has been. The distribution of the question can be seen in Figure 28.

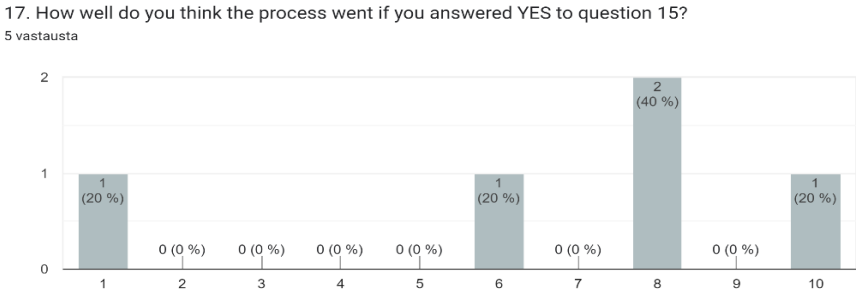

Figure 28. Responses to Question 17.

Questions 18 and 19 were moderately complex for respondents to answer, as responses from five respondents at a time were continuously recorded. Due to this poor sampling, they were excluded from the final work and interpretation. The responses were considered to be of limited research value.

In the focus of question 20, respondents were asked whether they owned the 8D process and participated in a role other than that of the owner. From the responses in Figure 29, the % of respondents, 71.4%, participated in the 8D process only as team members. In addition, the responses also indicate that the technical skills of the target group were also involved in the 8 D process. Technical skills account for a significant 42.9% of the results. Overall, seven responses were recorded for question 20.

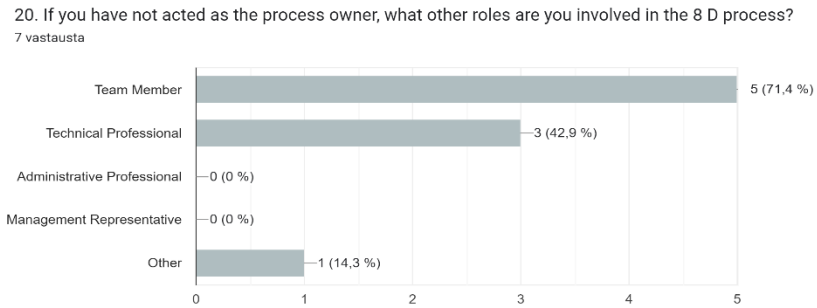

Figure 29. Responses to Question 20.

The next more important question is question 22, which asked respondents if they had to seek advice during the 8 D process. Asking for help in this context

meant asking for advice and resolving a problematic situation and issues related to the conclusion of the process. Question 22 is strongly associated with the following question 23. In question 23, respondents had to identify the persons in the organisation or at the levels of the organisation from whom help or advice had been sought. Of the respondents to question 22, 57.1% had not sought help or direction outside the 8 D process. This trend can be seen as a good sign. The process is familiar and transparent to those who have used it in their work.

On the other hand, 42.9% of respondents had to ask for help at some point in the 8 D process. The questionnaire did not ask respondents to specify at which stage of the process they asked for help. Figure 30 shows the breakdown of the responses given by the respondents.

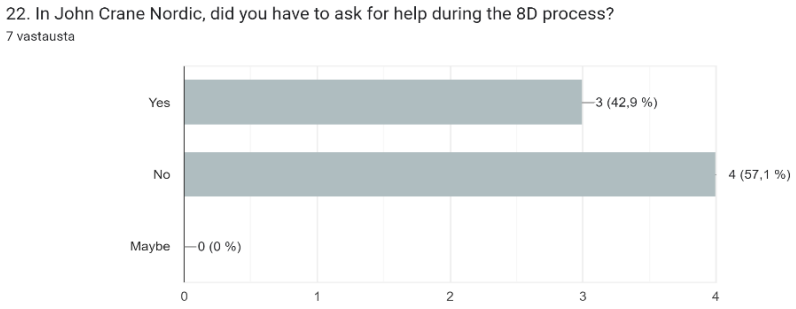

Figure 30. Responses to Question 22.

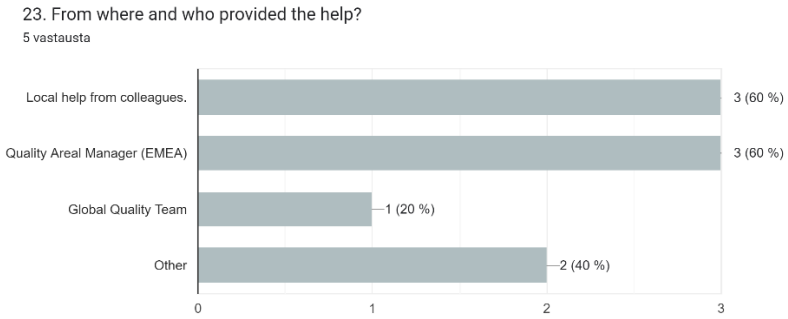

Figure 31. Responses to Question 23.

Figure 31 above shows that respondents have been assisted locally or by a quality manager in the European region. Both account for 60% of the responses. It should be noted that only a few reactions are recorded for this question. The other answer options for this question received only a handful of recorded responses.

For question 24, only two answers were recorded from all respondents, so it was left out of the processing due to its low research significance. The question was used to survey verbal feedback on what kind of help the questioners had received.

In question 25, respondents were asked - Do you think John Crane/Smiths has enough skilled staff to solve problems and implement the 8 D process? The responses to this question were distributed interestingly. Respondents felt that they would need more detail on this issue. As mentioned above, the hesitation and the answers gave the "maybe" option the highest score in question 25. As can be seen in Figure 32, the "maybe" choice garnered 50% of the responses given.

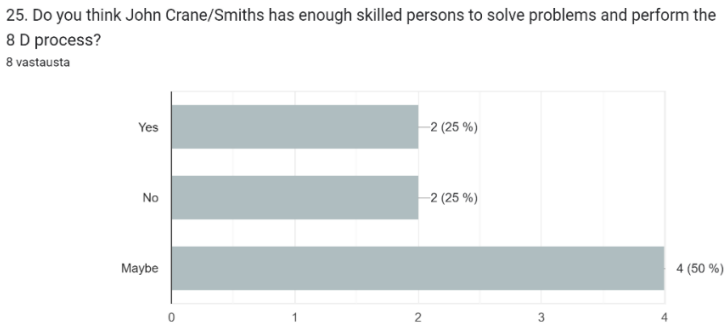

Figure 32. Responses to Question 25.

The last question in the second section asked respondents whether they had encountered cooperation between the Nordic countries during the 8 D process. Figure 33 illustrates that up to 75% of the respondents answered negatively. Although the study's author does not usually provide his own opinion on the question being studied, he would choose the "NO" option for this question as well. The most problematic aspect of the answers is that none of the respondents noticed cooperation between the Nordic services. 25% of the respondents selected the option "Maybe". Figure 33 shows the answers to question 26.

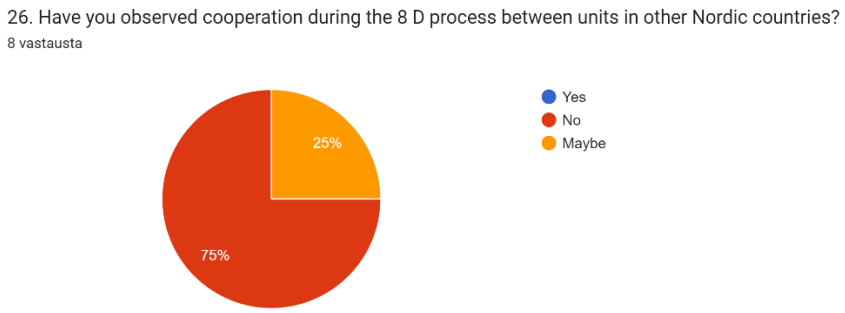

Figure 33. Responses to Question 26.

6.4 Results of Survey Questions 27-32

Detailed questions about the 8 D process were collected in the last section of the survey. This third part of the study contains six clarifying questions. These questions were used to bring out the respondents' opinions and views on development needs. If we do not consider the first section of the survey, where personal information was collected, this part of the survey is the shortest.

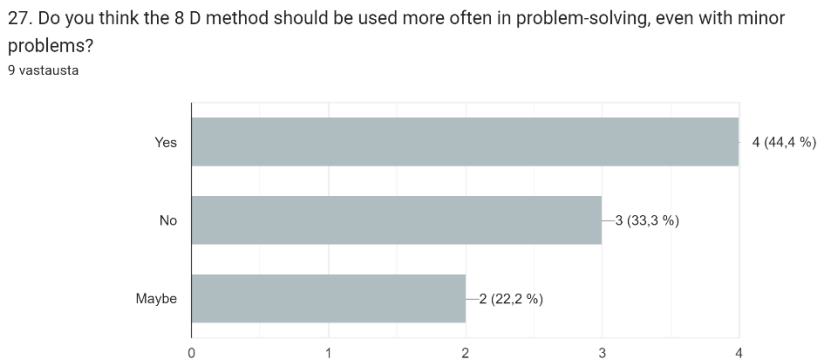

Figure 34. Responses to Question 27.

In question 27 of the survey, the respondents were asked their opinion on whether the 8 D process should be used to solve more minor quality incidents than before. From Figure 34 above, we can observe that the survey participants support this idea. The yes option is the largest group of answers, with a share of 44.4%. 33.3% of the respondents would prefer to use something other than the 8D process for minor problems. Two of the respondents needed more clarification on it.

Question 28 asked the respondents' opinion that The 8 D project starts automatically if the notification level exceeds a certain level. Do you think this is a good thing? The automaticity mentioned above has been mentioned in the previous sections of this study. Now in the survey, we wanted to inquire about the opinion of the participants. Figure 35 on page 60 shows that 62.5% of the respondents support that the 8 D process is started automatically if the problem exceeds a specific severity category. Naturally, the NO option also gathered answers. The proportion of no answers was 37.5% of the answers given. There was no uncertainty about the question, but all respondents had opinions.

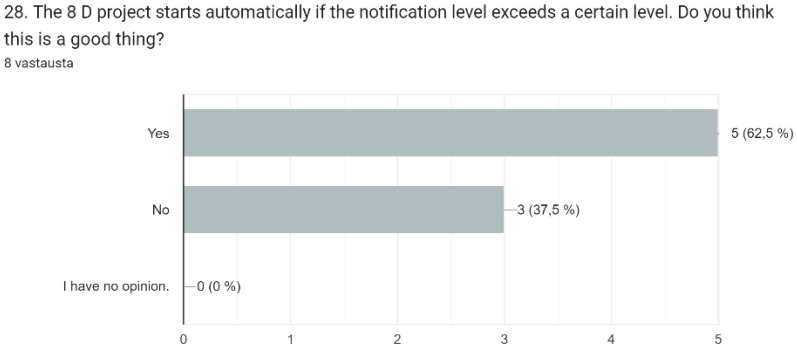

Figure 35. Responses to Question 28.

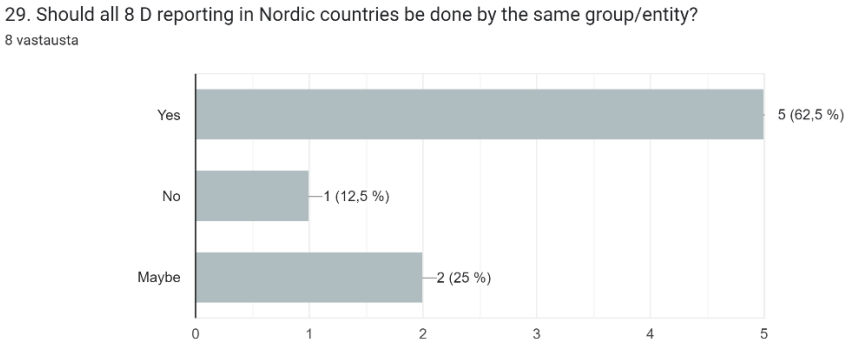

Figure 36. Responses to Question 29.

Question 29. was one of the most interesting in the reflection phase of the survey. The original question was intended to elicit an opinion on whether the same group should investigate all cases requiring the 8 D process. 62.5% of the respondents supported the question. Only one of the respondents thought that this should not be done. The graphics Figure 36, attached above the text, show that the option Maybe received 25% of the answers.

Question 30. is linked to question 29, so the respondents were asked about the benefits of all 8 D projects being carried out by the same group. Question 30 was verbal, and the answers varied widely. The answers emphasised the qualities of experience, efficiency, time use and better use of resources.

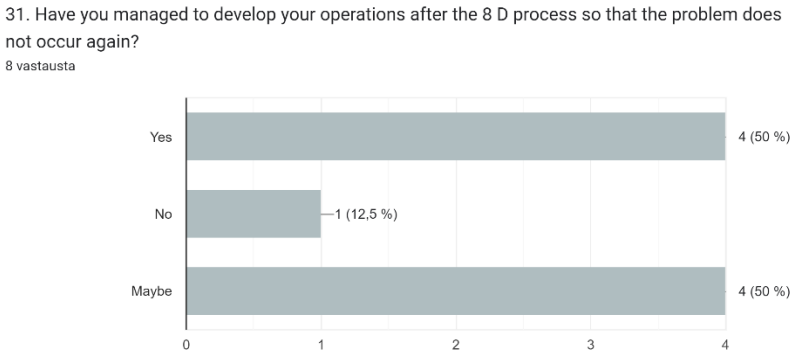

Figure 37. Responses to Question 31.

The answers to question 31 varied. However, it is worth mentioning that there was only one answer to the No option. All other contributions are either neutral or positive. One respondent has chosen two options for this specific question, as only eight respondents and nine provided answers. Figure 37 shows the breakdown of responses to question 31 on page 61.

Question 32 is the last question of the completed survey, asking respondents if they would like to participate in the 8D process again. Figure 38 Judging by the answers given, more than half of the respondents, i.e. 55.6%, declared they would like to participate in the 8 D process again. Three respondents expressed a possible wish to re-engage, representing 33.3% of the responses. Only one response was marked as a "NO" option.

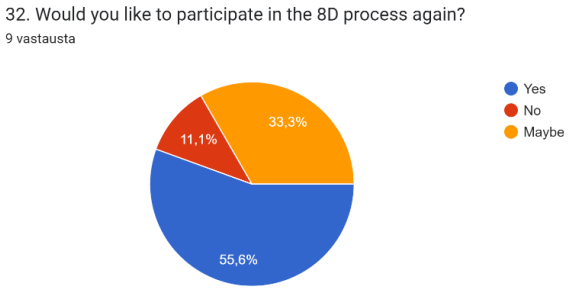

Figure 38. Responses to Question 32.

7 CONCLUSIONS

This study started from the point of view that there are shortcomings in the operating models and practices of the target company's problem-solving. The study aimed to find ways to improve processes and methods of operation utilizing a questionnaire interview by creating a clear picture of how those working on problem-solving themselves experience it. The aim is to use the results and conclusions in the target company's Nordic units and the community. The idea for this research came about quickly after the author started working at the target company. The culture of quality management and development is the globally chosen path in the target company, which we want to follow towards better performance. Even before the research, the organization has made clear choices about how quality and development will occur. The culture of quality management and development is the globally chosen path in the target company, which we want to follow towards better performance. Even before the research, the organization has made clear choices about how quality and development will occur. One of these methods chosen by the organization is the 8D problem solution method selected as the subject of the research. After a period of concept maturation and gaining experience, the study’s author and the production manager of the target company became familiar with the relevance of the chosen topic for the Nordic community.

The survey was conducted almost entirely without personal contact, either through the Teams program or through email conversations. This decision was considered ethically correct due to the previous COVID-19 situation and the desire to avoid any risk of potential illness during the study. At the same time, the study author wanted to contribute to the target company's carbon neutrality goal by avoiding unnecessary travel.

A questionnaire interview was used to collect primary data to identify the current perception and picture of quality professionals on the state of problem solving in the target company. This survey highlights the perceptions and images of the respondents. All the opinions and perceptions collected will be used in the future when designing quality and related processes in the target company. In this chapter, the author concludes by reporting the answers to the research questions and stating the main findings of the Primary Data collected.

7.1 Responses to Research Questions.

The study's central question is: How can we use existing problem-solving tools more effectively in Nordic profit departments? The research carried out and the thesis written will reflect the views and opinions of Nordic experts. Based on these, suggestions have been made on how to enhance the state of problem solving in the Nordic units of the target company. Problem-solving methods are subject to continuous improvement and should be an element of the company's quality strategy. The needs for action can be aggregated based on the assessments and responses of the respondents to the survey. Based on the answers given, the demand for improvement was readily apparent. It is to be assumed that the proposed measures from the thesis will be implemented, at least in part, in the company. In this way, the target company can be confident in the future of the effectiveness of problem solving in the area under study. The above is also an excellent help when the company seeks to increase productivity.

The first sub-question was formulated: how can the parent company contribute to improving problem-solving capabilities? Based on the questionnaire responses, it can be concluded that respondents have a high expectation that problem solving will be enhanced in the future. Implementing an efficient process will also free up resources for other essential tasks. During the survey, the author found that respondents expected action from the parent company. It can be interpreted that the respondents consider the parent company's development role necessary. The interviews conducted during the study showed that the participants are motivated and willing to develop processes as long as the development activities do not take time away from their actual work. According to the respondents, maintaining quality in our activity area is essential, and the organisation must be ready to put a lot of work and effort into achieving it. There are many ways to ensure that the quality of work can be maintained at a high level. Respondents reflected that it is essential to understand the requirements and expectations of the research topic being addressed at an organisational level. This will enable employees to work to meet these expectations and achieve quality results.

The second sub-question was formulated: What actions do problem solvers want to see? In general, when it comes to problem-solving, the ultimate goal is

to achieve a high level of quality. This requires a lot of work and careful attention to detail on the part of the organisation. The organisation's first step is understanding the problem and setting expectations accordingly. According to respondents, seeking guidance and feedback from others and using it constructively is also essential for continuous improvement. The contribution highlighted the roles of staff and the role of the organisation. By listening to and following these wishes expressed by respondents, problem solvers can consistently deliver high-quality results that meet customer or organisational expectations.

7.2 Findings of the study

While conducting research, the world and Europe are in a situation where a large-scale war occurs. The impact of the previous Covid-19 disaster and the ongoing war on the world economy are significant. The sharp rise in inflation and interest rates affect prices more than ever in almost a hundred years. In the market, we live where only the best succeed and stand out from their competitors. People and companies cannot afford to invest in low-quality products. The companies that make the best use of their know-how through quality management and development are successful now and in the future. The solution to the problem and its professional execution guarantees the company's ability to react and develop its operations so that the qualitative shocks remain small. Suppose quality management processes are implemented successfully and align with the company's strategy, vision, mission and values. In that case, it provides employees with a foundation they can rely on when performing their duties.

The conducted interview research and interviews brought out many areas for development and characteristics of the case company's problem-solving. It can be seen that the personnel in the Nordic countries are motivated to solve the problems that have arisen. It should be noted that the given tools are rarely used, but traditional solutions are relied on for problem-solving. The organisation seems to have a heavy structure and is perceived as distant. This reflection can be considered a natural feeling, as most decisions are made on the other side of the globe in the United States.

The organisation's distance and the slow pace of solutions do not encourage asking for help from outside one's unit. Quality management in departments worldwide is managed from the company's headquarters, which has implications for performing quality management in remote locations.

The 8D method is a familiar tool for quality personnel in Nordic units. The technique is considered structurally straightforward and has been perceived to provide practical solutions to the discussed problems. From the answers of the research group, it can be interpreted that the 8 D method can be used to achieve success and productivity if the process is carried out correctly. This method includes eight steps that guide problem solvers through identifying and addressing problems. By following the 8 D method, individuals and groups can create clear expectations, carefully approach all aspects of work, and solicit feedback from others. However, the organisation perceives asking for help as complex due to its distance and from other locations.
From the answers given, it appears that the 8 D method is hoped to be used to solve problems of lower quality than before. I interpret the matter so that the aforementioned tells about the reliability and efficiency of the 8 D method.

The participants in the survey represented many different professional fields of the company, even though they were identified as quality professionals at the initial stage of the survey. The variability is because organizations in other countries define which areas belong to which tasks. The gender of the respondents was strongly male, although gender does not play a significant role in this study. As a whole, it can be stated that most respondents are familiar with the concepts of Lean, problem-solving and 8D. More than half of the respondents admit to using the methods in their work tasks. The best-known problem-solving tools for the respondents were SWOT, 5WHY and 8 D, while the LEAN concepts became the most well-known 5S, Kaizen and Value stream mapping.

The experience base of using the tools is perceived as strong among the respondents, although there is significant room for improvement. More than half of the respondents say that they use problem-solving tools in their daily work. This can be interpreted so that the mentioned tools are perceived to be effective.

The respondents found the efficiency and level of the target company's problem-solving quite good. Of the given answers, only one ranked below the middle of the given scale, while the other answers were close to the top of the scale. The respondents felt that 70% of them get a solution to the problem at hand in their work by using problem-solving tools.

When asked about the problem-solving situation in the Nordic units, the respondents recognized the 8 D method and felt familiar with it. Most respondents have never been an 8 D process owner in their career and do not even want to participate in the process in the owner role. Only a third of the respondents expressed willingness to be the process owner. Respondents said their desire to be in the role of a group member, with an emphasis of up to 71.4%. Interpreting this could be that respondents consider the role of the process owner to be a demanding and time-consuming task in addition to their work. The respondents felt the importance of their participation in solving the problem was helpful in more than half of the answers. During the 8 D process, the respondents hardly had to ask for help from other units or parts of the organization. If additional support has been requested, it has been received from the quality manager of the own area, or the help has been local. Only once has the Global Quality organization been asked for help. The answers also reflect cooperation between different localities, as 75% of the respondents feel that association was not observed during the processes. A substantial majority consider it a good thing that the 8D process is started automatically when the scope of the problem exceeds a certain, predefined level. Autostart eliminates the judgment that humans sometimes do. Discretion gives the opportunity in borderline cases not to carry out a necessary investigation.

The question that the same person should lead all investigations in the Nordic units gathered strong support among the respondents. More than half of the respondents supported the implementation of this idea. The respondents listed benefits, e.g. that it would be the best use of existing resources and that this person and group have the best expertise. Referring to the above interpretations can also be interpreted that the answers given express the idea that managing the process in the context of one's work is perceived as complex. The survey respondents said that they have succeeded in developing their operations or functions with the help of the 8 D process. The problem has improved so well that the problem has not recurred. The last survey question inquired

about willingness to participate again in the 8 D process. More than half of the respondents were willing to participate in the process.

7.3 The Validity of the Research

To ensure the validation of a study, the researcher in charge must first have a thorough understanding of the observational nuances of the study's target groups to the results and conclusions. Conclusions are concise summaries that review the existing data. Understanding the observed phenomena is a prerequisite for drawing conclusions and interpretations. (Taylor 2013, 1-2.)

The validity and quality of a case study are determined without any set criteria. Criticisms of case studies are based on the fact that the study's authors are actively involved in the process and may even agree to participate in the organisation's affairs. The situation allows them to influence the results of the research. When validating a case study, the reader should be prepared to use different methods to assess the validation and quality of the study. (Seale et al. 2004, 481.)

The overall risks to the accuracy of research assertions can be categorized into four primary groups: individual elements, evaluation elements, numerical elements, and alternative numerical frameworks. Scientists must validate their declarations that the outcomes of their investigations are caused by the ratios of factors recognized in their studies - utilizing both rational reasoning and statistical proof. (Taylor 2013, 1-2.)

In qualitative research, the concepts of validity and reliability can pose challenges because there is no clear consensus on measuring them. However, their importance cannot be discounted. Qualitative research proves its validity by the author's integrity, the application of one's position, and the precision of the chosen method to the data. (Bassot 2022, 111.)

In qualitative analysis, dependability is not quantified as an objective numerical assessment but evaluated based on the sources cited and the techniques employed in the research. (Puusa & Juuti, 2020, 141.)

In many cases, qualitative researchers avoid using the word reliability in the context of their research. The justification for not using the term is often given as the inability to replicate their research results in different situations. The very nature of qualitative research involves variation between other conditions and between various researchers. (Bassot 2022, 111-112.)

We examined, gathered information, and analyzed the outcomes to the best of our knowledge and abilities. The final study documented and presented the results. Reviewing the literature using openly accessible expert sources within specific limitations. We collaborated with the organization to create a survey and chose questions that the author and stakeholders of the studies deemed essential. Regrettably, only a limited number of staff participated in the survey interviews. The survey was only directed at the quality team of the organization and not all staff groups. The selected group responded conscientiously within the allotted time frame, and the participation rate was 100%.

However, the result needs to be evaluated as not all respondents answered every question, so there was some variation between questions. As mentioned above, the survey ensured the quality and timeliness of the data. The survey received responses from both the quality management organisation and the production managers. The extension of the tasks shows that the data collected is sufficient to produce reliable results.

7.4 Administrative development ideas

Quality management and problem-solving must be excellent if a company is to succeed in a demanding and complex market. Many excellent examples of companies have correctly allocated their resources to quality management. Well-known companies such as Toyota, Tesla and Apple are recognised worldwide for their quality and value. There is a large amount of literature on the practices of these companies. The literature widely admires the culture of these companies. To achieve a leading position in the market, companies must ensure continuous improvement is vital to their operations and culture. The ability to solve problems is as essential to the process as creating problems. There is no such thing as a problem-free business, and there never will be.

This study identified specific gaps in the problem-solving practices of the Nordic entities and their visibility. The 8 D method chosen by the host organisation was already familiar to some extent to the participants. The questionnaire and survey revealed a lack of expertise in the 8 D process within the organisation. In light of the results, it is undeniable that more experts are needed if the 8 D process is to be used effectively in the organisation. However, training new professionals and providing training resources can be a potential problem, as the daily tasks limit their access to training.

This study shows that the 8 D method is used to solve problems in the Nordics, but the time needed to complete the process is considered too short. It would benefit the organisation's success to find solutions to free up resources and time to use 8 D more effectively. As a recommended course of action for the study, the organisation should consider a joint Nordic team to which cases requiring 8 D investigation would be referred. The team could consist of one professional from each Nordic location. The group could be guided by a monthly meeting where existing 8 D processes are presented to the collective group. At the same event, participants could collaborate with other participants. Meetings like those would be an excellent way to increase Nordic cross-border cooperation.

The survey showed that respondents would prefer to centralise all 8 D investigations in the hands of a single designated person. However, the study author does not believe that this theory would benefit the organisation, as one of the basic premises of the research was to increase cooperation between localities. In addition, centralising the activities of one person within the organisation creates a risk of data loss if the target person is withdrawn from the organisation.

Among respondents, LEAN practices are relatively well known. Of the most common Lean tools, 5S and Kaizen were rated as the most familiar by respondents. Lean method skills are highly valued in the target company, and significant investments are made to acquire them through training. However, knowledge of Lean methods has the same initial problem as the 8 D method. There are too few experts in the organisation to implement Lean practices. Too few experts can't implement processes thoroughly to completion.

The parent company can help overcome its organisation's problems by hiring more resources to fill the knowledge gap. The study author recommends hiring additional resources in the organisation if Lean skills are valued.

The organisation's global quality team handles all Lean issues and cases in its internal processes. As a solution to the lack of knowledge, the study author proposed to set up a particular training activity for the quality team of the global group to inquire about the willingness of the experts to be trained in Lean methods. A limited number of those willing will be offered full membership of the global team set-up, initially as a trainee and later as a whole team member. The experience and knowledge gained in the Global Group will be transmitted with the experts to smaller sites such as the Nordic countries. People who have worked in the Global Quality Team can, with the help of the parent company, take over the responsibility for training other employees in smaller units.

The target group expressed relatively few wishes about how they would like to see problem-solving in the Nordic units developed. The majority of the suggestions for improvement were about improving time management and the difficulty of getting professional help in the organisation. The organisation under study can significantly enhance its situation if it considers the author of the study's suggestions for improving it.

REFERENCES

Andersen, B. & Fagerhaug, T. 2006. Root Cause Analysis: Simplified Tools and Techniques. ASQ Quality Press. Milwaukee

Asana. 2022. What is 8D? A Template for Efficient Problem-Solving. Internet Article. Asana Incorporated. San Francisco. United States. Available: https://asana.com/resources/8d-template [Accessed: 20.3.2023]

Bassot, B. 2022. Doing Qualitative Desk-Based Research: A Practical Guide to Writing an Excellent Dissertation. Policy Press, Bristol

Carter, M. 2015. The 8-Disciplines Problem Solving Methodology. Publisher Unknown. Kindle Edition.

Carlson, C. S., Shain, D. H. & Carlson, C. 2012. Effective FMEAs: Achieving Safe, Reliable, and Economical Products and Processes Using Failure Mode and Effects Analysis. John Wiley & Sons, Inc Hoboken: United States

Chaudhuri, A.B. 2020. Flowchart and Algorithm Basics: The Art of Programming. Mercury Learning & Information. Virginia. United States.

Cheok, H. 8D Structure Problem-Solving. Qualistat Services, Butterworth. Penang. Malaysia.

Chevallier, A. 2016. Strategic Thinking in Complex Problem Solving. Oxford University Press. New York. United States of America

Coskun, A. 2018. Quality Management and Six Sigma. IntechOpen Limited. London: United Kingdom

Cowles, E. L. & Edward, N. 2015. An Introduction to Survey Research. Business Expert Press. Dallas. United States of America.

Creative Safety Supply. 2023. How Can This Tool Help You? Blog. Beaverton. Oregon. United States. Available: https://blog.creativesafetysupply.com/pdca-how-can-this-tool-help-you/ [Accessed: 11.3.2023]

Development Studios. 2023. Preston Road. Web site. Dallas. United States Available at: https://sixsigmadsi.com/what-is-an-fmea/. [Accessed:2 March 2023]

Dickson, A., Hussein, E.K. & Agyem, J.A. 2018. Theoretical and conceptual framework: Mandatory ingredients of quality research. International Journal of Scientific Research. E-journal. Available at: https://www.researchgate.net/publication/322204158_THEORETICAL_AND_CONCEPTUAL_FRAMEWORK_MANDATORY_INGREDIENTS_OF_A_QUALITY_RESEARCH [Accessed 22 February 2023].

Hammersley, M. & Campbell, J. L. 2012. What is Qualitative Research? Bloomsbury Publishing. London

Holloway, I. & Galvin, K. 2016. Qualitative Research in Nursing and Healthcare. John Wiley & Sons Incorporated. New Jersey. United States

Ionos. 2020. Fishbone diagram: Solving Problems Properly. Web article. Ionos Inc. Philadelphia. United States. Available: https://www.ionos.ca/startupguide/productivity/fishbone-diagram/ [Accessed: 1.4.2023]

Isixsigma. 2022. The history of Six Sigma. Web page. Quality Blog. Available https://www.isixsigma.com/new-to-six-sigma/history/history-six-sigma/ [Accessed: 25 September 2022]

Isixsigma. 2023. Deming Cycle. PDCA. Web Article. Connecticut. United States. Available: https://www.isixsigma.com/dictionary/deming-cycle-pdca/ [Accessed:12.3.2023]

Jobs S. 2018. Psychologist To Explore How Brain Remembers Precise Information. The Public Record. United States

John Crane Safematic. 2022. Company presentation for Business partners. John Crane. United States

Kananen, J. 2017. Laadullinen tutkimus pro graduna ja opinnäytetyönä. Jyväskylän ammattikorkeakoulu. Jyväskylä:

Kanbanize. 2023. 5 Whys: The Ultimate Root Cause Analysis Tool. Internet article. Sofia. Bulgaria. Available: https://kanbanize.com/lean-management/improvement/5-whys-analysis-tool [Accessed: 12 March 2023]

Kelley, K., Clark, B., Brown, V., & Sitzia, J.2003. "Good Practice in the Conduct and Reporting of Survey Research." International Journal for Quality in Health Care, vol. 15, no. 3, 2003, pp. 261-266, Available: https://doi.org/10.1093/intqhc/mzg031.[Accessed 9 April. 2023.]

Laine, M., Bamberg, J. & Jokinen, P. 2015. Tapaustutkimuksen taito. 3rd edition. Gaudeamus Helsinki University Press. Helsinki: Available at: https://kaakkuri.finna.fi [Accessed 5 March 2023]

Lean Institute. 2023. PDCA (Plan, DO, Check, Act). Web Article. Boston. United States. Available: https://www.lean.org/lexicon-terms/pdca/ [Accesed:12.3.2023]

The Leanway Consulting.2023. Using the PDCA Cycle to Support Continuous Improvement. Internet Article. Marietta. Available: https://theleanway.net/the-continuous-improvement-cycle-pdca [Accessed: 10 January 2023]

Leavy, P. 2014. The Oxford Handbook of Qualitative Research. Edited by Oxford University Press. Oxford. United Kingdom

Marquardt, M & Yeo, R K. 2012. Breakthrough Problem Solving with Action Learning: Concepts and Cases. Stanford University Press. United States

Matejcek, J & Jadrný, I. 2019. 8D Report-The way of quality 2019: Root cause analysis not only for claim issues. Amazon

Merriam, S. B. & Grenier, R. S. 2019. Qualitative Research in Practice – Examples for discussion and analysis. 2nd edition. San Francisco. United States

Moore, N. 2013. How to Do Research: The Practical Guide to Designing and Managing Research Projects. 3rd edition. E-book. Facet Publishing. London: Available at: https://kaakkuri.finna.fi/ [Accessed 8 March 2023]

Nicholas, J. 2018. Lean Production for Competitive Advantage: A Comprehensive Guide to Lean Methodologies and Management Practices. Second Edition E-book. Productivity Press, Milton. United States. Available: ProQuest eBook Central. [Accessed 13 October 2022]

Operational Excellence Consulting. 2023. The 8D Problem-Solving Process. Webpage. Fort Meyers. Florida. United States. Available: https://www.operational-excellence-consulting.com/opex-articles/8d-problem-solving-process [Accessed: 16. March.2023]

Puusa, A., Juuti, P. & Aaltio, I. 2020. Laadullisen tutkimuksen näkökulmat ja menetelmät. Gaudeamus. Helsinki

Quality-One. 2023. Eight Disciplines of Problem-Solving (8D). Quality One International. Michigan. United States. Available: https://quality-one.com/8d/ Accessed: 28 March 2023]

Rambaud, L. 2006. 8 D structured problem solving: A guide to creating high-quality 8D reports. PHRED Solutions. Breckenridge

Rantanen, M. 2023. Quality Manager. FinnJiit. Interview.10 January 2023.

Saldaña, J. 2011. Fundamentals of Qualitative Research. eBook. New York: Oxford University Press Inc. Available at: https://kaakkuri.finna.fi/ [Accessed 13. April 2023]

Schade. M.B. 2013. 8 D Problem-Solving 1:st edition. Business Online Learning. Great Britain.

Seale, C. Gobo, G. Gubrium, JF. & Silverman, D (eds) 2004. Qualitative Research Practice. SAGE Publications Limited. London. United Kingdom

Shankar, R. 2008. Process Improvement Using Six Sigma: A DMAIC Guide. ASQ Quality Press. Milwaukee. Wisconsin. United States

Smith, A. 2023. Global Quality Manager. John Crane Illinois. Interview via. Teams. 1 March 2023

Simons, H. 2009. Case Study Research in Practice. SAGE Publications Limited, London. United Kingdom

Sumerson, J.B. 2013. Finish Your Dissertation Don't Let It Finish You! E-book. John Wiley & Sons Inc. Hoboken. United States. Available at: https://kaakkuri.finna.fi/ [Accessed 6 March 2023]

Taylor, S.J. 2015. Introduction to Qualitative Research Methods: A Guidebook and Resource. John Wiley & Sons Incorporated. Hoboken. New Jersey. United States

Taylor, CS. 2013. Validity and Validation. Oxford University Press Incorporated. E-book. Cary. Available from: https://ebookcentral.proquest.com/lib/xamk-ebooks/detail.action?docID=1480995. Accessed [13. February 2023]

TechTarget. 2023. FMEA. Failure Mode and Effects Analysis. Internet Article. Newton. Massachusetts. United States. Available: https://www.techtarget.com/searchcio/definition/FMEA-failure-mode-and-effective-analysis. [Accessed:17.3.2023]

The Lean Way. 2023. Using the PDCA Cycle to Support Continuous Improvement (Kaizen). Blog. Georgia. United States. Available: https://theleanway.net/the-continuous-improvement-cycle-pdca [Accessed: 13.3.2023]

Visser, C.S.P. 2018. 8 D Problem-Solving Explained-Turning operational failures into knowledge to drive strategic and competitive advantages. In2Quality. United States of America

Walle, AH. 2015. Qualitative Research in Business: A Practical Overview. Cambridge Scholars Publishing. Newcastle-upon-Tyne. United Kingdom.

Wang, JX. 2011. Lean Manufacturing: Business Bottom-Line Based, Taylor & Francis Group. Baton Rouge.

Weeden, MM. 2015. Failure Mode and Effects Analysis (FMEA) for Small Business Owners and Non-Engineers: Determining and Preventing What Can Go Wrong. ASQ Quality Press. Milwaukee. Wisconsin. United States

Zarghami, A & Benbow, DW. 2017. Introduction to 8D Problem Solving: Including Practical Applications and Examples. ASQ Quality Press. Milwaukee. Wisconsin. United States. Available from: ProQuest E-book Central. [4 March 2023]

LIST OF FIGURES

Figure 1. Structure of the studies

Figure 2. John Crane. 2023. What we do? Webpage. Available: https://www.smiths.com/what-we-do/john-crane [Accessed: 2.4.2023]

Figure 3. Visual Knowledge Share. 2022. Use the DMAIC Approach to Continuously Supercharge your SOPs. Webpage. Available: https://vksapp.com/blog/dmaic-approach-intelligent-sops [Accessed: 30 March 2023]

Figure 4. Lean Enterprise Institute Inc. 2023. Plan, Do, Check, Act (PDCA). Webpage. Available: https://www.lean.org/lexicon-terms/pdca/ [Accessed: 1 April 2023]

Figure 5. Capvidia. 2023. What is FMEA? Web-article. The USA. Available: https://www.capvidia.com/blog/fmea-guide [Accessed: 2 April 2023]

Figure 6. American Society for Quality. 2023. What are the Eight Disciplines (8D)? Webpage. Milwaukee. Wisconsin. United States. Available: https://asq.org/about-asq [Accessed:10 February]

Figure 7. Visser, C.S.P. 2018. 8 D Problem-Solving Explained-Turning operational failures into knowledge to drive strategic and competitive advantages. In2Quality. United States of America

Figure 8. Matejzek, J & Jardny, I. 2019. 8 D Report-The way of quality 2019: Root cause analysis not only for claim issues. Publisher Unknown, Amazon

Figure 9. Visser, C.S.P. 2018. 8 D Problem-Solving Explained-Turning operational failures into knowledge to drive strategic and competitive advantages. In2Quality. United States of America

Figure 10. Zarghami, A & Benbow, DW. 2017. Introduction to 8D Problem Solving: Including Practical Applications and Examples, ASQ Quality Press, Milwaukee, WI. Available from: ProQuest E-book Central. [4 March 2023]

Figure 11. CS Odessa Corp.2023. When to use a fishbone diagram. Web-article. San Jose. United States. Available: https://www.conceptdraw.com/How-To-Guide/when-to-use-a-fishbone-diagram [Accessed: 19 March 2023]

Figure12. The West of England AHSN. 2023.The five why's analysis. Web-article. Bristol. United Kingdom. Available: https://www.weahsn.net/toolkits-and-resources/quality-improvement-tools-2/five-whys-analysis/ [Accessed: 21 March 2023]

Figure 13. Schade. M.B. 2013. 8 D Problem-Solving 1:st edition. Business Online Learning. Great Britain

Figure 14. Responses to Question 1.

Figure 15. Responses to Question 2.

Figure 16. Responses to Question 3.

Figure 17. Responses to Question 5.

Figure 18. Responses to Question 6.

Figure 19. Responses to Question 7.

Figure 20. Responses to Question 8.

Figure 21. Responses to Question 10.

Figure 22. Responses to Question 11.

Figure 23. Responses to Question 12.

Figure 24. Responses to Question 13.

Figure 25. Responses to Question 14.

Figure 26. Responses to Question 15.

Figure 27. Responses to Question 16.

Figure 28. Responses to Question 17.

Figure 29. Responses to Question 20.

Figure 30. Responses to Question 22.

Figure 31. Responses to Question 23.

Figure 32. Responses to Question 25.

Figure 33. Responses to Question 26.

Figure 34. Responses to Question 27.

Figure 35. Responses to Question 28.

Figure 36. Responses to Question 29.

Figure 37. Responses to Question 31.

Figure 38. Responses to Question 32.

APPENDIX LIST:

Appendix 1. Question Survey for Master Thesis Studies. 2023.Word-document

Appendix 2. Asana. 2022. What is 8D? A Template for Efficient Problem-Solving. Internet Article. Asana Incorporated. San Francisco. United States. Available: https://assets.asana.biz/m/25792dc247d41c0a/original/8d-worksheet-template.pdf [Accessed: 20.3.2023 [Accessed: 20 March 2023]

Appendix 1.

Question Survey for Master Thesis Studies

This survey is part of the Master Thesis studies. It can be connected to the study utilising the 8 D quality tool to solve the quality problems in John Crane Nordic units. This document is an appendix to the investigation, as mentioned above. The appendix contains the questions asked to the respondents in the survey. 32 questions total.

1. Question: What is your position in John Crane's hierarchy? *

- [ ] QEHS Manager
- [ ] Quality Represantive
- [ ] Production Manager
- [ ] Financial Manager
- [ ] Sales Manager
- [ ] Logistic Manager
- [ ] Engineering
- [ ] Other

2. Gender *

- [ ] Female
- [ ] Male
- [ ] Prefer not to say
- [ ] Other

3. How long have you been a part of John Crane/Smits? *

- ( ) 0-1 year
- ( ) 2-3 years
- ( ) 4-5 years
- ( ) 6-8 years
- ( ) 9-10 years
- ( ) 11-15 years
- ( ) 16-25 years
- ( ) Over 25 years

4. Are the concepts of ***Quality Management*** and ***Problem Solving*** familiar to you?

- [ ] Yes
- [ ] No
- [ ] Maybe

5. Is the concept of ***LEAN*** familiar to you?

- [ ] Yes
- [ ] No
- [ ] Maybe

6. Have you used ***Problem Solving*** or ***LEAN*** tools in your work?

- [ ] Yes
- [ ] No
- [ ] Maybe

7. If you have used LEAN tools, could you choose the methods from the list below?

- [ ] Kanban
- [ ] 5S
- [ ] Kaizen
- [ ] Gemba Walk
- [ ] Value Stream Mapping
- [ ] Continuous Flow
- [ ] Hoshin Kanri
- [ ] Just in Time
- [ ] Other

8. On the list below. Are there any standard methods for you?

- [ ] Fishbone Diagram (Ishikawa Diagram)
- [ ] 5 Whys?
- [ ] SWOT Analyzing (Strenght, Weakneses, Opportunities, Threats)
- [ ] Eight Disciplines 8D
- [ ] FMEA (Failure Mode and Effect Analyzis)
- [ ] PDCA (Plan, Do, Check; Act)
- [ ] DMAIC (Define, Measure, Analyze, Improve, Control)
- [ ] No

9. In the earlier question (7.) If you answered the option Other. Would you like to comment with a few words about your methods?

Pitkä vastausteksti

10. In the following, tell us how experienced a user you are of the methods chosen in the previous question.

	1	2	3	4	5	6	7	8	9	10	
Beginner	○	○	○	○	○	○	○	○	○	○	Professional

11. Have you used it in your daily work problem-solving tools?

- [ ] Yes
- [ ] No
- [ ] Maybe

12. How useful do you see problem-solving tools in general and John Crane?

	1	2	3	4	5	6	7	8	9	10	
Not useful	○	○	○	○	○	○	○	○	○	○	Extremely useful

13. In your current job, do you feel that problem-solving tools give you a solution to your problem?

- [ ] Yes
- [ ] No
- [ ] Neither

14. In John Crane, the generally chosen method for problem-solving is 8 D. (Eight Disciplines) - Is this method familiar to you?

- [ ] No, It is not
- [ ] Yes, I know the method.
- [ ] I am not sure?

15. Have you been an owner of the 8 D Solving process?

- [ ] Yes
- [ ] No
- [ ] Maybe

16. Would you become the owner of the 8 D process?

- ○ Yes
- ○ No
- ○ Maybe

17. How well do you think the process went if you answered YES to question 15?

	1	2	3	4	5	6	7	8	9	10	
Not well	○	○	○	○	○	○	○	○	○	○	It was fluent

18. In your opinion, which of the following areas in the process was unsuccessful?

- [ ] D0 (Preparation)- In modern 8D process this is considered as one theme)
- [ ] D1 (Team Eshtablisment)
- [ ] D2 (Defining th Problem)
- [ ] D3 (Containment)
- [ ] D4 (Verifying Root Cause)
- [ ] D5 (Identify Corrective Actions)
- [ ] D6 (Implement Corrective Actions)
- [ ] D7 (Preventive Actions)
- [ ] D8 (Team Regognition)

19. Why did the process fail? (**Question 18**.)

Pitkä vastausteksti

20. If you have not acted as the process owner, what other roles are you involved in the 8 D process?

- [ ] Team Member
- [ ] Technical Professional
- [ ] Administrative Professional
- [ ] Management Representative
- [ ] Other

21. Do you feel that your participation was helpful in solving the problem?

- [ ] No
- [ ] Yes
- [ ] Maybe

22. In John Crane Nordic, did you have to ask for help during the 8D process?

- [ ] Yes
- [ ] No
- [ ] Maybe

23. From where and who provided the help?

- [ ] Local help from colleagues.
- [ ] Quality Areal Manager (EMEA)
- [ ] Global Quality Team
- [ ] Other

24. If you answered **YES** to the question, **22.** Tell me what kind of help you received. And why was it worthwhile?

Pitkä vastausteksti

25. Do you think John Crane/Smiths has enough skilled persons to solve problems and perform the 8 D process?

- [ ] Yes
- [ ] No
- [ ] Maybe

26. Have you observed cooperation during the 8 D process between units in other Nordic countries?

- ( ) Yes
- ( ) No
- ( ) Maybe

27. Do you think the 8 D method should be used more often in problem-solving, even with minor problems?

- [ ] Yes
- [ ] No
- [ ] Maybe

28. The 8 D project starts automatically if the notification level exceeds a certain level. Do you think this is a good thing?

- [ ] Yes
- [ ] No
- [ ] I have no opinion.

29. Should all 8 D reporting in Nordic countries be done by the same group/entity?

- [ ] Yes
- [ ] No
- [ ] Maybe

30. What benefits do you think it would have? Describe in a few sentences.

Pitkä vastausteksti

31. Have you managed to develop your operations after the 8 D process so that the problem does not occur again?

- [ ] Yes
- [ ] No
- [ ] Maybe

32. Would you like to participate in the 8D process again?

- ( ) Yes
- ( ) No
- ( ) Maybe

Appendix 2.

8D worksheet template

Use this worksheet to solve a problem using the eight disciplines (8D) method of problem-solving.

D0

Planning

Gather data, feedback, and prerequisites required to solve the problem.

D1

Team members

List the team members involved in this project.

Name:	Position:	Role:

D2

Problem statement & description

Draft a clear and concise problem statement. Include details about how often it occurs, history that is relevant to the problem, how the problem manifests, etc.

Date:

Page 1/3

asana

8D worksheet template

Use this worksheet to solve a problem using the eight disciplines (8D) method of problem-solving.

D3

Interim containment action

Describe any temporary actions or plans to put in place while determining a permanent corrective action.

D4

Root cause & escape points

Identify all possible root causes and escape points for the problem. Use root-cause analyses to test all potential causes.

D5

Permanent corrective action

Compose a list of corrective actions to solve the problem and prevent similar issues from reoccurring. Include a deadline for implementation and how to measure effectiveness.

Date:

asana

8D worksheet template

Use this worksheet to solve a problem using the eight disciplines (8D) method of problem-solving.

D6

PCA implementation plan

Develop a plan to implement your corrective actions, including who is responsible for each step and the completion deadline.

D7

Preventative measures

Describe any measure to implement to avoid similar problems in the future.

D8

Team congratulation & reward

Take note of what each team member did exceptionally well and how this experience could help with future problem-solving. Express your appreciation.

Date:

asana