



TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

VALTTERI SUONTAKA
MANAGEMENT SYSTEM REFORMING IN AUTOMATION
INDUSTRY

Master of Science Thesis

Examiner: Prof. Nina Helander
Examiner and topic approved by
Faculty Council of the Faculty of
Business and Built Environment on
28 August 2017

ABSTRACT

VALTTERI SUONTAKA: Management System Reforming in Automation Industry

Tampere University of Technology

Master of Science Thesis, 76 pages, 2 Appendix pages

October 2017

Master's Degree Programme in Information and Knowledge Management

Major: Product and Process Information Management

Examiner: Professor Nina Helander

Keywords: management system, quality management system, ISO 9001, ISO 14001, quality, information security

Valmet Automation must transit to the 2015 versions of current ISO 9001:2008 and ISO 14001:2004 standards by September 2018. The organization aims not only to fulfill the minimum requirements of the standards but also to develop their operation as much as possible. The aim of this study was to create a plan to transit to the new versions of the standards. In order to minimize the duplicate work and maximize the benefits obtained from transition, it was also examined, what kind of company's management system should be in the future.

The study was conducted as a constructive research approach. The approach was utilized in the creation of the transition plan and the vision of the future management system. The theoretical background of the study consists of quality, management system, future trends and change management. In addition to the literature, benchmarking, interviews and other empirical material were utilized as the research material in the study. Based on this material, the current state of the management system was determined.

A gap analysis was conducted in this study, in order to identify, what organization should do to meet the requirements. The transition plan was created to fulfill these requirements which identified in the gap analysis. After the transition plan was created, it was taken into use in the organization. At the same time with the creation of the transition plan, the vision of future management system was designed. When creating the vision, future trends and their potential impacts on the management system were examined. The research of the future trends highlighted that the importance of information security will grow in the future. Therefore, the information security must be considered more and more in the future.

The vision of the future management system takes into account the renewed standards, the future requirements, and the usability, in order to create as a clear entity as possible. It was recognized in the thesis that utilizing ISO standard structure and end-to-end process structure in the documentation of the management system, various benefits can be obtained. With the new structure and more efficient linking, for example, the usability and auditing of the management system can be facilitated, and the system can be brought closer to the employees in different business functions.

TIIVISTELMÄ

VALTTERI SUONTAKA: Johtamisjärjestelmän uudistaminen automaatioliiketoiminnassa

Tampereen teknillinen yliopisto

Diplomityö, 76 sivua, 2 liitesivua

Lokakuu 2017

Tietojohdamisen diplomi-insinöörin tutkinto-ohjelma

Pääaine: Tuote- ja prosessitiedonhallinta

Tarkastaja: Professori Nina Helander

Avainsanat: johtamisjärjestelmä, ISO 9001, ISO 14001, laatu, tietoturva

Valmet Automaation täytyy siirtyä vuoden 2015 versioihin nykyisistä ISO 9001:2008 ja ISO 14001:2004 standardeista syyskuuhun 2018 mennessä. Organisaation tavoitteena ei ole ainoastaan täyttää standardien aiheuttamia minimivaatimuksia, vaan kehittää toimintaansa mahdollisimman korkealle tasolle. Tämän tutkimuksen tarkoituksena oli luoda suunnitelma uusiin standardeihin siirtymiseksi. Jotta kaksinkertainen työ voitaisiin minimoida sekä siirtymästä saatavat hyödyt maksimoida, työssä myös tutkittiin, millainen yrityksen johtamisjärjestelmän tulisi olla tulevaisuudessa.

Tutkimus toteutettiin konstrukttiivisen tutkimusmenetelmän avulla, jolla luotiin suunnitelma uusiin standardeihin siirtymiseksi, sekä visio tulevaisuuden johtamisjärjestelmästä. Tutkimuksessa käsiteltiin laatua, johtamisjärjestelmiä, alan tulevaisuuden trendejä sekä muutosjohtamista teoreettiselta näkökulmalta. Kirjallisuuden lisäksi työssä hyödynnettiin vertailuanalyysejä, haastatteluita sekä muuta empiiristä materiaalia. Tutkimusmateriaalin perusteella luotiin kuva johtamisjärjestelmän nykytilasta, jota lähdettiin kehittämään.

Työssä toteutettiin GAP-analyysi, jonka avulla tunnistettiin organisaatiossa kehitystä vaativat kohdat, joita uudet standardiversiot aiheuttavat. GAP-analyysin perusteella luotiin tarkempi projektisuunnitelma, jonka avulla voidaan täyttää uusien standardien aiheuttamat vaatimukset. Projektisuunnitelman valmistuttua se otettiin käyttöön organisaatiossa. Samanaikaisesti suunnitelman kanssa luotiin visio tulevaisuuden johtamisjärjestelmästä. Visiota luodessa tarkasteltiin myös tulevaisuuden trendejä sekä niiden mahdollisia vaikutuksia johtamisjärjestelmään. Tulevaisuuden trendien tutkimuksesta korostui selkeimmin tietoturvan merkityksen kasvaminen. Näin ollen tietoturva tulee huomioida tulevaisuudessa yhä paremmin yrityksen toiminnassa ja johtamisjärjestelmässä.

Visio tulevaisuuden johtamisjärjestelmästä huomioi uudistuneet standardit, tulevaisuuden vaatimukset sekä järjestelmän käytettävyyden luoden mahdollisimman selkeän kokonaisuuden. Työssä tunnistettiin, että hyödyntämällä johtamisjärjestelmän dokumentaatiossa ISO-standardirakennetta ja toimitusprosessien rakennetta voidaan saavuttaa lukuisia hyötyjä. Uuden rakenteen ja tehokkaamman linkityksen avulla voidaan helpottaa esimerkiksi järjestelmän käytettävyyttä ja auditointia, mutta myös tuoda järjestelmää lähemmäksi eri liiketoimintafunktioiden työntekijöitä.

PREFACE

This master's thesis project has been a very interesting assignment. I have learned a lot during this project and I also got known many new people. When I started this project, the amount of work and the schedule seemed a little frightening. However, afterward, I can be very happy with the outcome. At the beginning of the work, I faced some difficulties with determining the scope of the study, but in its entirety, only small difficulties came up and the study was completed even slightly ahead of time of the original schedule.

I want to thank especially Valmet Automation for this great opportunity and Jussi Näveri, my supervisor from Valmet, for great guidance at different stages of the work. I also want to thank my colleagues who helped me with this project. Also, Professor Nina Helander, deserves special thanks for good advice and great guidance.

I also thank my family and friends for support and help during this project and study years.

Tampere, Finland, 17.10.2017

Valtteri Suontaka

CONTENTS

1.	INTRODUCTION	1
1.1	Background of the study	1
1.2	Objectives and scope	1
1.3	Structure of the study	4
2.	THEORETICAL BACKGROUND.....	6
2.1	Quality	6
2.2	Management system.....	8
2.3	ISO standards	10
2.3.1	2015 versions of ISO standards	11
2.3.2	ISO 9001	12
2.3.3	ISO 14001	14
2.3.4	ISO 45001	15
2.3.5	ISO 27001	16
2.4	Certification process.....	17
2.5	Future trends in automation industry	19
2.5.1	Industrial Internet.....	20
2.5.2	Collaboration tools.....	21
2.6	Change management	22
3.	DESCRIPTION OF THE RESEARCH TARGET	26
3.1	Valmet Automation.....	26
3.2	Valmet Automation’s management system	27
3.3	Lean philosophy in Valmet	28
4.	RESEARCH METHODOLOGY AND MATERIALS	31
5.	ANALYSIS	35
5.1	Current state analysis	35
5.1.1	Interviews.....	35
5.1.2	Current state of ISO standards	38
5.2	Benchmarking	38
6.	TRANSITION PLAN	43
6.1	Transition process	43
6.2	Background	43
6.3	Gap analysis	44
6.3.1	Requirements management tool.....	46
6.3.2	Gap analysis outcomes.....	49
6.3.3	Review consultant options	51
6.4	Fulfilling the gaps.....	51
6.4.1	Consider pre-assessment	53
6.4.2	Transition review	54
7.	FUTURE MANAGEMENT SYSTEM	55
7.1	The new requirements for target organization’s management system.....	55

7.1.1	Future trends	55
7.1.2	Customer requirements	56
7.1.3	Usability	58
7.2	Vision of future management system.....	59
8.	DISCUSSION OF RESULTS AND CONCLUSIONS.....	65
8.1	Results	65
8.2	Meeting the objectives	67
8.2.1	ISO 9001:2015 and ISO 14001:2015 transition.....	67
8.2.2	Future management system.....	68
8.3	Evaluation of the research	68
8.4	Suggestions for further research.....	69
	REFERENCES.....	72

APPENDIX A: Empirical material

LIST OF SYMBOLS AND ABBREVIATIONS

AUT	Valmet Automation Oy
QMS	Quality Management System
HSE	Health, Security, Environment
HSEQ	Health, Security, Environment, Quality
ISO	International Organization for Standardization
ISO 9001	Quality management system standard
ISO 14001	Environmental management system standard
ISO 27001	Information security management system standard
ISO 45001	Occupational health and safety management system standard
PDCA	Plan-Do-Check-Act cycle
RCB	Registered Certification Body

1. INTRODUCTION

1.1 Background of the study

A management system is vital for the successful operation of a business. Organizations must create and utilize management systems in order to fulfill customer needs, requirements and expectations. An effective management system is a system, which can be adapted to meet changing customer needs. (Summers 2005, p. 35) Customer requirements follow the trends of the industry and the general values of the world. The changing world shapes the customer requirements, which is why the companies must constantly monitor the trends and develop their operation. To assure the customer of high-quality of the operation, companies must prove the fulfillment of the requirements. With different certified standards, companies can improve their processes, but they can also communicate about the quality of the operation to external parties.

In September 2015, new versions of ISO 9001 and ISO 14001 standards were released (SFS-EN ISO 9001:2015, SFS-EN ISO 14001:2015). The organizations, who have certified ISO 9001:2008 or ISO 14001:2004, have three years' transition time from the date of publication. Therefore, the organizations, who want to maintain these standards must make the necessary changes before September 2018. (ISO 2015, p. 7)

1.2 Objectives and scope

This study was made for Valmet Automation (AUT), which has a long experience of automation business. AUT provides solutions which are designed to maximize the profitability of its customers' business by improving production performance and cost, energy and material efficiency. According to Valmet (2016), high-quality is an essential element in all its activities. Therefore, the quality must be continuously improved. The renewed 2015 version of ISO 9001 and ISO 14001 standards work as a driver for the change. In order to fulfill the new requirements, many measures must be made in the organization.

There are two main objectives in this study. Firstly, creating *transition plan* from current ISO 9001 and ISO 14001 versions to 2015 versions. Secondly, to create *a vision of the future management system* which takes into account various factors such new standards, future trends and changing customer requirements. The transition to the new versions is essential to do on a strict schedule, because ISO organization has defined the deadline for the transition. The reformation of the whole management system is a widespread process that does not fit the time constraints of the transition process. However, the transition to the new versions will have a major effect on the AUT's management system, which is

why, it was good to study what kind of the management system should be in the future. By defining the vision of the future management system already at this stage, it is possible to avoid duplicate work by utilizing the information of the vision with the transition process.

AUT's aim is not only to fulfill the minimum requirements imposed by the standard revision, but also rather resolve how the development of the management system could maximize the benefits. Therefore, it is also essential to consider future scope within the transition process. Due to the different time frames of this study and the actual transition process, some parts of the transition plan has been implemented during the study and some parts are scheduled to be implemented after the study is ready, by using the results as a base for management system reformation. The scope of the study is presented in Figure 1.1.

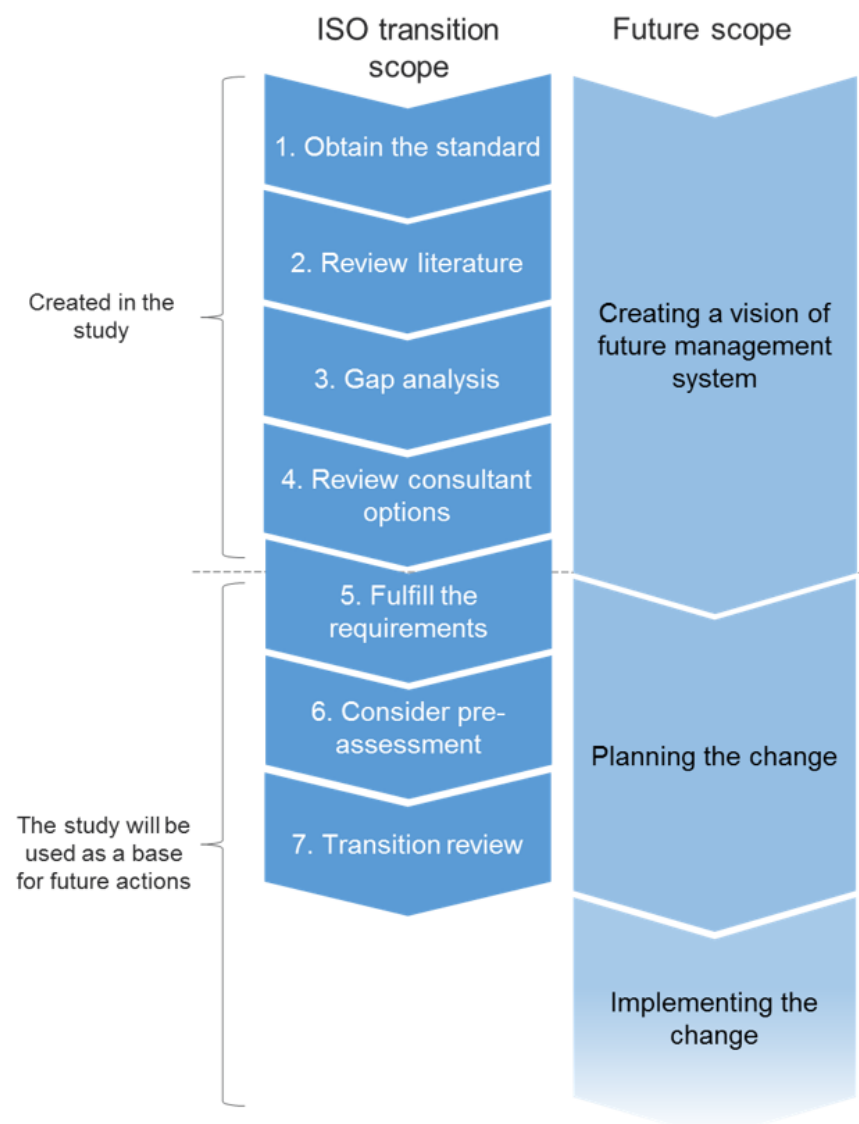


Figure 1.1. *The scope of the study.*

The transition plan includes seven steps which are presented in more detail in Chapter 6. First four of the phases of the transition process were made during the study. The fifth step, *fulfill the requirements*, was started during the study, but the most of its subtasks will be made after the study is ready. The vision of the future management system was created within the transition process, but the actual plan for implementing the change will be made after the study.

Scientific literature, benchmarking as well as interviews and other empirical material were utilized in the study. There were several theories in this study that had to be discussed in order to get good and reliable results, but they also work as a basis for further studies. The relations between the scopes of this study are illustrated in Figure 1.2.

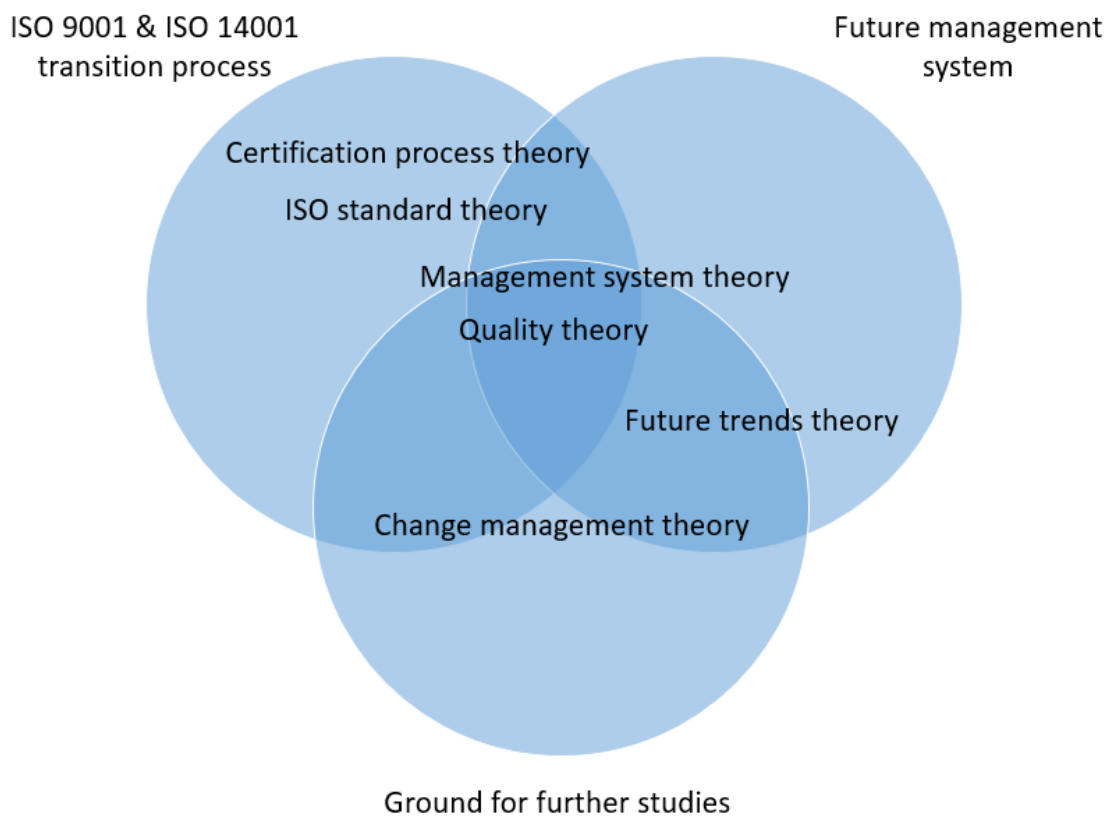


Figure 1.2. *The relations between the theories and the scopes.*

Figure 1.2. illustrates how different theories were used in the study. Also, all the theories and the results of this study work as a basis for further studies and operation related to the management system. In this figure, *ground for further studies* illustrates which theories need further research when creating the implementation plan for the future management system.

Quality and management system theories worked as background theory for all of this study. Therefore, these have been located in the middle of the figure. ISO standard and certification process theories were used mainly for planning the transition process, but they also worked as a background information for the vision of the future management

system. The theory of future trends was used for identifying the upcoming trends in the automation industry. It worked as a basis for the vision of future management system, but it is also essential to study the topic more widely in the forthcoming studies and when creating the implementation plan.

The change management theory is placed farthest on the side of the *ground for further studies*, to illustrate that the change management has a critical role in the management system reformation. The change can contain great risks, which is why it is essential to consider, what risks the change might contain and how to plan and implement the change in such a way that it would bring the greatest possible benefits.

1.3 Structure of the study

The structure of the study was designed to support as much as possible the purpose and intelligibility of the study. In Chapter 2, the theoretical background of the study is presented. The work has two main scopes and therefore it was essential to consider several theories: quality, management system, ISO standards, certification process, future trends and change management. The relations of these between these theories and the scopes of the study were discussed in Chapter 1.2.

In Chapter 3, the research target is described. The general information of the Valmet Automation and its management system are described in the chapter. The aim is to provide briefly the information on AUT's history and its operation, so that the reader can have a better understanding about the context. The chapter also introduces lean philosophy applied in Valmet, because it is present in all operations of Valmet, which is why it was essential to consider in the context of this study.

In Chapter 4, the research methodology and materials are introduced. The chapter discusses the research strategy and its implementation. The study has been implemented as a constructive research, and according to it, the research process has been created. The research process and its relation to objectives of this study are discussed in the chapter.

In Chapter 5, the analysis methods of this study are discussed. The chapter introduces the methods and the results which was conducted from current state analysis and benchmarking. The results of this chapter were used in the following chapters to help with creating the transition plan and the vision of the future management system.

In Chapter 6 the transition plan to 2015 versions of ISO 9001 and ISO 14001 was created. The chapter introduces the transition process, gap analysis and the created plan for fulfilling the new requirements. All the results of the gap analysis and the more specific plan for transition are not introduced in this study, because they are only for internal use of the target company.

In Chapter 7, the vision of the future management system was created. The requirements for the future management system have been discussed from many different points of views, such as future trends, customer requirements, usability and the total effectiveness. Based on these findings, a vision of the future management system was created. The implementation plan and the actual implementation are excluded from the scope of this study.

In Chapter 8, the results of the study are discussed. The results are evaluated and discussed from the perspective of meeting the objectives of the study. The chapter also introduces the suggestions for further research and the recommendations for the target organization. These suggestions are based on the results of this study.

2. THEORETICAL BACKGROUND

2.1 Quality

Quality has a close relationship with management systems. Especially total quality management has a great role in ISO 9001 standard and management system. (Goetsch & Davis 2010) Therefore, to understand the management systems and to achieve good results in reforming the management system, the first thing is to understand *quality*.

According to Sower (2011, p. 3) quality is often misunderstood and misapplied. For example, in some companies, the quality is thought only to be the quality department's responsibility. Although, everyone in the organization should take quality into account. There are also various beliefs regarding quality. For instance, some people think that quality is just avoidance of things that cause dissatisfaction. On the other hand, some people see the quality as some kind of "magic bullet" which appears, for example, in the form of quality programs which can magically improve the performance. Thought, the success of the improvements is very unlikely through quality programs, without the culture of the organization is also developed. (Sower 2011, p. 3)

According to Sower (2011, p. 5), the term *quality* is a much more complicated than it appears. The roots of quality are far in the history and definitions have varied at different time points. However, for centuries, quality has been connected to the excellence. At modern age, ASQ has defined quality as:

"a subjective term for which each person has his or her own definition. In technical usage, quality can have two meanings: (1) the characteristics of a product or service that bear on its ability to satisfy stated or implemented needs and (2) a product or service free of deficiencies." (Quality Glossary 2002, p. 56, cited in Sower 2011, p. 6)

If different people see quality differently, it can cause problems for example for measuring. In order to measure the quality, there should be clear definitions and rules for its implementation and measurement. Therefore, the organizations should determine what quality means in their organization and establish clear instructions related to it.

Goetsch & Davis (2010, p. 5) define quality as:

"a dynamic state associated with products, services, people, processes and environments that meet or exceed expectations and helps produce superior value."

Goetsch & Davis (2010, p. 5) clarify the background of the definition by considering separately each element of the definition. Quality can be seen *dynamic*, because in the different times and circumstances the quality can be seen differently. For example, back

in the days the gas prices were much cheaper than today, so the people valued more the horsepower of the car than the low petrol consumption. Today, the gas prices are up, so the consumption affects more the total costs of the car, so the people have started to see the low consumption more important factor than the efficiency of the car. (Goetsch & Davis 2010, p. 5) So it can be said that various things affect the quality. Also, people's values are constantly changing, which is why the company needs to continually improve its operations and remain aware of the general values of its operating environment.

Goetsch & Davis (2010) consider *products, services, people, processes and environment* at their definition. They highlight that quality does not apply just to the products and services. For instance, in a short time period, two competitors who focus on continuous improvement might produce products of comparable quality. Although in the longer term, the situation may look very different. The competitor who does not look just the quality of the finished product, but looks beyond it and focuses on the continuous improvement of the people, processes and environment that are involved in the manufacturing of the product, more likely wins in the long run. (Goetsch & Davis 2010, p. 5)

Also Sower (2011, p. 3) identifies quality as an important factor for companies so they can compete effectively in business. So, it is clear that companies should consider quality as a competitive asset but they should also remember to continuously improve it broadly.

Quality is a strategic asset for business. In today's world, organizations should include quality in their strategic processes. (Sower 2011, pp. 25–31) According to Sower (2011, p. 31), many organizations invest sufficiently in strategic planning. Though, the implementation of the strategy is in a much lower level. It is important that the organization also pay attention to the deployment of the planned strategy, because without proper implementation, the plan is an empty document. (Sower 2011, p. 31)

Philip B. Crosby has determined four absolutes for quality management:

1. quality must be defined as conformance to requirements – not just as a good thing to do;
2. the best way to ensure quality is prevention, not inspection;
3. the standard for quality must be zero defects, not “close is good enough”;
4. quality is measured by nonconformance, not indexes (Goetsch & Davis 2010, p. 20).

The first guideline of Crosby can be seen reasonable, because many times it can be hard to motivate the personnel to operate with a new way unless it is not easier or mandatory way to operate. On the other hand, *the second* point of Crosby's guidelines refers to that, it is important to find the root cause and prevent the possible risks. Also ISO 9001:2015 emphasizes the risk management more than the previous versions (SFS-EN ISO 9001:2015), so the companies should pay attention to it if they want to have ISO 9001 certification. *The third* point highlights that the idea of zero mistakes should be committed

to the company's way of thinking and the company should always strive towards perfection to improve their operation such as Toyota's lean approach is (Womack 1996). To develop the quality, it is important to measure it effectively (Goetsch & Davis 2010). At *the fourth* point of the guidelines, Crosby refers to the importance of measuring and he recalls that quality is measured through deviations. The deviations should be minimized in order to produce a consistently good quality.

Goetsch & Davis (2010, p. 21) have identified several trends that will affect the future of the quality management. Those trends are: *increasing global competition, increasing customer expectations, opposing economic pressure* and *new approaches to management*. According to Goetsch & Davis (2010, p. 21) the competition has become tougher at the emerging industrialized nations, which has *increased the global competition*. Because of the increasing globalization, the future management system should take into account more and more different global factors. The companies should also prepare for new global competitors, as well as, they should pay attention to their own global operation that all units fulfill the objectives which are set for them.

The other trend is *increasing customer expectations*. The customers' awareness has increased and with that also the expectations have grown. Today's global customers are not interested in just the quality of the end product, but also the quality of the organization that backs it up. Customers demand excellent products or services from the organization, but it should also provide, for instance, accurate billing, reliable delivery, after-purchase support and social responsibility. (Goetsch & Davis 2010, p. 21)

The third trend is *opposing economic pressure*. This trend is also a result of the globalization. There is more supply for customers, in which case they also demand more. Therefore, the companies must increase their quality but also lower the prices in order to succeed in the market. (Goetsch & Davis 2010, p. 21)

The last trend *new approaches to management* refers to company's management methods. The old approach of giving motivational speeches to employees without making any fundamental changes will no longer work. Company's management should also show leadership and actually lead people. (Goetsch & Davis 2010, p. 21) Also, ISO 9001 has brought better leadership up in the new version of the standard. (SFS-EN ISO 9001:2015). This makes the development of leadership and its demonstrating a new requirement for organizations.

2.2 Management system

There are various definitions for terms *management system* and *quality management system*. These terms are partly used crosswise in literature, but some sources see clear differences between them. Many sources refer with *quality management system* only to ISO 9001 standard (SFS-EN ISO 9001:2015; Santos et al. 2012). However, some sources

comprise that quality management system means a wider entity. For example, according to Pun et al. (1999), the quality management system assists the organization for better performance and business results. They also see that the quality management system can consist of several standards like in their case the both ISO 9001 and ISO 14001. (Pun et al. 1999) So there is no common explanation for the quality management system in literature. For example, according to some sources quality management system means only ISO 9001 standard, but some sources use a broader definition.

A management system is more often referred to a wider context than a quality management system. The management system can be seen as the basis for the more specific management systems. These more specific management systems are, for instance, ISO standards such occupational, health and safety management system, which can be considered as part of the management system (Santos 2012).

In this study, the term *quality management system* is used in the context of ISO 9001 and the term *management system* reflects a broader perspective. Therefore, in this study the topic *management system reforming in automation industry* refers to the whole documentation and operation methods of AUT, including different standards and requirements.

In this study, the scope of observing the management system is especially in the field of ISO 9001:2015 and ISO 14001:2015. However, many other factors are as well taken into account in the reformation of AUT's management system. In Figure 2.1 is summarized the key factors of the management system based on the literature.

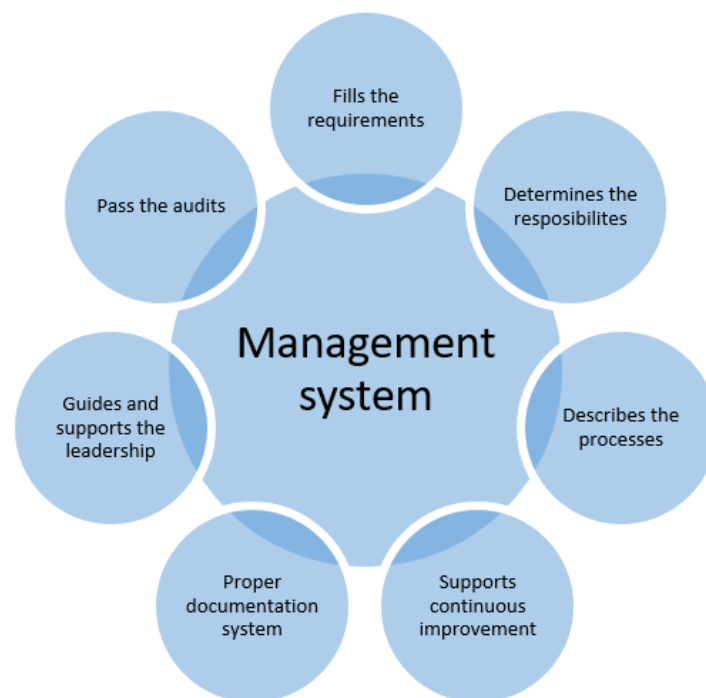


Figure 2.1. Management system.

According to ISO (a), a management system reflects the way in which an organization manages the inter-related parts of its business in order to achieve its objectives. With objectives, ISO (a) means for example product or service quality, operational efficiency, environmental performance as well as health and safety in the workplace.

Therefore, the management system should also fill the requirements and pass the audits so that the organization can get the certifications. In this study, the management system covers not only the ISO standards, but also considers the customer requirements which can have impacts on the management system.

ISO 9001:2015 highlights the importance of determining the roles and responsibilities (SFS-EN ISO 9001:2015). Therefore, a proper management system should take those into account. The management system should also illustrate and steer the operation of organization which is why describing the processes is essential.

Continual improvement has been in the key position already at ISO 9001:2008, but in the 2015 version, it is highlighted even more (SFS-EN ISO 9001:2008; SFS-EN ISO 9001:2015). Therefore, it is important that the management system is up to date. Most importantly, with the continual improvement, the organization can improve the efficiency (Bessant & Francis 1999). In order to operate efficiently, the organization should have skilled management. The importance of leadership has been emphasized also in the ISO 9001:2015 (SFS-EN ISO 9001:2015).

The management system should be documented properly. The relevant information should be available and up to date. (SFS-EN ISO 9001:2015) The documents serve as an evidence of compliance with the requirements, but above all, they guide the employees and the whole organization to operate properly and to develop their activities even better.

2.3 ISO standards

The International Organization for Standardization (ISO) is the federation of national standards bodies which operates globally. The history of ISO started in London, in 1946, when 65 delegates from 25 countries met to discuss the future of International Standardization. ISO founded in 1947 with 67 technical committees, which gather a group of experts together to focus on a specific subject. (ISO 2017)

According to Gibbon & Henriksen (2011), the roots of quality management standard can be seen emerged at the end of the 1970s, when it occurred within military standards. ISO 9000 quality management series of standards developed in 1987, and today, it is one of the most well-known and bestselling standards. There are over one million companies and organizations in over 170 countries who have certified ISO 9001 standard (ISO b).

Nowadays ISO's technical committees draw up International Standards. The work involves also governmental and non-governmental international organizations in collaboration with ISO. (SFS-EN ISO 9001:2015, p. 42) There are different ISO standards and guidelines for different purposes. This study examines these four standards: ISO 9001, ISO 14001, ISO 45001 and ISO 27001.

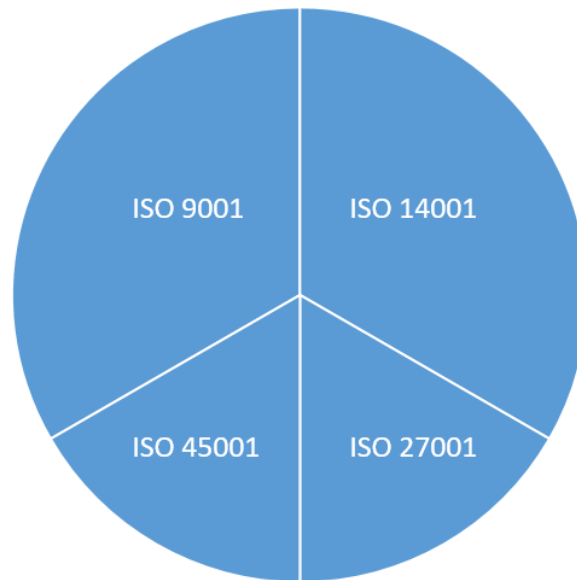


Figure 2.2. *The standards which are discussed in the study.*

Figure 2.2. demonstrates that ISO 9001 and ISO 14001 standards are discussed more broadly in this study than ISO 45001 and ISO 27001 standards. ISO 9001 and ISO 14001 have the main focus because they are currently certified in AUT. Therefore, the transition plan, which is created in this study, takes into consideration these two standards. ISO 45001 and ISO 27001 are considered in the future scope of the study.

2.3.1 2015 versions of ISO standards

In 2015, ISO made a reformation concerning standards ISO 9001 and ISO 14001. Also, OHSAS 18001 is being developed and it will move under ISO standards with name ISO 45001. In the older versions, the standards had different structures. In 2015 versions, ISO has paid a special attention to the structure. Currently, ISO 9001, ISO 14001 and ISO 27001 have a common structure and ISO 45001 will also follow the same structure. The structure is following:

- 0 Introduction
- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Context of the organization
- 5 Leadership

- 6 Planning
- 7 Support
- 8 Operation
- 9 Performance evaluation
- 10 Improvement.

The common structure among the standards, for example, eases the integration of standards to the company's management system. There are also many other changes, which will be discussed in more detail in Chapter 6. Also, the impacts on the company's operations will be considered in this study.

2.3.2 ISO 9001

ISO 9001 is a quality management system -standard. According to Barafort (2017, p. 177) ISO 9001 is the leader of the management system standards. Applying the certificate is a strategic decision for a company or an organization. The standard can help the organization to improve their overall performance and to create a basis for sustainable development initiatives. (SFS-EN ISO 9001:2015, p. 43).

The standard offers many benefits for an organization, such the ability to provide products and services that meet as well as the customer requirements but also the statutory and regulatory requirements. With the standard, the company or the organization can have better possibilities to enhance customer satisfaction, it can address the risks and opportunities regarding its context and objectives and have the ability to demonstrate that it fills the requirements of the quality management system. (SFS-EN ISO 9001:2015, p. 43)

ISO 9001 promotes process approach adoption into the quality management system's developing and implementing. Interrelated processes form a system which understanding and managing improve the effectiveness and efficiency in achieving its intended results. With a process approach, the organization can control the interrelationships and interdependencies among the processes of the system so that the organization's overall performance can be enhanced. The process approach includes the systematic definition and management of processes in order to achieve intended results in accordance with the quality policy and strategic direction of the organization. By using the process approach in a quality management system, an organization can have a better understanding and consistency in meeting requirements, can evaluate the processes in terms of added value, can achieve the effective process performance and improve the processes based on the evaluation of data and information. (SFS-EN ISO 9001:2015, pp. 44–45)

Plan-Do-Check-Act (PDCA) cycle is one key element of ISO 9001. PDCA cycle can help with managing the processes and the system as a whole. (SFS-EN ISO 9001:2015, p. 45) A company or an organization can ensure with PDCA cycle that its processes are adequately resourced and managed and that opportunities for improvement are determined

and acted on. According to Sokovic et al. (2010), PDCA cycle is more than just a tool. PDCA encourages to continual improvement and embeds it to organization's culture. The using of PDCA cycle means that the organization continually look for better methods for improvement. (Sokovic et al 2010) The connection between the structure of ISO 9001 and the PDCA cycle is demonstrated in Figure 2.3.

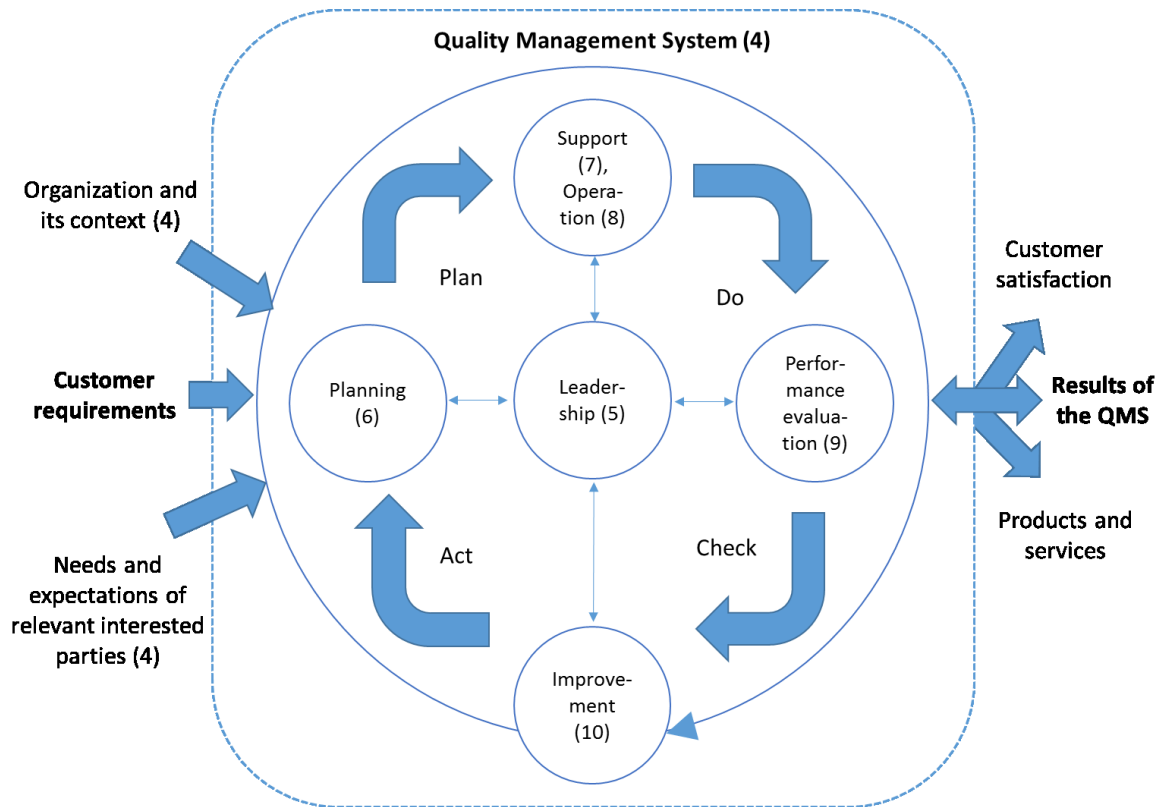


Figure 2.3. The structure of ISO 9001 in PDCA cycle (SFS-EN ISO 9001:2015).

The first phase of PDCA cycle is *planning*, where an organization set goals for a system and its processes. In this phase, it is also important to determine the resources to achieve the desired results and identify and address the risks and opportunities. According to Summers (2005, pp. 240–241), the planning phase is the most important part of the cycle, but also the most time-consuming part. In the second phase, *do*, the organization should select and implement the solution which was planned. In this phase, it is critical to ensure the success of the implementation of the solution by assigning responsibilities to specific individuals and holding them accountable for the accomplishing task. Knowing who is doing what and when, it is easier to ensure that the project stays on track. (Summers 2005, pp. 290–291)

In the *check* phase, the organization should monitor and measure the processes and the resulting products and services against policies, objectives, requirements and planned activities. The organization should also report the results explicitly. In the final stage, *act*, organization should take actions to improve performance. (SFS-EN ISO 9001:2015, p. 45–46) According to Summers (2005, pp. 293), even small improvements can lead to a

great impact on the organization's financial statement. It is also good to notice that PDCA is a cycle and the organization should use it as part of its activities and support continual improvement. (Sokovic et al. 2010)

According to Lo et al. (2013, cited in Psomas & Anton 2015, p. 2090) justifying the quality practices is not sufficient for the effective operation. The company must focus on a clear understanding about the influential factors to achieve the full effectiveness of the ISO 9001. When there is a lack of motivation to implement a quality management system, the further development of it and improvement of its effectiveness cannot be successful. The lack of internal enthusiasm and motivation can also hinder the impact of ISO 9001 performance. (Psomas & Antony 2015, p. 2090)

2.3.3 ISO 14001

ISO 14001 is an environmental management system -standard. ISO 14001 is developed to enable companies to improve their own activities in a more environmentally friendly direction. It is essential to find the right balance between the environment, society and the economy in order to satisfy the current needs without destroying the future generations' ability to meet their needs. (SFS-EN ISO 14001:2015, p. 47) According to Boden (2017), the amount of CO₂ emissions has increased highly in the past decades. The growth rates concern, because the greenhouse gases affect the climate change and the wellness of environment. On the other hand, also the society is causing more and more expectations for sustainable development, transparency and accountability. This is dependent on, inter alia, by increasingly stringent legislation, climate change, growing pressures on the environment, the inefficient use of resources and improper waste management. These things have led organizations to adopt a systematic approach to environmental management by implementing environmental management systems. (SFS-EN ISO 14001:2015, p. 47)

ISO 14001 aims to provide a framework for organization to protect the environment and respond to changing environmental conditions. The standard defines the requirements for the organization, which it must fill to achieve the intended outcomes, and to get the certification. As ISO 9001, also 14001 follows PDCA cycle and supports continual improvement. (SFS-EN ISO 14001:2015)

According to Di Noia & Nicoletti (2016, p. 94), ISO 14001 standard has become increasingly strategic for organizations in globalized markets. Also, the number of certified organizations has grown steeply in past years, for instance, in the year 1999 the number of ISO 14001 certifications was approximately 14 000 and 2013 the number was over 300 000. (Di Noia & Nicoletti 2016, p. 94–97) According to Whitelaw (2004), the major factors that make the companies adopt the standard are:

- to send “green” image in order to gain or retain a market share;
- to attract more ethical investments;

- to decrease insurance risks;
- to decrease prosecution risks;
- to decrease different costs (see Di Noia & Nicoletti 2016, p. 97).

The success of the environmental management system depends on the commitment of all levels and functions of the organization. It is essential that the top management lead and show example by their own actions. The top management can integrate the environmental management into organization's business processes, strategy, decision making and incorporate it into organization's management system. (SFS-EN ISO 14001:2015) According to Boiral et al. (2017, p. 20–21), the most common reason for drawbacks in a successful certification process is related to the cost of implementing the standard. The standard can offer some great economical benefits, but because of the limited resources in many organizations or insufficient commitment from managers, the drawbacks can occur. The other major reasons for an unsuccessful certification process are problems with documentation, superficial adoption, time constraints and resistance of change. (Boiral et al. 2017, p. 20–21) In order to certificate the standard successfully and avoid the drawbacks, organizations should pay attention to the certification process.

2.3.4 ISO 45001

ISO 45001 is currently under development by a committee of occupational health and safety experts. It will be the occupational health and safety management system -standard. The new standard will base on the former occupational health and safety standard (OHSAS 18001). The new standard still has many changes such as its structure is changed to follow the 2015 versions of ISO 9001 and ISO 14001. (ISO c). According to Kleinová & Szaryszová (2014) new ISO 45001 can help an organization to integrate the occupational health and safety management system into the organization's management system which includes ISO 9001:2015 and ISO 14001:2015.

According to International Labour Organization (ILO) more than 2.3 million people die every year as a result of work-related accidents or diseases. An organization is responsible for the health and safety of its employees and other people under its control. The aim of the ISO 45001 is to enable an organization to improve its occupational safety and health performance as well as to manage its risks. The standard provides a framework for organizations to prevent deaths, work-related injuries and ill health and to improve the safety and healthiness of the workplace. (ISO 45001:2016)

The standard can offer various benefits for an organization by enabling it to improve its occupational health and safety performance by:

- developing and implementing an occupational health and safety policy and objectives;

- ensuring that top management demonstrate leadership and commitment to the system;
- establishing processes which take into account its risks and its opportunities;
- determining the dangers and risks associated with its activities and seeking to eliminate them or minimize their effects;
- establishing operational controls to eliminate or minimize the risks;
- increasing awareness of hazards and risks related to occupational health and safety;
- evaluating the performance of occupational health and safety and trying to improve it;
- establishing and developing the competencies which necessary;
- developing and supporting an occupational health and safety culture in the organization;
- ensuring that employees are informed, consulted and participated. (ISO 45001:2016)

To ensure that the implementation of the standard succeeds, the organization should consider many things. First, the role of the management in successful implementation is high. The top management should show leadership and their commitment to the system. They should also develop, lead and promote occupational health and safety culture in the organization. Of course, workers can affect it with their own contribution. In order that employee can act right, the policies and instructions must be clear and compatible with the overall strategy. Also, it is important that the occupational health and safety management system is integrated into the business processes of the organization and it will be monitored and continuously improved. (ISO 45001:2016)

2.3.5 ISO 27001

ISO 27001 is developed for establishing, implementing, maintaining and continually improving an information security management system. The information security management system should be integrated with an organization's processes and overall management structure. Information security should also be considered in the designing of processes, information systems and controls in order to form an effective information security management system. (SFS-EN ISO 27001:2013) According to Disterer (2013) with ISO 27001 -certification company can achieve fulfilment of well-known and accepted security standards and get the trust of customers. Verification of compliance with the standard can also reduce the risk of fines or compensation payments caused legal disputes, if the organization follows the requirements of the standard. The requirement for planning, implementation, operation and continuous monitoring and improving a process-oriented information security management system is a central factor of ISO 27001. (Disterer 2013)

2.4 Certification process

To verify the compliance of international standards, an organization must pass a certification procedure which is controlled by an authorized certification organization (Registered Certification Bodies RCB). (Disterer 2013) DNV is a global RCB, that introduces ten steps for implementation of a new standard. The certification process is presented in Figure 2.4.

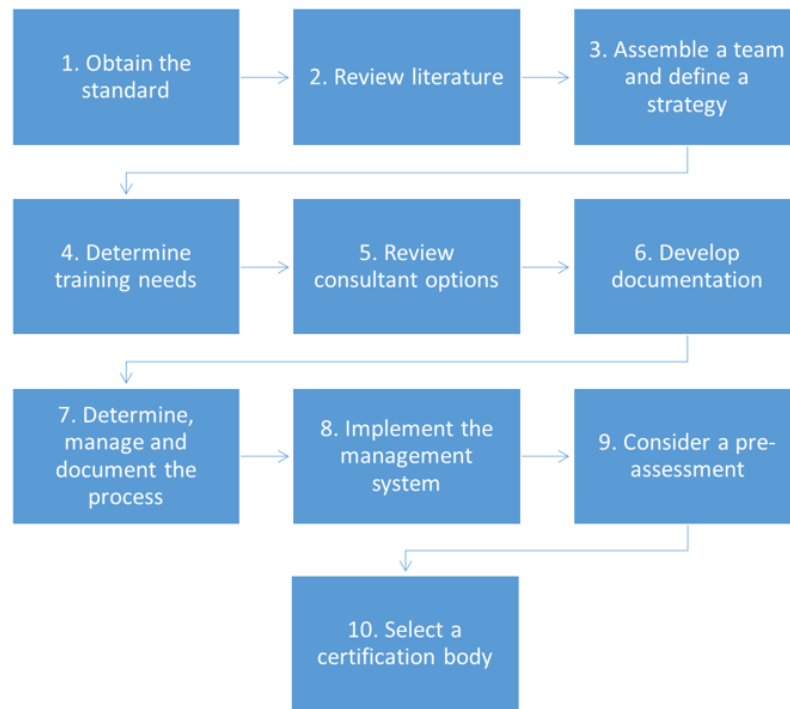


Figure 2.4. Certification process of a new standard.

In the first step, the organization should get familiarized with the standard. In this step, the organization should consider if the standard would be helpful for the organization. (DNV) This step is essential when the organization is certifying a new standard, because it is important to consider whether the standard is necessary for the organization and what benefits it can offer. The overall cost of standardization can be large, so it has to be compared with the benefits it will generate.

Next, *in the second step*, the organization should review the literature. There is a great number of published information available which can help the organization to understand the implement the standard. It is also useful to explore the guiding material which can be attached to the actual standard. (DNV) Good preparation facilitates the process and can save considerable time in the process.

After the organization has made the decision to implement the standard, *in the third step*, it should assemble a team for the certification process. The team is responsible for implementing and maintaining the management system. The team should plan the strategy

along with senior management, which is supported by the management system. (DNV) According to SFS-EN ISO 9001:2015 the role of management is important for the certification process but it is also important to consider its role in the different functions of the company in order to meet the requirements of the standards.

In the fourth step, the organization should determine the training needs of the team. The members of the team should know the full details of the standard in order to manage the certification process successfully. If there is a need for more knowledge, the organization can use consultants, *in the fifth step*, to give advice to create working, realistic and cost-effective plan for implementation of the standard. (DNV)

In the sixth step, the documentation is under the scope. The documentation should cover the requirements of the standard but also support the operation of the organization. (DNV) According to Sower (2011, p. 126), the control of the documents is essential for a quality management system. Personnel who use the QMS related documents must be assured that the documents are properly approved and up-to-date. There can occur quality problems, if for example, some procedure has changed but the documentation related to that procedure has not been updated. (Sower 2011, p. 126) There are many different platforms for documentation, so the organization should determine which platform they will use with their documentation of the management system. The platform should take into account the needs of the organization to ensure effective management, communication and implementation of the management system. (DNV)

In the seventh step, the organization should determine, manage and document the processes and their interactions with their strategy, policies and objectives. The processes should cover areas such as product and service realization, management processes and they should meet the needs and expectations. After this step, the organization can implement the management system *at the eighth step*. In this step, the communication and training are the major factors in order to achieve successful implementation. (DNV) Communication is an important thing to consider in order to achieve successful certification process, but proper communication is also required in ISO 9001 standard. (SFS-EN ISO 9001:2015)

After implementation, *in the ninth step*, the organization should consider a pre-assessment. In this step, the organization can have a preliminary evaluation of their management system by a certification body. This can help the organization to identify the non-conformance areas and allow the organization to correct these areas before the audits. Finally, *in the tenth step*, the organization should select the certification body who conducts audits. (DNV)

There are different views about certification processes. The processes can differ highly depending on the source. For example, according to Disterer (2013), the first step is to

choose an RCB. With the help of the RCB, the organization can determine which requirements the organization already meet and which still need some actions to achieve successful certification. (Disterer 2013) The organization, can for example, exploit gap analysis to find the factors that require development. With gap analysis organization can highlight those points, which currently have deficiencies and need to be improved. (Mineraud et al. 2016)

In the main audit, representatives of certification organization carry out a site visit, which can last several days. The representatives interview the all the responsible persons by asking unpredictable questions related for instance to policies, related processes, details and features. With the help of interviews, the representatives try to get the best possible picture of the level of the certain things in the organization. After that, the certification organization will write a report, which describes the results of the audit. The results include for example the explanation of improvement measures, which have to be implemented necessarily before the next audit. (Disterer 2013)

ISO standard certificate is valid for three years from certification and after that, it needs to be re-certificating in order to maintain it. Usually, the re-certification demands less effort than the new certification. (Disterer 2013) Although, the required workload depends on whether the standard has been changed. ISO reviews standards every five years, and if there occurs the need for change, the standard will be updated to meet the new requirements (Fonseca 2015).

2.5 Future trends in automation industry

According to Wollschlaeger et al. (2017), industrial communication is in the development phase. Industrial Internet is a big future trend in the automation industry. (Wollschlaeger et al. 2017) Wollschlaeger et al. (2017) highlight that these concepts are not entirely new, but they have emerged in a context of information and communications technology years ago. However, these things have been topical lately because, new more advanced technology enables the better utilizing of Industrial Internet based solutions and developing new solutions. (Wollschlaeger et al. 2017)

The world has changed greatly in past decades. Technology has developed, which has led to the development of new working methods. This has in turn affected to the whole operating environment. Digitalization has brought the digital technology integrated into every day's tasks, but also in companies' operation. Employees can keep virtual meetings or work remotely. This can save huge amount of travel and room expenses, but to enable this, the organization must have a working technology. (Alasoini 2015)

There are many things, which have developed largely in 2010's, but for Valmet, the development of Industrial Internet and collaboration tools have been topical. Therefore, in this study, the future trends discuss mainly on Industrial Internet and collaboration tools.

2.5.1 Industrial Internet

According to Posada et al. (2015), global movement can be seen in some of the most advanced economies which are seeking to develop their productivity and efficiency in industrial manufacturing by making use of the latest developments in information and communications technology. IoT (Internet of things) refers to the objects, which are networked, and they are equipped with solutions which provide intelligence (Wortmann & Flüchter 2015, p. 221). Industrial internet means IoT solutions for industry. Nowadays mobile and cyber-physical systems are used in many applications from industrial control systems, modern vehicles to industrial IoT (Internet of things) which enable, for example, condition monitoring, structural health monitoring, remote control and remote diagnosis. (Sadeghi et al. 2015)

Information security is a great concern with the systems related to the industrial internet. These systems are attractive targets for attacks, because they generate, process and exchange security-critical and sensitive data. Cyberattacks can be very serious for company's information, but also even to its employees. IoT has enabled that the cyberattacks can cause physical damage or even threat human lives. It can be seen the new challenges will arise with the industrial IoT, for example, regarding security, privacy, standardization, legal and social aspects. (Sadeghi et al. 2015) This study examines in particular the effects of Industrial Internet on standardization and the information security related questions.

According to Sadeghi et al. (2015), in the near future, cloud-based services enable the better management of customer requirements in the production processes and planning by allowing a new level of product individualization with a lower cost. One of the objectives of the industrial IoT is that the smart products know their history and can control their own production process.

The warranty issues and customer claims raise different things to consider with industrial IoT. For example, if a company outsource its production to a third party's smart factory, the infrastructure and any information related to the production process must be ensured to be trustworthy. The company can be obligated to provide evidence of the quality of resource materials and correctness of production of a product to a third party. (Sadeghi et al. 2015)

According to Sadeghi et al. (2015), it is essential that an organization has a comprehensive cybersecurity framework in order to protect its IoT systems. The framework should cover all abstraction layers of heterogeneous IoT systems through the platform boundaries. Sadeghi et al. (2015) also highlight that security solutions are inappropriate if they do not scale to wide networks of various different devices and cyber-physical systems with constrained resources and real-time requirements.

Industrial Internet related solutions are currently a great trend in the field of industry (Sadeghi 2015). Many sources have also identified industrial internet closely connected to today's automation industry (Rahmani 2016; Beyerer & Usländer 2016). Therefore, it is important to consider industrial internet in this study, because it can have impacts to the management system, especially in the field of information security. In Chapter 7 the connection of industrial internet to AUT's information security and management system is considered.

2.5.2 Collaboration tools

Collaboration is important for company's efficiency. Collaboration can be challenging especially if there is no possibility to face-to-face meetings or the collaboration is implemented across time zones. Collaboration tools can ease the collaboration and enable working from different locations. They also enable, for instance, the facilitation, automation and control of the entire development process. (Lanubile et al. 2010, p. 52)

There are various collaboration tools. According to Lanubile et al. (2010, pp. 52–55) different collaborative development tools are, for example, version-control systems, trackers, build tools, modelers, knowledge centers, communication tools and web 2.0 applications. Version-control systems allow team members share software artifacts in a controlled manner. There are also version-control systems, which operate in a peer-to-peer network. By peer-to-peer manner operating version-control systems can provide a clone of the project's repository on local to a local machine, when centralized tools allow developers only to check out the project. In addition to traditional collaborative softwares, Web 2.0 applications offer also, for example, direct user contributions, rich interactions and community building. (Lanubile et al. 2010, pp. 52–55)

With trackers, the team members can access remotely to the tracking function database, which manages issues related, for example, to defects, changes and requests for support. Build tools allow projects maintain remote repositories and create and schedule workflows. The more distributed the project is, the bigger is the need for secure, remote repository and build management. Modelers are collaborative modelling tools which, for instance, help developers to create formal or semiformal artifacts. Knowledge centers are content management systems, which allow team members share explicit knowledge on the Web. It can contain internal documents, technical references, standards, FAQs and best practices. They can also include knowledge management activities, such as expert identification and skills management. (Lanubile, 2010, pp. 52–55)

Communication tools can help with communication in situations when direct interaction is not possible. Communication tools can be divided into asynchronous and synchronous communication tools. For example, email, newsgroups and forums are asynchronous communication tools. Synchronous communication tools are for example conference

calls, chats, instant messaging and videoconferencing. There are various softwares which offer these services. (Lanubile, 2010, pp. 52–55)

In the future, the collaboration tools will become more common, which allow employees to work remotely. According to Johns & Gratton (2013, p. 8), experts have projected that in a couple of years, over than 1.3 billion people will work remotely by using virtual solutions. It can be identified three waves in virtual working models: virtual freelancers, virtual corporate colleagues and virtual co-workers. The first wave, virtual freelancers, become familiar for businesses in the 1980s when “freelance nation” of virtual workers came up by utilizing email. The connectivity grew with computers and internet, so it also enabled new working groups to enter labour markets, such stay-at-home parents. (Johns & Gratton 2013, pp. 4–5)

By globalizing the second wave came up. Virtual corporate colleagues become common in big global firms. However, virtual and remote working bring up some challenges such lack of teamwork. The employees also lost the sense of community which also affected to the work input. Currently, the third wave is rising to strive the way of working back to more collaborative methods. Because of globalization and today’s work environment, the virtual working is essential for companies. Although, the collaboration tools have enabled the more effective way to work virtually in teams. (Johns & Gratton 2013, pp. 5–6) So it can be said, that virtual working will be more common in the future. Therefore, its effects on information security and the organization’s management system are discussed in this study.

2.6 Change management

New ISO standards have brought many new requirements. New requirements as well as reforming the management system require a lot of changes in the organization which is why the change management is an important thing to consider. Also, ISO 9001 standard requires planning and managing the changes (SFS-EN ISO 9001:2015). Therefore, the organization has to pay a special attention to it.

Center for Chemical Process Safety, CCPS (2011) defines a change as some addition or corrective action, after which the approach is not the same as the previous one. According to Todnem (2005, p. 369), change management can be defined by a process which is continually reviewing the direction, capabilities and structure of the organization to serve the changing needs of both external and internal customers. In today’s highly competitive and continuously evolving environment, the successful change management is essential for organizations. According to CCPS (2011), the purpose of the change management is to ensure that the possible changes have been evaluated and the actual management of the changes have been started before the organization is making any changes.

Luomala (2008, p.4) emphasizes that the impulse for change must come from an organization's own activities and the identified need for change. In the change situation, it is necessary to first define the objectives and justify the need for change. In order to achieve successful change, it is important to pay attention also to the development of the organization's functionality. In practice, this means that the issue needs to be examined more broadly, taking into account, inter alia, working conditions, information flow, encouragement, leadership, work content and physical conditions. (Luomala 2008, p. 4)

According to Wincek et al. (2014), there are many types of changes to which organization should pay attention, such: task allocation changes, modification of working conditions, personnel changes, organizational hierarchy changes and organizational policy changes. On the other hand, the bigger the project is to which the change is affecting, the harder the change is to implement (Cho et al. 2015). Cho et al. (2015) also say that especially the projects which have several sub-projects are very depended on successful change management, because they are more susceptible to changes and unpredictable contingencies.

John Kotter (1995) has researched changed management in his study "Leading change". Kotter has presented eight steps process for change management. The process is presented in Figure 2.5.



Figure 2.5. Kotter's change management process (Kotter 1995, p. 61).

Kotter (1995, p. 59) says that the success in change process demands time. By skipping the steps, it is only possible to create the illusion of fast speed, but it will not produce a

satisfying result. The first step of Kotter's process is to *establish a sense of urgency*. The idea of this step is to get a clear vision of the change. It is important to have an evidence which proves that the change is reasonable and urgent. The first step operates as a basis for the second step, *forming a powerful guiding coalition*. Many times, the idea of a change comes from individuals or some groups. The first step is essential, because with a small number of people, the change process does not progress, so the leaders of the change must motivate and show the need for change to the other people. (Kotter 1995, p. 60) According to Kotter (1995, p. 60), over 50 % of companies fail in the first step. The biggest reason for failures is that the executives do not understand how hard is to get people out from their comfort zones and toward change. He also emphasizes the importance of leadership with questioning that there are often too many managers and not enough leaders. (Kotter 1995, p. 60) To success, the change requires support from influential people. According to Kotter (1995, p. 61), it is said that the major change is impossible if the head of the organization is not an active supporter.

In the third step, *the vision should be created*. The idea of the vision is to clarify the direction in which the organization needs to move. The first draft of the vision is usually not clear, but it should become a clear plan with help of teamwork. The sensible vision is important, because without it a transformation effort can become confusing and take the organization to nowhere or even to the wrong direction. (Kotter 1995, p. 63)

The fourth step, *communicate the change vision*, is important in order to get the change process started. According to Kotter (1995, p. 63) the change is impossible if there is plenty of people who are committed to the change. The change requires often also short-term sacrifices, which can cause dissatisfaction with the employees. Without knowing that the change will be useful, the employees will not make any sacrifices. Therefore, it is important the communicate the vision of the change and justify its necessity. (Kotter 1995, p. 63)

The fifth step, *empowering others to act on the vision*, is closely related to the fourth step. Even though, the most of the people would understand the importance of the change, there often are also obstacles related to the change process. The obstacles can occur in different forms, such as, individual person's or inappropriate organizational structure. It is important to find out the obstacles and discover a solution to remove them. (Kotter 1995, p. 63)

When the relevant parties for the change have been convinced of the usefulness of the change and the biggest obstacles have been removed, it is possible to continue to the sixth step, *planning for and creating short-term wins*. The transformation requires time and the advantages and the benefits can appear after many years. In order to motivate the people to change, it is important to reach short-term wins during the process. If there are no short-term wins, many people can give up or even join to those people who have been resisting the change. That can greatly affect the success of the change process. (Kotter 1995, p. 65)

Lindner (1998) also says that, when an employee is motivated, he/she also works more effectively. Therefore, the whole change process is important to plan well, and not forgetting short-term wins.

The aim of the seventh step, *consolidating improvements and producing still more change*, is to take maximum advantage of the change. It is important to consolidate the implemented improvements and produce more change. The organization can for example Hire, promote or train current employees who can implement the desired vision. The organization also can also consolidate the process with new projects, themes and change agents. (Kotter 1995, pp. 61–67) Kotter (1995, p. 66) also remind, that victory should not be celebrated too early. It takes time that the changes are properly merged into the culture and practices of the organization. (Kotter 1995, p. 66–67) Therefore, it is important to make sure that the change process also meets the long-term goals. the company should also remember to continually improve its operations, and not just settle with the originally planned objectives.

The final step is *institutionalizing new approaches*. One big factor in this step is to present the achieved benefits. It is important to show employees how the new approaches, behaviours and attitudes have helped to improve performance. Without proper communication, people can make their own conclusions, which may not be correct. That, in turn, can cause misunderstandings. The new approaches should be merged into the organizational culture in order to achieve the biggest possible benefits from the change. By that way the change can last, and is not just a momentary improvement. (Kotter 1995, p. 97)

Personnel have a great impact on the success of the change. Therefore, it is essential to train and motivate personnel to be committed to the change. According to Gill (2003), almost two-thirds of surveyed companies see education and training important for successful change. Also Noe (2010) states that training is important for companies in order to compete in today's business environment. Motivation can be seen one key factor for the successful change. If the employees are not motivated, they are less likely willing to start learning the new working methods or to take necessary measures that the change requires. The motivating requires skillful management, who can lead the change successfully to the end. According to Gill (2003), companies rank the leadership as the most important factor for the successful change. Gill (2003) also finds that effective leaders can motivate and inspire people to want to do the things which are needed to be done. Therefore, it is important to pay attention that the managers are skillful who are responsible for the change. Training should also take into account both, the managers who lead the change and the personnel who are relevant to the change. With well-planned change management and with appropriate training, the change will more likely to success.

3. DESCRIPTION OF THE RESEARCH TARGET

3.1 Valmet Automation

Valmet has become the global leader in developing and supplying of process technologies, automation and services for the pulp, paper and energy industries. Valmet operates in 33 countries and it has over 12 000 employees in 161 locations. In 2016, Valmet's net sales were approximately 2,9 billion euros. (Valmet 2016, p. 6–9) Its history can be seen begun in the 1750s. Today, the company is known as Valmet, but in its history, it has been associated with many different companies and areas of business activities. (Valmet 2017)

The roots of Valmet are in the Viapori, where a small shipyard started to operate in 1759. The shipyard operated as an individual company to the 1900s, when Finnish state bought the company and it became part of the state metal factories (Valtion Metallitehtaat) which is later known as Valmet. Many companies which are nowadays part of Valmet, have founded during the 1800s, for example, Karlstad Mekaniska Werkstad, Beloit Corporation and Sunds Bruk. In 1946 many Finnish state-owned metal factories merged into Valtion Metallitehtaat and five years later, in 1951, it renamed to Valmet Oy. The name Valmet was in use for half a century, and in the year 1999 Valmet and company named Rauma merged into a new company named Metso Corporation. In 2000s Metso made a lot of acquisitions in pulp, paper and power industries. Metso expanded its operation also in other business areas. For example, in 2009 Metso bought a textile company, Tamfelt, which is one of the global leading companies in its operation field and currently it part of Valmet Corporation.

Closer to current position Valmet was moved in October 2013, when the Board of the directors of Metso Corporation decided to demerge Metso into two companies: Valmet and Metso. Metso's pulp, paper and power businesses transferred to Valmet and mining, construction and automation business remained at Metso. Automation become part of Valmet when Valmet bought Process Automation Systems business from Metso in January 2015. (Valmet 2017)

During Valmet's history, its product range has been wide, including various things such, aircrafts, weapons, locomotives, tractors, the engines of the ships, elevators and paper machines (Valmet 2017). Nowadays Valmet's product range is much more focused. Valmet is divided into four business lines: Automation, Pulp and Energy, Paper as well as the Services. (Valmet 2016, p. 6–9) Each business line offers products and services to their customers that are suitable for its own operation area. This study is done for Valmet Automation (AUT), but also the other business lines are considered in the work to obtain the best results.

Automation business line offers advanced automation, quality control, measurements, analyzer solutions and global expert services for the pulp and paper, power generation, marine oil and gas and other process industries. AUT operates globally and it offers a variety of products and services. Typical for AUT is a project portfolio, which consists of different sized projects.

AUT's net sales were approximately 290 million euros in 2016 which is about 10 percent of the whole organization's net sales. The main products of AUT are Distributed Control Systems (DCS), Quality Control Systems (QCS), analyzers and measurements, vision systems as well as performance and service solutions. (Valmet) For this study, it is essential to ensure that the different processes operate as required by standards and produce products that meet the requirements.

3.2 Valmet Automation's management system

Valmet's business lines have operated individually. They all have had their own management system and they have certified standards individually to their business. At present, Valmet has a project that aims to create a single management system for the whole organization by the end of 2018. Currently, the coverage of ISO 9001 Quality Management System is 84%, ISO 14001 Environmental Management System is 70% and OHSAS 18001 Occupational Health and Safety Management System is 55%. Valmet's aim is that by 2020 at least 90% of Valmet's people work in operations which are certified by all previously mentioned standards. (Valmet 2016) These aims touch all the business lines. The global management system will contain the higher level instructions which are same in all business lines. However, in order to work effectively, there must be AUT level management system, which operates as a part of the global management system, and it specifies how the corporate level instructions are applied in AUT.

In this study, the various interviews were conducted and information was collected from Valmet's internal system to identify the current state of the organization's management system. Currently AUT has been certified ISO 9001 and ISO 14001, and has partial compliance with OHSAS 18001. The quality manual and the instructions related to quality and environmental aspects are stored separately in the databases. There is one software for databases which is commonly used in the organization. Although, there are also many other databases used alongside with the main software. Various databases and different softwares can be seen to complicate the integration and perception of the overall picture of the management system. Therefore, the management system should be designed well, so that the management system would be easy to understand and utilize, despite many different softwares and tools.

3.3 Lean philosophy in Valmet

The roots of lean are in 1940s Japan, where Toyota developed the Toyota Production System. The system is based on thinking that the producing should be a continuous flow which not requires long productions runs to be efficient. (Melton 2005, p. 662) For the first time, the term lean production has appeared in literature in 1988 when John Krafcik published an article “Triumph of the Production System” in which he studied diverging production systems at car factories. The study found that Japanese’s practices are more effective than Americans. (Krafcik 1988, p. 41–50)

Lean focuses on removing seven types of waste: over production, waiting time, transport, inventory, over processing, motion, defects. These all factors affect the efficiency of the production process. (Melton 2005, pp. 664–668) In addition to seven types of waste Valmet also identify the low level of utilization of skills as a waste. Valmet aims to eliminate all these types of wastes in order to achieve more efficient business. Continuous improvement is also closely connected to lean thinking. Lean thinkers aim for perfection and to get as near to perfection as possible, the continuous improvement is necessary. (Melton 2005, p. 664–668)

The theory of lean thinking is the base of lean philosophy applied in Valmet, but it is refined to fit Valmet’s purpose. In Valmet organization, the lean thinking is strongly present and built on the company’s values. Lean is merged into Valmet’s operation, processes and strategy. Lean emphasized flow of products, services and information through the operations and functions, rather than just maximising the use of resources. With lean based actions, all the employees can create more value and improve work with less effort. (Appendix A: Empirical material, Valmet Flow)

The key action in lean philosophy applied in Valmet is that Valmet has put the customer in the middle by thinking customer in all operations to achieve high customer satisfaction. With lean, Valmet strives for renewal and excellence by continuous improvement. Valmet also highlights that lean organization is a learning organization that focuses on closing the performance gaps in all its actions. The occurred problems are recognized as opportunities for improvement and employees are recognized as problem solvers. In Valmet, the aim is to focus on finding the solution to the occurred problem rather than searching the responsible for the occurred problem. The identified problems can help to prevent problems and threats in the future. (Appendix A: Empirical material, Valmet Flow) In Figure 3.1 is presented Valmet’s fundamentals for lean thinking.

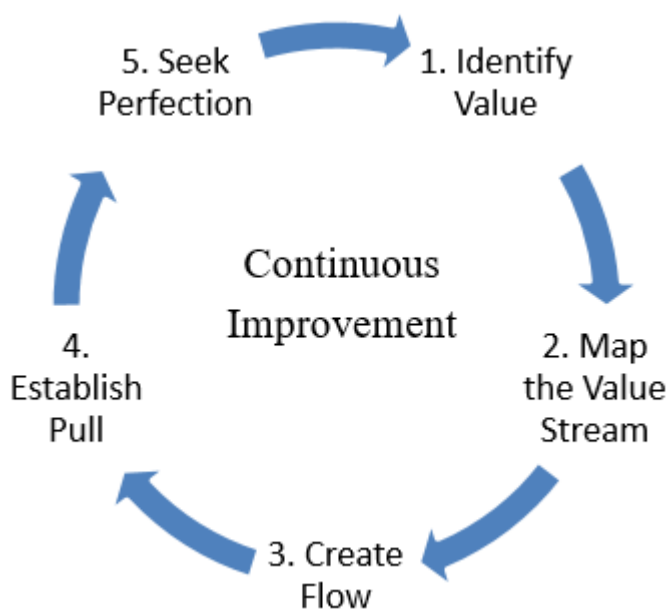


Figure 3.1. Fundamentals of lean thinking (Appendix A: Empirical material, Valmet Flow).

Valmet has described fundamentals of lean thinking as a cycle of continuous improvement. *The first step* is identifying the value. Value is important to the companies and its pursuing is important. (Valmet Flow) Womack & Jones (2015) proposing five principles to guide companies. Valmet's principles are in line with Womack & Jones' principles. According to them, companies have to provide first the desired value to the customers. With this Womack and Jones mean that company should not try to convince the customers to want things which are easiest for the company to provide. In a successful business, it is important to hear the customers in order to provide as much value to them as possible and to improve the own business. (Womack & Jones 2015)

The second step is mapping the value stream. In this step, Valmet instructs to document all the current work process and identify all the steps related to value stream. After that, it is possible to identify the steps which do not create value and eliminate those. (Valmet Flow) Womack & Jones (2015) says that in the second step company should challenge each step of the value stream to see do they provide value to customers.

In the third step, the value-creating flow should be done. Valmet advises making the value-creating steps in tight sequence so the process will flow smoothly towards the customer. (Valmet Flow) Womack & Jones (2015) say that the flow should be continuous and the waiting times and inventories between steps should be eliminated.

The fourth step is establishing pull effect. In this step, the customer pull value from the next upstream activity. (Valmet Flow) Womack & Jones (2015) says that the firm should let the customer pull value from the company. According to them, the pull method brings more value than the push methods which are used by a firm with long response times

because they try to convince the customers that they want what the firm has already produced.

The final step is seeking the perfection. When the value is specified, value streams are identified, waste is removed and both flow and pull are introduced, the process begins again and continues until a state of perfection is reached. (Valmet Flow) According to Womack & Jones (2015), the process of searching for perfection is endless and the perfect state is provided with zero waste.

Lean is taken into account in Valmet as well as in production, design, management and in all other activities of the company (Valmet Flow). Because the lean culture is strong, lean philosophy has to be considered also in reforming the management system and this study. However, lean is not the key factor in this work, so in this study lean is not treated as a research subject, but it has guided the planning and reforming of the management system.

4. RESEARCH METHODOLOGY AND MATERIALS

In this research, constructive research approach is used as the main research method. According to Crnkovic (2010, pp. 3), constructive research is a construction of existing knowledge used in new ways with adding the missing links. In the construction research, the researcher makes the projection into the future planned solution and is trying to find solutions to fill the conceptual and other knowledge gaps. (Crnkovic 2010, pp. 3)

According to Lukka (2005, cited in Rautiainen 2014, pp. 10), the ideal outcome of the empirical work constructive research approach is a solution to the originally find the problem but also proof the found solution in practice and has both high practical and theoretical value. There are seven steps in constructive research:

- 1) to find a practically relevant problem which also has research potential;
 - 2) to examine the potential for long-term research co-operation with the target organization;
 - 3) to obtain a general and comprehensive understanding of the topic;
 - 4) to innovate and construct a theoretically grounded solution idea;
 - 5) to implement the solution and test whether it works in practice;
 - 6) to examine the scope of the solution's applicability;
 - 7) to show the theoretical connections and the research contribution of the solution.
- (Rautiainen et al. 2014, pp. 10)

The first two steps were completed already at the beginning of the thesis work. At the first step the practically relevant problem should be found and at the second step the long-term co-operation with target organization should be constructed. In this research the problem was to plan a management system for Valmet Automation which meets the new standards, but also works more effectively to support the organization's operation in the future's changing environment.

The third step is to obtain a general and a comprehensive understanding of the topic. In this study, the author increased his knowledge with literature but also with familiarizing himself with the company's internal materials. The deeper knowledge of the topic was collected through preliminary interviews.

At the fourth step of the constructive research is to construct a theoretically grounded solution. In this study, the theory was used as a background information for research but also to show good practices. Those good practices applied to fit the company's needs. A large part of the research was an internal study of the company. In this phase of the study,

the solutions to the founded gaps were searched through interviews. The interviews provided mainly qualitative data. According to Saunders et al. (2009, p. 482), qualitative data is based on meanings expressed through words and it is a collection of non-standardized data.

At the fifth step, the founded solution should be implemented and tested. This allows to see, does the solution work properly. In this study, the main aim is to create a plan for future management system. There is no confirmed date when the management system will be implemented, but because the organization is big, the process will take some time. Therefore, the actual implementation of the actual management system was not carried out in this work. Although, in this study a requirements management tool was developed to support AUT's management system. The tool allows the organization to manage the requirements more efficiently.

The sixth step of the process examines the scope of the solution's applicability. In this study, the tool has been developed according to the needs of Valmet Automation. The tool could be suitable also for general use, but it is made for AUT, so it is intended only for organization's internal use. Therefore, the details of the tool do not appear in this work. The tool is introduced in Chapter 6.3.1.

The final step of the constructive research is to show the theoretical connections and the research contribution of the solution. Chapter 2 of this study works as a theoretical background that influenced the development of the solution. The more detailed examination is carried out in Chapter 7.

In this study, the conducted research strategy followed Lukka's (2005, cited in Rautiainen 2014, pp. 10) constructive research process, but it was partly modified to suit to this research as well as possible. The strategy was planned to meet the objectives of the work. The objectives were largely practical goals from the side of the organization, but other goals were also the creation of value generated by theoretical and new knowledge of the research. The research process of this study is presented in Figure 4.1.

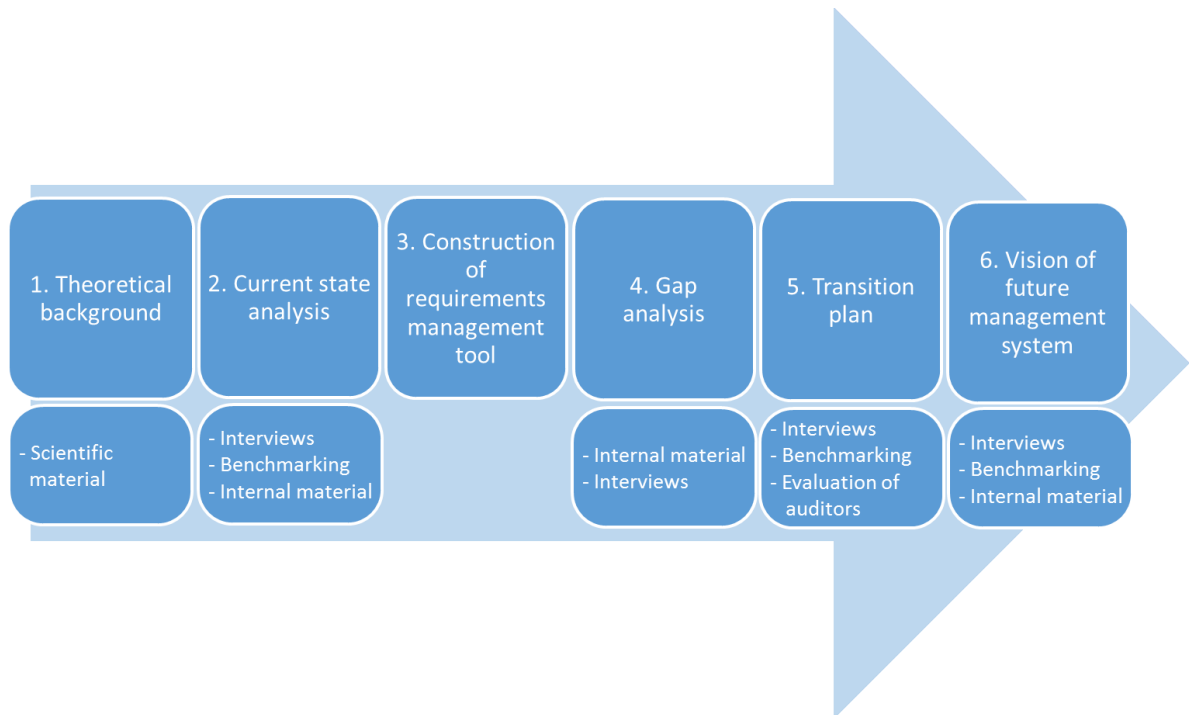


Figure 4.1. *The research process of this study and the used material.*

In the first step, the theoretical background for the research was gathered. This includes acquiring the proper knowledge and understanding of the topic. A variety of sources and databases were utilized in the gathering process of theoretical background. The scientific databases used in the research were, inter alia, Scopus, Web of Science and Google Scholar. In addition to scientific databases, information was also collected from libraries. Numerous keywords were used to search for information and the search operators were used to trim the search results. The reliability of the results was evaluated, inter alia, according to the number of references and the year of publication. The theoretical background covered information about management systems, ISO standards, certification process and future trends including industrial internet and collaboration tools.

After the theoretical background, the current state analysis about the target organization was conducted. In current state analysis, the organization's present state analysed related mainly to its management system, standards, processes and communication. The analysis was conducted by utilizing AUT's internal material and interviews. The obtained results were compared to the theory. The current state analysis was essential to conduct, because it works as a basis for the research. The analysis enables the identification of weak and strong spots of the organization. According to Lukka (2005, cited in Rautiainen 2014, pp. 10), the comprehensive understanding of the topic is one step of the constructive research. By current state analysis, also the understanding of the topic increased which enabled progress in the research.

Innovating and constructing an idea is one step of the construction research process. (Lukka 2005, cited in Rautiainen 2014, pp. 10) In this research, the idea was formed to

help in ISO standard clarification and managing process. The created solution, requirements management tool, also works as a proof of concept of this research. The tool was found to be a viable solution for managing the requirements so it had a great significance for the work but it also can help the organization in the future. In the fourth step of the process, a gap analysis regarding ISO 9001 and ISO 14001 was carried out. The requirements management tool was utilized to identify the gaps and to manage the requirements of the standards. In this step, the functionality of the tool was tested with ISO standards and it proved to be a working solution.

In the fifth step, from basis of the gap analysis the transition plan to 2015 versions of ISO 9001 and ISO 14001 was carried out. The transition plan includes the actions and schedule which determines how the organization can achieve the compliance of the new standards. In this study, only the main elements of the transition plan are presented, because the more detailed plan is intended only for company's internal use. In order to construct the transition plan, it was essential to conduct more focused interviews, examine the results of the gap analysis and utilize information from benchmarking to get an accurate image of the necessary actions. Also, in this step, the transition plan was evaluated by external auditors and their views were utilized to refine the transition plan.

The last step is to create a vision of future management system for Valmet Automation. At this stage, the information obtained from interviews and organization's internal material, had an important role. It was crucial to take into account the company's future plans and goals, but also the future trends of the industry. With the reformation of the current management system, the organization aims to respond to future requirements and challenges. To find a viable management system and a proper way to operate, benchmarking was also utilized at this stage. Benchmarking was conducted with Valmet's other business line, because their approaches are closer to the AUT's way to work than for example some external company's.

5. ANALYSIS

5.1 Current state analysis

In order to develop the organization's management system, it was essential to define the current state of the management system and the ISO standards. The information for the current state analysis was gathered from Valmet's internal databases as well as by interviewing AUT's personnel and by observing the operation. Scientific articles also bring perspectives into consideration and supported the obtained results. The Appendix A, describes the empirical material which was used in the study.

5.1.1 Interviews

Interviews were conducted with people who work in different positions in the organization to make the results as comprehensive as possible. The interviews were conducted between May 2017 and September 2017. The most of the interviews consisted of two parts: common part and targeted part.

The common part consists of the questions related general information of the interviewee, management system and communication. The common questions were:

- General information
 - Describe briefly your job profile in Valmet.
 - How long have you worked in Valmet?
- Management System
 - Tell your own opinion. What is a management system in an organization?
 - Can you describe what kind of management system AUT has, and how it is documented?
 - Have you used often the documented instructions of the management system in your work?
- Communication
 - How well the HSEQ issues are communicated in AUT?
 - How well the job-related communication is implemented?

The aim of common part was to collect comparable information from different positions. The obtained material collected to a table, to make analyzing and categorization easier. The interviews helped to determine the current state of the organization. In this study, the management system refers the organization's framework which works as a basis for operation and it is formed in accordance with standards. However, the terms *management system* and *quality management system* are used crosswise related to this context. In this

study, the term *management system* is used instead of the term *quality management system*, because according to interviews the term *quality management system* can cause misunderstandings. Also, many sources determine the term *quality management system* more narrowly, for example, Goetsch & Davis (2010, p. 335) see that *quality management system* refers only to ISO 9000 standard family. Although, the term management system is used in many other contexts than quality, which results a great number of definitions. Because the definitions vary greatly in literature, it was expected, that the definitions of management system vary also between interviewees. Therefore, the interviews were started by asking from interviewees their view about the management system.

Many respondents considered the management system as a basis of the business and processes:

“Management system is the alpha and omega of everything. It is ground for business, efficiency, developing new innovations and designing the strategy.” – Senior Manager

“Management system should include upper-level descriptions and goal and it also should lead by step by step to practical processes.” – Director

The above definitions are well in line with the definitions found in literature (Pun et al. 1999). The clearest answers and views on defining the management system were obtained from people who had worked on quality matters. This was also expected, because the control of the management system belongs to the quality function. The interviews also revealed that the term *management system* was not anonymous for all interviewed persons. However, it is not that important to know how to define the term, but the employees should rather understand the context of the management system and know how it is related to their own work. Based on the interviews, it can be said, that the definition should be stressed during the management system development.

When employees know for what purpose a task is done in a way as it is instructed to do, they are also more motivated to do so. A clear management system can help the employee to understand the entities, as well as the impact of certain practices to other business area. For example, a worker from production can more easily neglect to do a certain intermediate stage, if he does not understand its importance or he feels it useless. However, this stage can be very important for the overall picture. Therefore, the instructions must be clear and be linked to relevant processes.

Interviews highlighted that especially the usability and clarity of the documentation of the management system should be improvement. The quality manual was mandatory requirement in ISO 9001:2008. AUT has implemented the quality manual as a separate document which is located in the quality database. The utilization rate of the quality database is due to weak linking between business processes and general quality and environmental procedures. Better linking would bring these procedures closer to the employees and the actual work. However, there are own instructions integrated into processes in

order to ensure that the processes are carried out correctly. Although, currently the same instructions are documented in different databases, which complicates the managing the documents. Several different files in different databases make it difficult to update, track and verify the guidelines.

Valmet has a great number of software and databases used by different people. In AUT there are many departments which have a different kind of processes and needs. This has led to the fact that the departments have implemented different systems that they have felt the most suitable for their own purposes. Therefore, the major reasons for the weak knowledge regarding the documentation of AUT's management system and its low utilization rate are various separate information systems and different working methods.

According to interviewees, the level of the communication of general HSEQ issues has been improved highly in past few years. Currently, in Valmet corporate level, the HSEQ issues have been considered well. Every new employee in Valmet perform HSEQ related training. HSEQ-issues are also informed well in Valmet's intranet. The AUT level issues are documented in AUT's database or integrated straight into the processes. In this section, the interviewees did not see the necessary need for improvement, although with reformation of AUT's management system, also the communication can be further improved.

Another section of interviews was reserved for targeted questions. Targeted questions discussed in more precisely about the work and competence area of the interviewed person. The interviews were used to gather background information about processes, business lines, functions and practices. The aim was to get also a clear picture of the company's future directions and opinions on suitable methods from the different people.

The targeted questions were for example:

- Can you describe the process of software business? How they differ from the other processes?
- How do you see the future of the software business in AUT?
- What kind of Industrial Internet related projects are currently going on?
- How the information security related issues have been taken into account in Industrial Internet projects?

The interviews were scheduled so that the author of this study got as good starting information as possible and got answers to the awaked questions during the process. At the beginning of the process, interviews covered more general issues. More specific interviews were conducted at the later stage of the process when the collected information on basis of theory and general interviews started to raise more specific questions.

A great number of information was gathered from the interviews, which were used in the study. The all results of the current state analysis are not introduced in this study, because

they are the case organization's internal material. However, the all obtained information has been used in the research process and they have affected the results.

5.1.2 Current state of ISO standards

The organization has already ISO 9001:2008 and ISO 14001:2004 certificates. The gap-analysis of the new versions of these standards is presented in Chapter 6. The organization has also partial compliance of OHSAS 18001. Even though the organization has partially met the requirements of the OHSAS 18001, it has not certified it to the whole organization. According to Valmet Annual Review (2016), currently, approximately 55 % of the whole Valmet's organization is covered by OHSAS 18001. Valmet organization's aim is to certify one common global management system by end of 2018. The common management system would cover ISO 9001, ISO 14001 and ISO 45001 (formerly OHSAS 18001) standards. (Valmet Annual Review 2016)

Currently, AUT is identifying ISO 45001 requirements for the future certification. The certification process is at designing stage in ISO 45001. Therefore, this work takes into account the high-level requirements of the standard, but the actual requirements are not defined. Information security was found to be an important factor for AUT in the future, therefore ISO 27001 was also examined in the study. The study also ponders the possible benefits which the standard can offer.

5.2 Benchmarking

Benchmarking was one of the main analysis techniques in this study. According to Anand & Kodali (2008, p. 258) definitions of benchmarking vary widely. The key themes which can be identified from benchmarking are comparison, measurement, identification of best practices, implementation and improvement. (Anand & Kodali 2008, p. 258) Camp (1989, cited in Anand & Kodali 2008, p. 258) has created one of the most cited definitions for benchmarking:

“Benchmarking is the search for the best industry practices which will lead to exceptional performance through the implementation of these best practices.”

There are various methods for benchmarking. Stapenhurst (2009, pp. 19–20) introduces seven methods for benchmarking:

1. *Public Domain* means benchmarking which use material for example from consumer magazines and newspapers.
2. *One-to-one* is a method where an organization's operation is compared to another by visiting the other organization.
3. *Review* benchmarking involves often a team, which visits each participant organization, and identify the strengths, weaknesses and best practices. According to

examination the team can make recommendations and facilitate improvement activities.

4. *Database* method is a benchmarking in which an organization's performance level is evaluated by comparing organization's data to other databases.
5. *Trial* benchmarking is implemented by trialing and/or testing other organization's products and services and comparing them to the similar products or services of own organization.
6. *Survey* means a benchmarking method in which independent organization usually surveying customers to examine customer's perception of strengths and weaknesses compared to competitors.
7. *Business Excellence Models* method uses an independent assessor who scores aspects of the organization by a Business Excellence Model such as European Foundation for Quality Management or Baldrige Award. (Stapenhurst 2009, pp. 19–20)

In this study, three of Stapenhurst (2009) methods were used: database, one-to-one and public domain. The first step was to decide with which organizations to perform the benchmarking. The benchmarking was decided to conduct with Valmet's other business lines because their operational practices largely correspond to AUT's practices, because they all operate under the same parent company. Benchmarking was conducted with Valmet's other business lines by face-to-face meetings and by examining their management system database. One-to-one benchmarking were either conversations or interviews, but some meetings were also arranged as Skype conferences. With database benchmarking was utilized Valmet's common databases as well as documentation of business lines' individual management system. Public domain benchmarking was also conducted in this study, but with more narrow extent. It was carried out by examining the open material of external organizations.

Benchmarking was used to find the best practices related to ISO transition process and the management system reformation. The attention was paid particularly to the method how the certain requirements were fulfilled, how the management system was created and what kind of structure their management system has. With benchmarking, the aim was to find out, on which level each document is classified. In this case, different levels of documents mean whether the document is a Valmet corporate, AUT or business function level document. In Figure 5.1 is presented the relations between different types of benchmarking and the key outcomes achieved from the benchmarking.

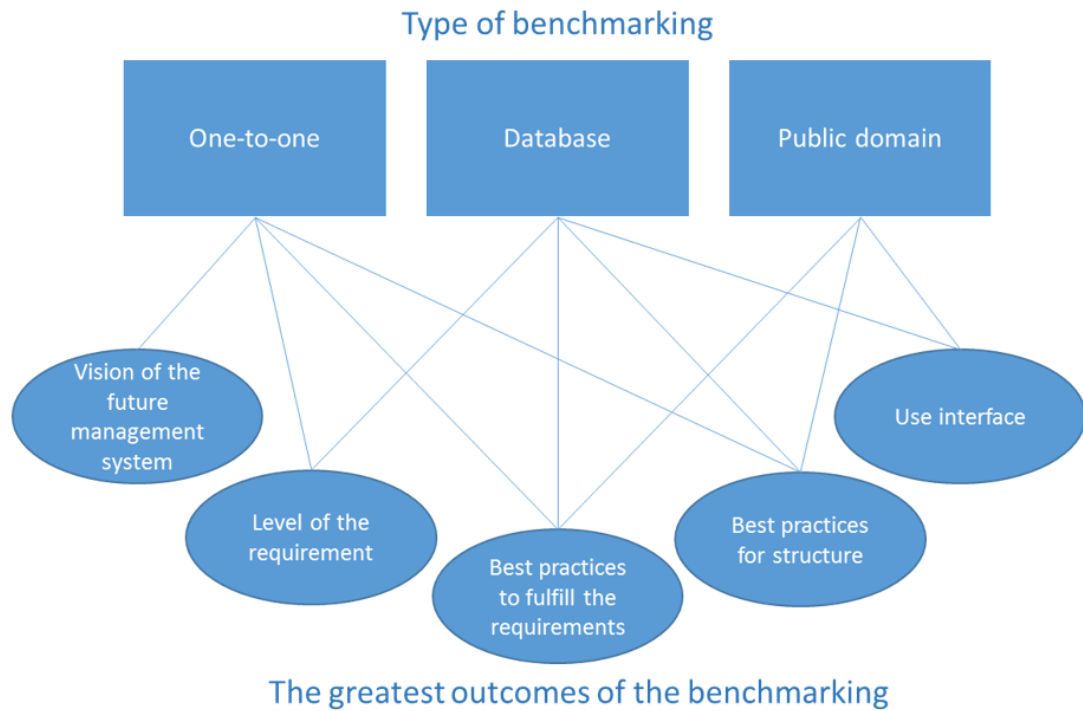


Figure 5.1. *The relations between the type of the benchmarking and the outcomes.*

There are different ways to document the management system. Benchmarking revealed for example that documentation of the management system can be conducted with more visual interface or manual-type documentation method. The visual interface can contain for example process charts or figures which are tied to the usability of the system. The users can, for example, move in the database by clicking some part of the process chart to get additional information about it. In this case, manual-type documentation method means a documentation system, from where a user searches information through a table of contexts.

When the company is large and has several different functions, it is good to understand that all the documentation related to the management system is not in one place, and also the functions have their own guidelines that are part of the entity. However, the guidelines of the functions should be in line with the general guidelines of the organization. To ensure this and to improve the efficiency of the management system, linking between the functions and the management system should be done.

The visual interface can be seen more modern solution than a manual. According to interviews, the visual version is more user-friendly, and it illustrates better the management system and the company's overall picture. The visual interface enables, for example, more effective usage of process charts and illustrative figures. Visual interfaces can also provide some other benefits. According to Goldman (1999, p. 295) visualization can aid learning. Also, Kirrane (1992) has studied visual learning and according to her, the visual pictures help to get people's attention. (Kirrane 1992) With visualizations, it is easier to describe the relationships and the structure. Therefore, more visual management system

could raise personnel's attention and can help them to understand the management system as an entity. According to current state analysis, the challenge is to understand the management system's relation to processes and the actual context of management system. Therefore, it needs to be paid special attention to the clarity, usability and binding of the management system to processes.

On the other hand, the manual based management system can ease the forming of a quality manual. Although, the quality manual is not required anymore in 2015 version of ISO 9001 standard. Therefore, organizations can consider new options for their management system. However, even the quality manual is not mandatory anymore, it can offer benefits for organization. For example, if the manual is made for external use, the organization can convince external parties of high-quality operation.

Even if the company uses a visual interface, it must form a tree structure as a ground of the system. New ISO standards use a common structure. Therefore, it is worth to consider would it be sensible to use the same structure as the standards. There are many positive sides which can be identified with this approach, such, it can ease the auditing, but it also can aid to update the system. The same structure as the standards can ease the job of auditors, because they can check more easily, has the organization considered all the clauses of the standards. Also, updating can be easier if documentation of the management system has the same structure as standards. For example, if the standard is renewed, it is easier to check what is still missing and how many changes need to be done. However, AUT aims to create the management system which can create the greatest benefits as possible for organization and not just to ease the auditing. Therefore, it was particularly important to consider which factors enhance the usability of the management system and which could help to improve the company's performance.

In terms of structure of the management system, the benchmarking with other business lines was also particularly important because Valmet is developing a management system that covers the entire organization. Although Valmet is developing an organization's comprehensive management system, AUT needs to develop its own management system, which specifies corporate level instructions and explains how AUT apply them in its operation. However, the management system must be in line with Valmet's management system and operate as a part of it. The structure of documentation of the management system was not only benchmarked with other business lines but also with public domain. Benchmarking was found very useful research method because it revealed many good practices that other organizations have used with their management system.

The biggest findings of the business line benchmarking related to the ISO standard transition process. It was important to know which clauses of the standards were already determined or were planned to be determined at Valmet corporation level. This was important because, if some processes have already been determined at Valmet corporate

level, it is not sensible to design and determine the processes again at AUT level. Although, the suitability of Valmet corporate level descriptions for AUT must be checked, and if necessary, more detailed descriptions should be created.

The benchmarking which was implemented with Valmet's other business lines helped also to determine the actions what actions needed to be done to fulfill the requirements. Also, the transition processes of the other business line were benchmarked. Their transition process was generally conformed to a process that can be described on the upper level through five steps:

1. Identifying the changes in new ISO 9001 and ISO 14001 standards
2. Performing a gap analysis
3. Filling the missing links
4. Performing internal audits
5. Identifying areas for improvement and making the actions.

The transition process was success at their business line, so the process as well as the other information from benchmarking was considered in the creation of AUT's transition process. Only the general characteristics of the process are presented in this study, because the more detailed process is intended as an internal material of the organization.

One-to-one benchmarking was also utilized so that different views can be taken into account in the creation of the future management system. The information obtained from one-to-one benchmarking helped to shape the vision of the future management system. It also aided to determine the level of the documents, for example, answer the questions such is it necessary to create a lower level instructions to specify certain corporate level procedures. The aim was also to find the best practices for fulfilling the requirements and for the structure of the documentation.

The information gathered from benchmarking was utilized with the transition process and with planning the future management system. The gathered information was compared into scientific material and the material obtained from AUT. On this basis, the transition process and the future management system was created and the outcomes the analysis process and the outcomes are presented in the following chapters.

6. TRANSITION PLAN

6.1 Transition process

AUT will transit from ISO 9001:2008 to ISO 9001:2015 and from ISO 14001:2004 to ISO 14001:2015. Both standards will be certified simultaneously, so they will be considered as a one transition process. The literature was used in the planning of the transition process. The literature views of the certification process are discussed in Chapter 2.4. The process follows mainly the process described by DNV (Figure 2.4), but it has been modified to be suitable for the organization. The modified transition process is presented in Figure 6.1.

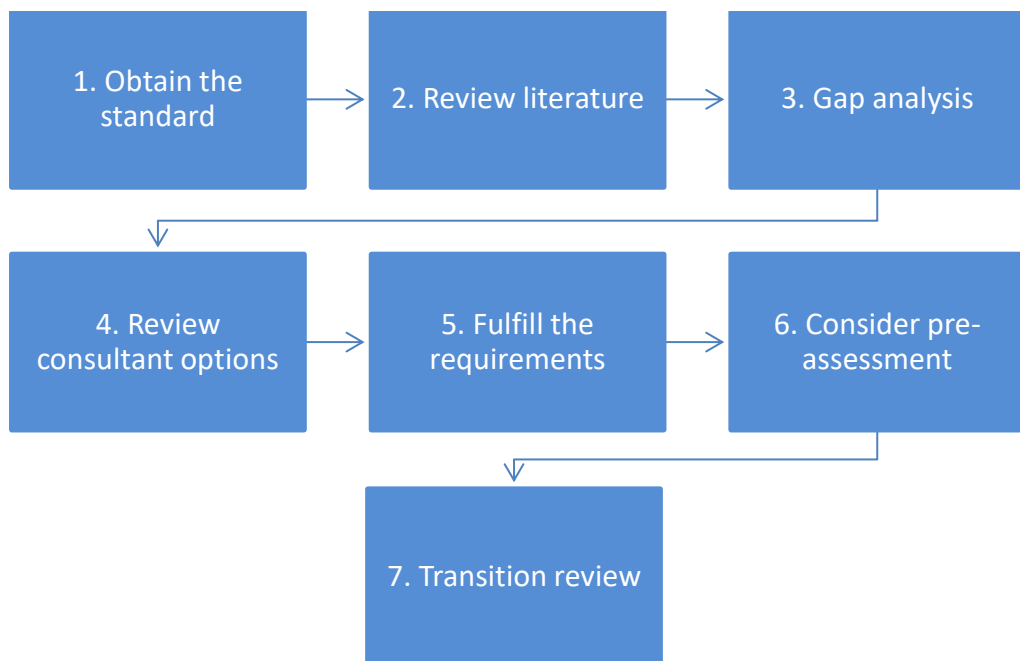


Figure 6.1. Transition process.

The transition process is described in more detail in Chapters 6.2 – 6.4. In Chapter 6.2, the background of this transition process is described and first two phases of the transition process. Third and fourth phases are presented in Chapter 6.3. The last three steps are presented in Chapter 6.4.

6.2 Background

The starting point for this research was that the decision to move to the new standard versions had been already made. The decision was clear because there was only one other option, to abandon the standard. However, the standards are essential for business, there-

fore standard abandonment was not an option for the company. So, *the first step: obtaining the standard*, was already done at before this research was started. In that step, the organization become familiar with the standard and make the decisions would it certificate the standard.

In the second step: reviewing literature, a deeper knowledge of the standard and the transition process were collected. The literature review of the topic is conducted in Chapter 2. The most important findings were to improve general knowledge and to find the best practices from different processes. Together with interviews and observation, a literature review enabled the creation of a picture of the future management system. It was good that a picture was obtained at an early stage, so that the factors related to the future perspective could be considered in the transition to the new versions of the standards. The different factors were, for example, the form of the management system, future documentation guidelines, communication guidelines as well as management guidelines. This supports, lean philosophy, for example, documentation is done to fit the future management system with the best possible way and by using the common documentation instructions. More information and findings on future management system are presented in Chapter 7.

6.3 Gap analysis

The gap analysis was carried out for ISO 9001:2015 and ISO 14001:2015 standards. Gap analysis used to find out whether the new standard versions meet the requirements. The organization has already the certifications of former versions of above-mentioned standards. The organization has been audited based on the previous versions and it has got the certificate by meeting the requirements, therefore mainly just the revised requirements were considered in gap analysis. Because there are also same requirements in the old and in the new versions, the more specific consideration is given only to the new requirements. The gap analysis process is presented in Figure 6.2.

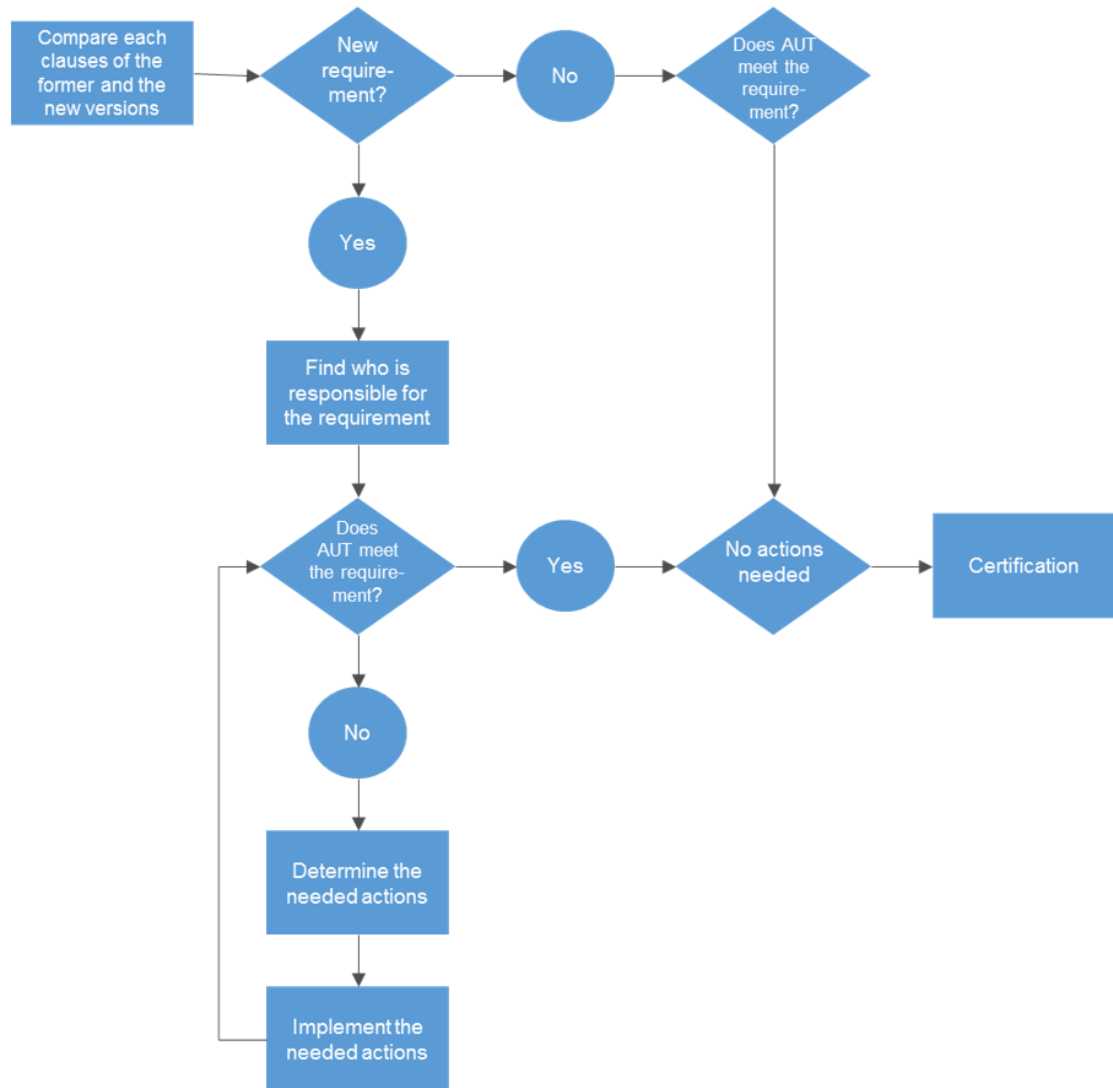


Figure 6.2. Gap analysis process.

The first step of the process is to compare the requirements of the former and the new versions. If the requirement appears also in former version, the requirement is seen already completed, so there is no need for further actions. Those requirements that are new or changed must be noted down and after that, they have to be examined in more detail.

Next, it is necessary to determine would the new requirements already fulfilled. To clarify the fulfilment of the requirement, it should be defined to which functions the requirement it is related. From the databases of the functions and with the help of the responsible persons it is possible to determine the level of compliance.

If the organization does not meet the requirement, the actions to should be defined. In this stage, also a transition plan for certification should be implemented. The transition plan is a plan which determines how the detected gaps will be fulfilled in the organization. It determines the actions, timeline and the way to monitor and report the progress of the

certification process. The responsibilities for the transition process also will be defined in the transition plan.

After the organization has defined the needed actions, the implemented transition plan should be followed. When the needed actions are completed, it must be checked again does the organization now meet the new requirements. After the organization has checked that it meets all the requirements of new standards, it is ready for certification. The audits will be conducted by authorized certification body.

6.3.1 Requirements management tool

In order to analyse, manage and monitor the compliance level of the requirements, the tool for requirements management was created. The tool is created in Microsoft Excel because it offered a suitable platform for the purpose. The fact that the new ISO standards have the same structure was taken into account in the designing process of the tool.

First, all the clauses of the ISO 9001:2015 and ISO 14001:2015 were placed on the table. Next, each requirement of the ISO 9001 and ISO 14001 compared to each other and marked down if there is possibility to combine those requirements into one requirement.

For example, ISO 9001 has a requirement:

“Top management shall demonstrate leadership and commitment with respect to the quality management system by ensuring that the resources needed for the quality management system are available?”,

while ISO 14001 has almost the same requirement:

“Top management shall demonstrate leadership and commitment with respect to the quality management system by ensuring that the resources needed for the environmental management system are available?”.

So, it is possible to combine these requirements into one requirement:

“Top management shall demonstrate leadership and commitment with respect to the quality management system by ensuring that the resources needed for the quality and environmental management system are available?”.

This not only eases the reviewing the requirements, but also helps to organize the requirements for management system. All things are not reasonable to present separately, for example in some situations it makes more sense to present the quality and environmental issues in the same context. In Figure 6.3 is presented one section of the tool.

Standard	Clause	Requirement
	5	LEADERSHIP
ISO 9001	5.1	Leadership and commitment
ISO 9001	5.1.1	General
Headlines	5.1.1	Does top management demonstrate leadership and commitment to QMS and EMS by:
ISO 9001	5.1.1.e	e) ensuring that the resources needed for the QMS are available?
ISO 14001	5.1.1.d	d) ensuring that the resources needed for the EMS are available?
Combination	5.1.1	Does top management demonstrate leadership and commitment to QMS and EMS by ensuring that the resources needed for the QMS & EMS are available?

Figure 6.3. Requirements management tool.

Next, the requirements were compared to the former versions. If the requirement was new or changed, it marked with “x” to the column “Changed”. This enables the user of the table to sort the table and analyze more easily for example which requirements have changed. There is also column for additional information according to the change. In Figure 6.4 is presented how the changes are marked to the table.

Clause	Requirement	Changed	Information of change
6	PLANNING		
6.1	Actions to address risks and opportunities		
6.1.2.a	a) actions to address these risks and opportunities?	x	

Figure 6.4. The example of change section of the tool.

When the new requirements have been clarified, the requirements were targeted for different levels and functions. Because of the Valmet’s global management system project, the link to system shall be secured. There are various requirements which should be determined in more detail in AUT’s documentation in order to be compatible with automation business. Therefore, the requirements must be analyzed and to find out should the guideline be documented in Valmet or AUT level.

Next, it was determined to which functions the requirement is related on. At AUT there are several functions, so it is important to determine which function must consider the which requirement. In Figure 6.5 is presented an example of using the tool to categorize the requirements.

Valmet level	AUT Procedure	Top management	R&D	Sales	Delivery Project	Supply Chain	Global Sourcing	Service
	x							
x								
x			x	x	x	x	x	x
					x			x

Figure 6.5. The example of using the tool to categorize the requirements.

The next step was to assess the fulfillment of the requirements. The column “Comments / Actions” contains information about the about the actions needed to be done to achieve the compliance. The level of compliance is set on a scale of three stages compliance, partial compliance and lack of compliance. In the table, these are described by letters C, P and L. To improve visualization, also color coding has been used to describe the level of the compliance. In the column “Evidence of conformity” is presented the link to the documented material which proves the conformity.

Conformity means that the organization meets the requirement. If the organization meet the requirement there is no necessary need for actions. However, if there has been found better solutions or places for improvement, the actions are determined to the column. In that case, the changes are not mandatory for the standard, but they will improve the organization’s activities. This additional information about improvement is important for the organization, because their aim is not just to meet the standards, but also to develop their own operation as well as possible.

Partial conformity means that the organization has not a full compliance with the requirement. The requirement for example may have changed, so there are some new elements which the organization has to take into account.

Lack of conformity means that there are serious shortcomings, which must be corrected. The steps to conformity are specified in the table. There are as many steps that the requirement need to be fulfilled. After every step, there is a column “Status” which reflects the current state of the phase. This will enable the effective monitoring of the process. An example of the process monitoring is shown in Figure 6.6.

Comments / Actions	C-P-L	Evidence of Conformity	Step 1	Status
	C			
	P			
	L			

Figure 6.6. *The example of requirements management.*

After the all requirements have the *conformity* status, the organization meets the all requirement of the ISO 9001:2015 and ISO 14001:2015. In this study, the tool was used first to ease the gap analysis process. At the later stage of the thesis project, the tool was also used to categorize the different standards. It used to help to find a suitable structure for the future management system. In the future, the organization will be able to take advantage of the tool for certification of new standards and requirements management.

6.3.2 Gap analysis outcomes

The results of the gap analysis showed that there was a high number of changed or new requirements at ISO 9001 and ISO 14001. In the analysis, the requirement was not considered as changed if the change was negligible, for example, wording change. However, some wording changes can have a strong influence on a meaning of the requirement. For example, the substitution of word *managing* by *leading* changed the significance of the claim considerable in ISO 9001:2015. Leading can be seen more participatory and guiding than managing. Therefore, if there was a doubt that, for instance, a new word form can have influence on the significance of the requirement, it was considered as a changed requirement. It was more sensible to review too much than too few requirements, therefore the number of new or changed requirements may be slightly larger than the actual one. If the number of requirements reviewed would have been too small, it would be possible that some clause would be ignored. That, in turn, can lead to that the company may not meet the requirement. The starting position of the new or changed requirements according to gap analysis is presented in Figure 6.7. The actual scale is hidden from this work, because it is intended as an internal material for the organization.

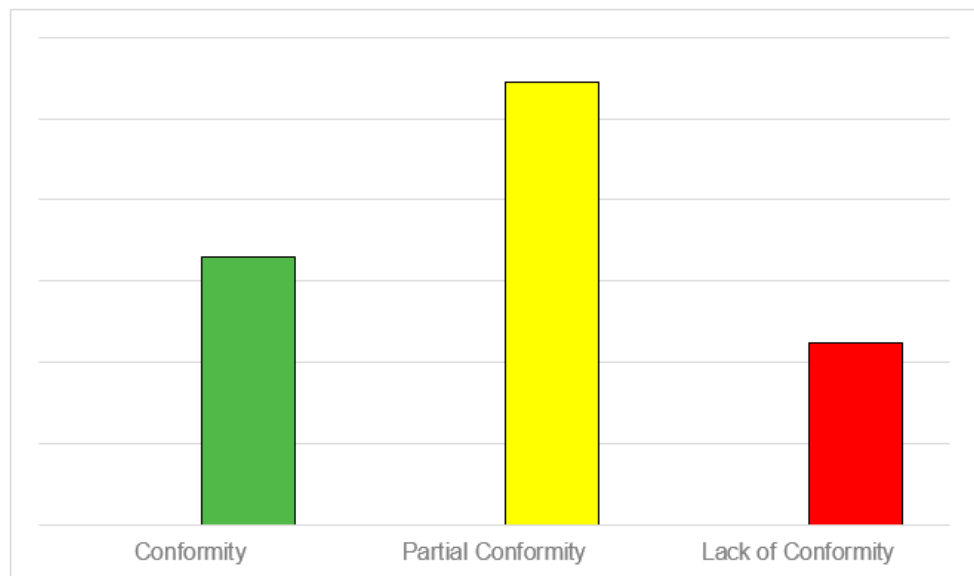


Figure 6.7. *The starting position of the new/changed requirements.*

According to gap analysis, many of the changed requirements were already fulfilled in AUT. Although, the most of the requirements has a partial conformity, which means that they still need some actions. These can, for example, be requirements, which have minor changes. In that case, the organization should, for example, update current instructions to meet the new requirements and inform the relevant parties of the changes.

The last category is lack of conformity, which also was the smallest category. The requirements which are in this category, are mainly new or contain major changes. With

these requirements, the organization has more job, because it may need to design completely new processes, guidelines, practices and documentation.

A high number of requirements needed actions. Some of them were individual requirements, but most of the requirements were related to larger entities, such risk-based thinking, life cycle management, externally provided processes, control of changes, leadership and communication. Monitoring the larger entities is easier than monitoring a large number of individual requirements.

The entities on which AUT should pay attention especially are *risk-based thinking* and *externally provided processes*. These entities have been chosen for further consideration in this study because, according to the gap analysis, AUT needs to put the greatest input to update these requirements. As the results of the gap analysis showed, the organization has a great number of other requirements for reviewing and fulfilling, but they are not discussed in more detail in this study due to the scope of this study.

In ISO 9001:2015, risk-based thinking has emphasized. Clause 6.1 discuss risks and opportunities in both ISO 9001:2015 and ISO 14001:2015 standards. However, risk-based thinking has also been discussed in other sections of the standards too. With this, ISO aims to emphasize the risk-based thinking and bring it into part of organization's everyday operation. The risk management was already at good level at AUT before the new standards. Although, because risks and opportunities is a new entity in this extent and the documentation requirements have changed, it is essential to pay a special attention to this entity.

Risk and opportunities comprise the all operation of the organization so it also involves all the functions. There are instructions of risk management at Valmet corporate level, but there should also be AUT level instruction and more specific instructions in every function. The functions have processes which vary much, so one risk management process can not cover the whole operation of the organization. The risk management actions should be determined in more specific at functions own database to clarify for example at which points of the process the risk assessment and measuring is done, and what are the actions if risks occur. However, functions' instructions must be in line with AUT's and Valmet's instructions.

Externally provided processes was also an entity, which has changed much, and it also needed attention from the functions. Many requirements that are related to externally provided processes are already familiar from ISO 9001:2008. In the 2015 version, these requirements are presented as their own entity and the requirements have also changed.

Externally provided processes are related substantially to different functions, because different functions have different processes where they utilize external services. Currently, the organization has not defined outsourced processes as a whole, but outsourced processes have been defined in different databases for different purposes. Therefore, the first

step with this entity will be that the business functions considers their outsourced process, services and products and base on the consideration they express their opinions. From base of information gathered from functions, it is possible to form an overall picture of the organization's outsourced processes.

After this, the criteria for evaluation, selection, monitoring of performance and re-evaluation for previously identified external providers should be defined. The organization must also maintain documented information of these activities and any necessary actions for evaluations. (SFS-EN ISO 9001:2015, p. 61.) Even the organization and its functions have considered externally provided processes also previously, there are many parts which are needed to be improved. The greatest improvements are required in the field of criteria for evaluation, selection and monitoring the process, product and service providers. Even the criteria would be documented properly, they also should be used. Therefore, the criteria should be clear and available for relevant parties.

In documenting, attention should be paid to that the documents from different levels are in line with each other. With well-made planning and appropriate linking, the clearer entity can be created. A clearer entity also improves usability of the instructions. When all the instructions are planned well and the linking is done properly, the whole management system will be more effective.

6.3.3 Review consultant options

Companies can use external consultancies during the transition process to assist with different tasks related the transition process (Casadesús & Karapetrovic 2005). Therefore, the organization should consider, would it be worthwhile to use an external consultant. According to DNV, the consultant can advise the organization with workable, realistic and cost-effective strategy plan for implementation. The transition process was decided to be implemented mainly with internal resources, so that the knowledge embedded from transition process will stay in the organization.

However, the possibility for consultation will be re-examined during the process. If some questions rise about interpreting of requirements, the consultation can aid with fulfillment of the requirements. The other option is to make use of consultation after the requirements are fulfilled. The certification body can help with pre-assessment, to ensure that the requirements are fulfilled to the right extent. If any remarks appear, there will be still time to take the necessary actions before auditing.

6.4 Fulfilling the gaps

The fulfilment of the requirements involves many different parties from the organization such different business functions. To fulfill the requirements the functions should also develop their procedures and documents related to them. The process for fulfilling the

requirements was developed, to facilitate the guidance and monitoring of functions the progress of the process. The quality team assigns tasks to relevant functions, that will follow in Figure 6.8 presented steps to fulfill the requirements.

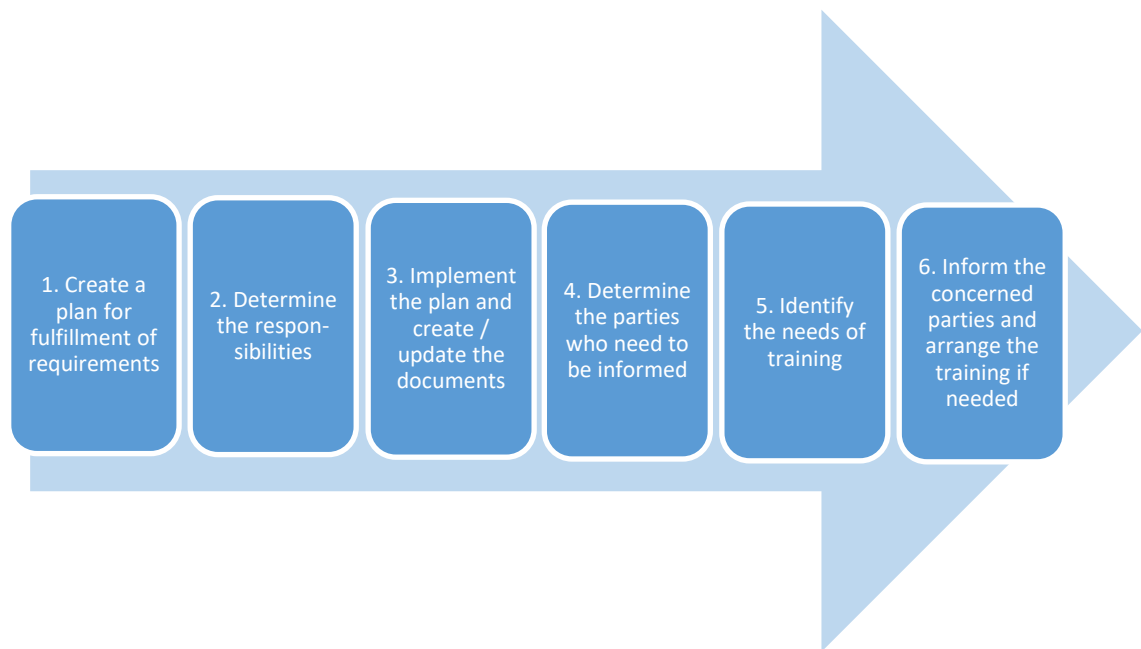


Figure 6.8. Steps for fulfilling the requirements.

Each function assigns a responsible persons, who have the task to fulfil the certain requirements at function. First, the responsible person creates a plan which determines the actions which must be done within the schedule. Next, it should be defined who is responsible for each task of the plan. There are different levels of the requirements. Some tasks can contain for example just minor actions, but some can require a great labour input, if the function has to develop for example completely new process and describe it. Therefore, different requirements can demand different amount of work and resources.

After the plan is created and the responsibilities are determined, the plan should be implemented. If the plan is designed well at the earlier steps, there are better chances to success with the implementation. It is essential to change processes and practices to meet the new standards, but it is also important to remember to update documentation. The requirement can demand new documents, which should be created. Though, the old documentation should be reviewed, so that it does not provide outdated or duplicate information.

Once the implementation is ready, at the fourth step, it should be determined which party needs to be informed of the change. These parties are especially those people who are related to the changing practices, but if the change is big, the matter should be communicated more widely.

At the fifth step, the need of training should be identified. The need depends highly on the level of the change. Training is important so that the employees know what has changed and how the changes affect their operation. The training enables that the changes take effect also in practice. Goetsch & Davis (2010, p. 272) say that it is important that managers know what training is needed in the organization. However, managers face difficulties to determine the needs of training. (Goetsch & Davis 2010, p. 272) Although, it can be said that the needed training is easier to identify in the scope of the standard transition, than the training which is related to the organizational general operation. The starting point for the training should be the changes that were made to meet the requirements. The managers of the business functions know best what training is needed to make the relevant people aware of the changes. Therefore, the managers of the functions will determine the needed training at the specific function.

At the final step, the concerned parties should be informed and the training should be arranged if it is needed. There can be identified two main aspects for training. First, the general informing related to the changed standards, and second, the more specific training regarding the changed working instructions and methods. These aspects should be taken into consideration while creating the training plan.

6.4.1 Consider pre-assessment

In this step, the pre-assessment will be considered. The plan for pre-assessment requires more information on changed processes and its affects to the operation, which is why the more specific plan and results of the pre-assessment have not been discussed in this study. However, the preliminary plan has been made. The pre-assessment is designed to be implemented through internal audits. The internal audit is planned to contain seven main steps:

1. Plan internal audit
2. Determine the needs for training
3. Determine related parties
4. Finalize the plan
5. Management approval for audits plan
6. Implement the training
7. Implement the audit.

If the internal audit reveals some areas which do not meet the requirements, the plan for corrective actions should be made. After the plan for corrective actions is made, it should be implemented. Once the actions have been implemented, the internal verification of compliance has been achieved.

6.4.2 Transition review

Transition review is conducted by an external certification body. The certification body evaluates the organization, and decides on the basis of the audit, does the organization get the certifications of ISO 9001:2015 and ISO 14001:2015. In this step, the organization does not have the actual major tasks, other than arranging the audit. However, before the audit, the all changes must be made and implemented.

The standards are indispensable for AUT's operation, so auditing must go successfully through. Therefore, attention needs to be paid to that the process progresses on time and the all steps must be implemented with sufficient precision to achieve the best possible results with available resources.

7. FUTURE MANAGEMENT SYSTEM

7.1 The new requirements for target organization's management system

There are new demands that affect the AUT's management system. Industrial Internet and collaboration tools are growing trends in the automation industry. Valmet is also investing in these new technical solutions and therefore their impact on the management system should be examined. Also, customer requirements have changed due to new technical solutions, and the changed values of the people. These impacts on the management system are considered in Chapter 7.1.1.

Based on interviews and observations, it can be noted that the utilization rate of the current management system database could be higher. In order to create an effective management system, the usability should be good. Therefore the usability of the management system should be improved to increase the usability and efficiency of the management system. The usability of the management system is considered more in Chapter 7.1.3.

7.1.1 Future trends

Valmet has paid a special attention to keeping and developing its advantage in Industrial Internet solutions. Valmet offers, for example, remote control solutions for mills and plants and is working to utilize big data analytics in preventative maintenance as well as remote communication possibilities. Valmet has taken the first steps in introducing the motion and voice control into control rooms. Also, Valmet is increasing its service offerings by virtual and augmented reality applications. One example is a virtual boiler inspections demonstration, which integrates thousands of individual measurement results into a virtual reality 3D model. (Valmet 2016)

Schallehn's et al. (2017) IoT customer survey shows that the security concerns are the major obstacle for customers to invest in Industrial Internet solutions. As found in Chapter 2.5.1, information security is in a key position in Industrial Internet. Insufficient information security can have major consequences, because with Industrial Internet, the risks are not limited only to information security but they can also threaten the environment or the physical security of people.

Information security is a great factor also for collaboration tools. Collaboration tools have become more and more common so the amount of information processed through them will increase in the future. Collaboration tools can contain plenty of crucial information, so the consequences of security threats can be large.

In both Industrial Internet and collaboration tools the biggest risks are identified to be caused by service providers, access control, and a platform. Unreliable service providers can, for example, use insecure software or their methods have a low level of information security. Valmet utilizes trusted and certified partners and service providers which increases reliability. Especially ISO 27001 contributes the creation of a good level of information security. Therefore, it is important standard to consider. Even though the service provider is trustworthy, there are many things to which the organization should pay attention. One of the biggest factors is access control. It is essential that only those people can access the files that are intended for them. There are procedures for access control. However, when there are coming many new technical solutions it is essential to review the current procedures and update them to meet the new requirements.

Collaboration tools allow people from different places and organizations work together. If there are many external parties who use the collaboration tool, it is even more important to have a strong access control. It is also essential that the collaboration tool has a full audit log, which enables monitoring who has seen, viewed or edited any document. The access control can be seen even more important for Industrial Internet solutions, because they contain risks which can have major impacts.

Even the solutions for Industrial Internet and collaboration tools have been implemented well and the platform, as well as its suppliers, are reliable, there are possibilities for security threats. For example, the users should be taken into consideration when planning the information security. Security awareness is one of the key factors in information security. According to Arachchilage & Love (2014), users which do not have proper knowledge can be a great threat for information. By the scope of the management system, these new trends should be noticed especially, because the communication and the right actions are essential. The management system can affect greatly to knowledge of the employees. The future management system should be planned in such a way, that it gives personnel and relevant parties all needed information clearly and easily. Importance of usability is discussed in more detail in Chapter 7.1.3.

7.1.2 Customer requirements

According to interviews, the customer requirements have changed in past years. As in Chapter 7.1.1 discussed, new technical solutions have resulted if no entirely new requirements, but at least more stringent requirements related to information security. The information security is not only a big entity which has grown very significantly during the past few years. People's awareness of the environment and safety related factors have increased (Costea-Dunarintu & Chitiba 2015), which has affected to common opinions and shaped the customer requirements.

According to Costea-Dunarintu & Chitiba (2015), the organizations must create, design and implement new solutions for sustainable business due to the pressure of environmental issues. The companies who follow trends, have also a better reputation and brand. According to Peña (2002) reliability, reputation and brand are strongly related to each other. A good reputation is also more difficult to create than lose a good reputation. Many big companies have faced major brand value loses caused by disregarding of environmental or safety related issues. For example, according to Mansouri (2016), car production company Volkswagen has faced great brand loses caused by its emission scandal. Therefore, it is important to pay attention to safety and environment related factors in business and the management system, because management system works as a basis for operation.

People's values have changed over the years. People's values related to environment and safety can be seen increased. According to interviews, this can be seen also from customer requirements which have had more and more requirements related these issues. By certifying ISO 45001, AUT can improve its safety practices, but also increase its brand as a more safety related operator. If the organization does not have certified standard, but the other party has requirements related to that standard, the organization has to present with separate documents the fulfilment of the requirements.

ISO 9001:2015 does not require a quality manual, but it can still be useful to create and maintain. The requirement has been removed from the standard, because ISO aims to give freedom for organizations to plan the best suitable method in order to document and prove the fulfilment of the standard. However, customers and partners may request a quality manual where they can see the description of the company's operations in terms of quality management. A quality manual which is created for customer or partner organizations is usually a more compact version of the quality manual. It can contain a general description of company's procedures, but the more specific description is documented into company's internal database.

Instead of creating the actual quality manual, AUT can create the manual for external parties which communicates how quality, environment and safety are considered in organization's operation. It should not contain information just from ISO 9001, but also other certified ISO standards, such ISO 14001 and ISO 45001. By this way, the organization can provide effectively information about all the standards and answer widely to customer requirements from different areas. The manual is a summary of organization's management system. Therefore, before creating the manual, the documentation database of the management system, should be updated. If the management system documentation is created well, the formation and maintaining the quality management system will be easier.

7.1.3 Usability

The usability of the management system can be seen one of the main requirements for the AUT's future management system. Based on the interviews, the current AUT's management system does not have the best usability. Weak usability means that the organization does not take the full advantage from the management system. AUT aims at the effective and high-quality operation which is why the usability of the management system should be good. There are various factors which should be taken into consideration when handling usability such, the users of the system, the platform, the structure, the documentation practices and the options for continuous improvement. The main user group of the management system is the personnel of the organization. However, the level of use depends on many different factors, for example, new employees can need more information from management system than the more experienced employees. According to interviews, the main user groups of the management system are quality and HSE teams, but the level of the usability should be increased in other functions. The user group is limited, partly because there are various functions which have their own databases for their work instructions. The current documentation system has been met the requirements of the standards, but it does not take the full advantage from the management system.

The aim of this study is to create vision of the future management system, which would offer the biggest possible benefits for the organization. It has become clear from the interviews that it is not essential that every employee use the database of the management system every day, but the system should support the company's operation and help its employees to act as required by the standards. Well-designed management system help personnel to understand the importance of the management system and its linkage between the different functions. The linking between the management system's database and processes of functions should be made well. By this way, the management system would not be a separate database only for quality and HSE functions, but a system which links the different functions together and reflects organization's working methods.

The user group must be taken into consideration at management system documentation. For example, the guidelines should be written so that all parties who use that document will understand it. The author of the document should consider the documentation from the user perspective. If for instance a document is created, which target group includes employees for different positions, it should use terms which are familiar to all relevant people. If there is a possibility for misunderstanding, it is important to explain the terms and abbreviations.

It can be seen, that the current document structure does not fully support all the user groups of the management system. When designing the structure of the management system, the users should be taken into consideration in order to create as good usability as possible. It is important that management system's documentation is organized, in the way that the organization gets the maximum benefit from it. If the management system is

built just for the certification body to get standard as easy as possible, the starting point for the creation of the management system is wrong already from the beginning. The standard should help the organization to improve its overall performance and to create a basis for sustainable development initiatives (SFS-EN ISO 9001:2015, p. 43). Therefore, it is essential to consider what the organization wants to achieve with the standard and which is the best way to implement it. Using the same structure as standard in the management system, can help the organization with audits, but it is important to consider is that the best solution for the organization's operation.

Common documenting practices help with the usability of the management system. When the documents follow the common instructions and, for example, use the same structure, it is easier and more efficient to utilize the documents. Currently, the organization has common templates for documenting. However, the utilization rates of the templates can be further improved in order to create as efficient management system as possible.

The platform is also a big factor for the usability of the management system. Currently AUT is using most commonly one database software. The database is widely used in Valmet and according to interviews it has so far worked well to support the company's operation. However, AUT is considering to change their documentation database to a more modern platform, because the currently used software is a bit outdated, which is why the usability is not as good as with modern systems. When choosing a new documentation system, attention should be paid also usability of the platform.

Continuous improvement is also an important factor for usability. When world and work environment develop, at the same time the usability requirements will also change. For example, in today's business world different collaborations tools are becoming more common. Some documentation platforms support continuous improvement more than the others. For example, platforms which support collaborative working, can allow the users to give feedback straight to the document which aids with continuous improvement. By that way the wrong information, outdated material or the things that need updating are easier to detect and correct. It is also important to be aware that just the new platform will not help with continuous improvement. It is essential to create the guidelines for continuous improvement and clear documentation templates, so the documents would be easy update also by other people than the original author.

7.2 Vision of future management system

Based on scientific material, interviews, benchmarking and Valmet's internal material the vision of AUT's future management system was created. Valmet corporate's future plans also affected highly the vision of the AUT's management system. As Chapter 5.2 discussed, Valmet is going to certify the common management system to the whole corporation. Though, there are big differences between the different business lines, for which a common management system cannot comprehensively cover all business lines, other

than on a more general level. Therefore, there have to be more specific instructions at business lines' own databases.

In this study, the scope was to create the vision of AUT's management system. The AUT should have its own management system in order to work efficiently. Although, it is essential that the management system is well in line with the corporate level management system. The communication between different levels of the management system is important. Functional linking helps to monitor that the instructions and guidelines of different levels are in line with each other.

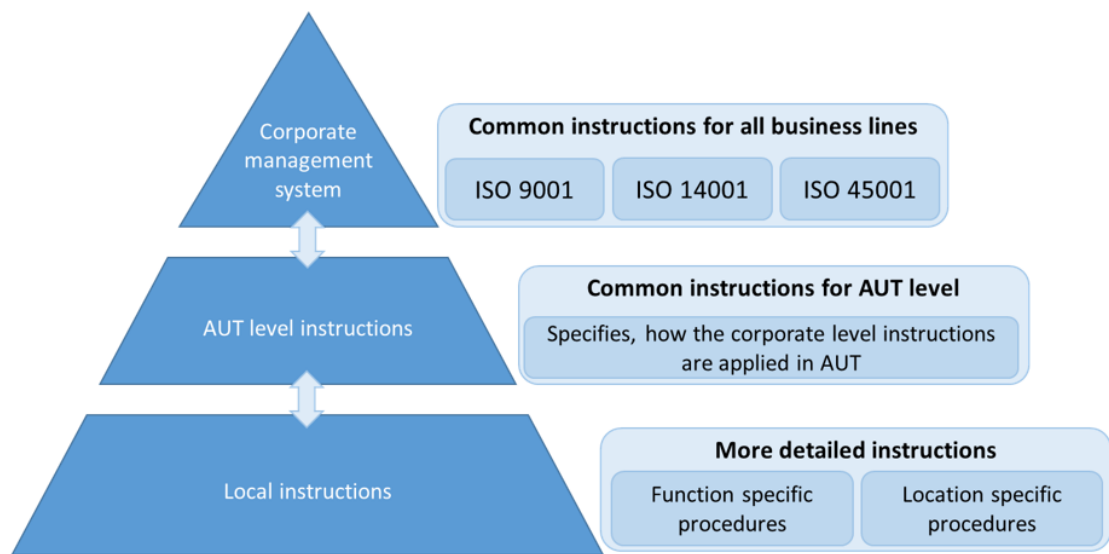


Figure 7.1. *The vision of the levels of the management system.*

In Figure 7.1, the vision of the management system's levels has been presented. Corporate's common management system is at the top of the pyramid. Corporate's common global management system will be created in the near future. The corporate level management system will include higher level instructions for all the business lines. Corporate level describes the processes which are common for all business lines.

AUT's management system consists of the second and the third level of the pyramid. The purpose of AUT level instructions is to describes and specifies how the corporate level instructions are applied in AUT. AUT's common instructions are presented on the second level. AUT level documentation consists for example of AUT-level processes and their instructions.

At the bottom level of the pyramid, there are local procedures which consist of function specific and location specific instructions. Also at inside AUT organization, the different functions and locations have different procedures. Therefore, there must be more detailed instructions, which describe how the operation works at the lower level. Interviews emphasized that the best solution would be, that the instructions are placed directly in the tool where the actual process is made. For example, it is more effective that instructions

are accessible directly from the tool they are using, than searching the instructions from external database.

ISO 9001, ISO 14001 and ISO 45001 will be Valmet corporate level standards, and they will be certified globally in the future. This allows the organization to move away from unit-based certification structure and to certify one common global management system. This will harmonize corporation's operation and targets for reducing costs in the future. Although, the more detailed documentation may be needed in addition to the corporation level documentation. The corporate level documentation is high-level documentation, which gives a good overview, but at lower levels, such in business lines and functions, the procedures and instructions is needed to be described in more detail.

In addition to the global management system, there can be business line specific standards. The future can bring new needs that must be taken into account in the management system. For example, future trends, new technologies and increasing customer expectations can cause needs, which can have impacts on the management system. The organization, can for example, ponder if some new standards help to meet these needs. Therefore, it is important to design the management system in such a way, that it is possible to add the whole new standard alongside the other standards. By anticipating and planning the actions by keeping an eye on the future, it is possible to prevent the extra work and support the change management.

The current documentation of AUT's management system has been implemented on a function basis. The documentation structure has different sections for every function. Also, general quality, environmental and safety instructions are divided into different sections. By this way the same instructions occur in many places which make it more difficult to update the system, but also to find the relevant information. According to interviews and benchmarking, the most effective solution for the operation would be if the management system would follow the process structure. Instead of the separate functions' instructions, the instructions should be available chronologically according to the progress of the process.

The effective use of this kind of solution requires a more visual interface. At the starting page of the management system, there could be a higher-level figure of the end-to-end process. The figure makes it possible to get better understanding of the overall picture of the operation, understand the relationships between different functions, and to know what to do at which stage. It should be possible to move in the system by clicking some part of the process, and after that the further information and instructions related to that section should be opened.

There are also general quality and HSE procedures, which are higher level instructions and which cannot be targeted at a specific phase of the process. The general descriptions

can be same with all these standards, which makes it unnecessary to define them separately. If quality and HSE instructions would follow the structure of the new versions of the ISO standards, the organization can achieve many benefits. By applying the same structure with quality, environment and safety instructions, it is possible to create a clearer entity. The common structure also allows the use of same general instructions in all areas: quality, environment, safety and possibly in the future also the information security.

The structure which follows the standards, can help with auditing, because it is easier to see how the organization has responded to each requirement of the standards. Also, it can help the updating of management system, for example in situations where a standard has changed. When the standards and the management system has the same structure, it is easier to compare does the current management system fulfil the new requirements or is some actions needed. By this way, it is possible to facilitate the change management, because it is easier to identify which points need some changes. Figure 7.2 summarizes the main benefits of the structure of the future management system.

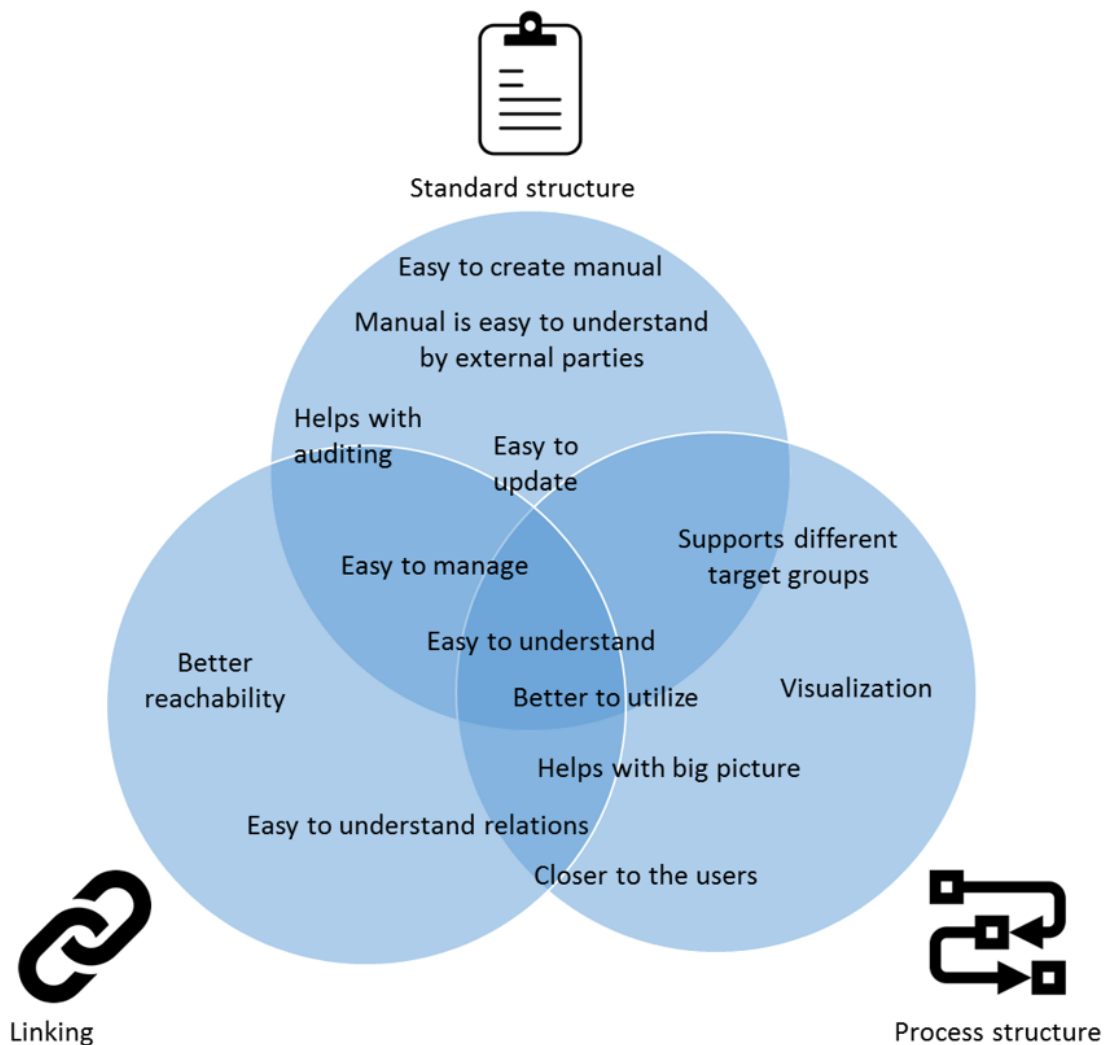


Figure 7.2. The main elements and their benefits of the future management system.

By combining ISO standard structure and end-to-end process structure into part of the management system, it is possible to increase further the effectiveness of the system. By increasing the effectiveness of the system, the organization also follows the lean philosophy. A more efficient system facilitates the usability and makes it possible to save time.

The vision is to organize business functions' documentation of procedures under the same structure which follows the end-to-end process. The current quality, environment and safety procedures are documented separately, but the vision is that, the general HSEQ procedures would be organized under the ISO standard structure. This vision would allow the serving of the different target groups such, users, administrators of the system, auditors and external parties.

Linking is an important factor, because without proper linking it is hard to find relevant information and the duplicate documents can appear. It is essential that there is only one master document which is referred to other documents. The linking should be implemented between corporate level and AUT level, and in AUT level between general HSEQ procedures and more detail process instructions. By that way the overall picture of corporation and AUT's operation would be easier to perceive. Therefore, the factor *easy to understand* is placed to the middle of the figure, because it is achieved as the sum of these elements.

The process structure facilitates the describing of processes in a visual way. *Visualization* in a management system, such process maps can *help users to understand the big picture*. Although, without proper linking the system is not efficient to use. Linking together with process structure can ease understanding the relations between different parties. By this way, the management system would be *closer to the users*, unlike currently the system is almost exclusively used by employees from quality and HSE related roles. Well-made linking also provides *better reachability*, the users can, for example, find all relevant information easier when the relevant documents are linked into specific points of the process.

The new standard structure is becoming more common also in other ISO standards. Therefore, it can be assumed that the structure would be the general structure for a longer period of time in these standards. Linking the standard structure and the process structure effectively together would *ease the managing and updating* of the management system. For example, new standards would be easier to merge into the management system. This can also ease to the updating of the standards in the future, for example, if the structure of the standards remains the same, but the requirements changes, it would be easier to identify the gaps between the management system and the new standard.

The standard structure would also *help with auditing*. The proper linking can ease the work of auditors and the employees who are involved in the audit, because the information that can be used to prove compliance is more readily available. It was observed in

the study, the HSEQ issues are important to communicate with external parties. When the HSEQ instructions are organized under the standard structure, the external version of *manual is easier to create* on the basis of general HSEQ instructions. If the manual follows the standard structure, it would also be *easier for external parties to understand the manual*, because the structure will become more and more common in the future.

8. DISCUSSION OF RESULTS AND CONCLUSIONS

8.1 Results

The scope of this study was divided into two parts: the transition plan to 2015 versions of ISO 9001 and ISO 14001 standards and the vision of the future management system. Therefore, it was not possible to identify just one final result. The study produced two separate results, which however, were important to examine together. The transition plan and study of the future trends and future management system supported each other during the research process.

The work was conducted as a constructive research. Different methods were used to construct the results. The study utilized scientific literature, benchmarking, and empirical material such interviews and organization's internal databases to create the transition plan and the vision of the future management system.

The results of this study are large entities. Therefore, this summary discusses only on the main elements of the results, which are presented in Figure 8.1. These elements required different levels of research measures. The biggest work was related to gap analysis, which also included the creation of the requirements' management tool. According to findings obtained from gap analysis, the actual transition plan was possible to be created. The more specific plan and the schedule to implement the transition are not presented in this study, because it is the internal material of the organization. In this study, the transition plan is introduced at a higher level which includes the process for fulfillment of the requirements, consideration of the pre-assessment and the transition review.

Simultaneously with the transition process, information was gathered to create the vision of the future management system. Valmet's future plans were heavily taken into account when creating the vision. The result was a management system, which contains three layers: the corporate level, AUT level and the local level. This model is presented in Chapter 7.2. The vision of the future management system was created in order to create an efficient management system which utilizes the new structure of the standards, but is also easier and more efficient to use by employees. The vision includes two main elements, standard structure and process structure which are linked in together in order to offer benefits to as many parties as possible. These benefits and their linking to these elements are discussed in Chapter 7.2.

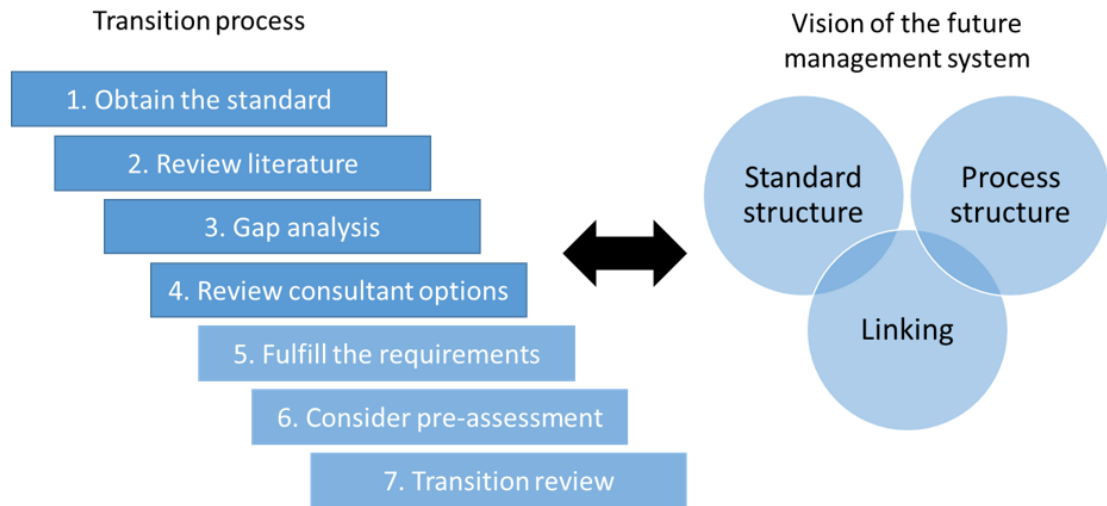


Figure 8.1. *The main elements of the results.*

Figure 8.1 highlights that the two scopes of this study were closely linked in together. It also introduces the transition process which was created in the study. The figure demonstrates with darker colors, that first four steps of the process were completed in the study and the last three will be fulfilled according to the transition plan after the research is ready.

The vision of the future management system will be used as a base for the reformation of AUT's management system. There are still many needed actions before the implementation of the vision can be started. The suggestions of these future actions and future studies are presented in Chapter 8.4.

Reformation of the management system requires effective change management. Also, the trends which shape the future of the quality management, can bring new issues to be considered when reforming and maintaining the management system. As in Chapter 2.1 were discussed, there are various trends which should be taken into consideration in organization operation. For example, increasing global competition may emerge as new competitors. Therefore, the organization should pay attention to its global operation and ensure that all locations fulfil the requirements and objectives which are set to them. This requires training and monitoring to contribute the fulfilment of the objectives. This is important for an organization to maintain the competitiveness and to increase further its market position.

In Chapter 2.1, new approaches for management were also discussed. The organization should pay attention to managerial methods. The organization should pay attention especially to that the managers show the leadership. It is essential that the managers show example and follow the required instructions also themselves. ISO 9001:2015 also em-

phasizes the leadership and the top management's commitment to the management system. Valmet's management can be seen to be well committed to the development of the management system, and it is important to remember to maintain the commitment also in the future.

8.2 Meeting the objectives

In general, it can be seen that the study fulfilled well the objectives which were targeted to it. Because there are two different scopes in this study, the fulfillment of the objectives must be examined also separately. These objectives have been assessed in Chapters 8.2.1 and 8.2.2.

8.2.1 ISO 9001:2015 and ISO 14001:2015 transition

The aim was to create a plan for transition to 2015 versions of ISO 9001 and ISO 14001 standards. The transition to new standards can be seen mandatory for AUT, because these standards have a great business impact. For example, many customers of AUT require certified standards to prove the quality of the operation. The transition could have done by fulfilling only the minimum requirements of the new standards. This approach would not have required such an accurate project plan, but the benefits for the organization would also have been minimal. The organization wanted to achieve the greater benefits by creating a more specific transition plan which would cover the global operation of AUT.

The transition plan created in the study and the implementation of the plan started already during the study process. The process started on time, and the plan seemed competent. It is noteworthy, that the results of the success of the minimum goals will be achieved after approximately one year after the plan was designed. The minimum objectives have been met when the transition audits to the new standards has been successfully passed. However, this does not yet correspond to the success of the overall project objectives. The aim was to enhance the operation of the company. However, this can only be observed after a few years.

A certification body conducted ISO 9001:2008 and 14001:2004 audits during the study. The capability of the organization to transit to the new versions of the standards was preliminarily evaluated by auditors. The transition plan was already designed at the time when the audit was arranged, so the auditors evaluated the plan. Their comments regarding the transition plan were:

“Organization has made preparations concerning transfer activities for 2015 editions. Activities are well planned, much better than average.” – The head auditor of the certification body.

The opinion of the certification body confirms the view of the successful plan. However, the achieving the objectives is largely depending on the success of the implementation, which is why the real results of the transition process will be obtained over a longer period of time.

8.2.2 Future management system

The purpose was to create a vision of the future management system. It had to take into account the future trends, changing customer requirements and the new standards. These factors were considered in the study, but it is important to take into account, that the aim was only to create a vision and to identify the factors which should be taken into consideration in the reformation of the management system. Therefore, it was not intentional to discuss any deeply on these factors in this study. However, it is important to consider these factors more specific in further studies and when designing the implementation plan for the reformation of the management system.

The vision was assessed at the organization. The vision was seen to be sensible and form a good basis for the development of the management system. It can be said that the vision met the objectives of this study, however, the overall objectives have a larger scale, which aims to business benefits. Therefore, the actual results can be seen in a few years, after the implementation has been done. It should be noted, that the results are not reliable immediately after implementation. The change takes time and the results can be more realistically evaluated after the reformed management system has become more familiar to the organization.

The future scope was included in the study, because the aim was to prevent duplicate work by considering future management system already while designing the transition plan to new versions of ISO standards. The vision, as well as the ground work, supported the planning of the transition. With this way, the study also followed lean philosophy. Hence, the study met the objectives also in this regard. The future study, for example, helped to understand which documents should be made on AUT level, and which will be documented at the corporation level. The study also revealed for example that the documents should be saved also in doc-format, so they are suitable for transferring to a new documentation platform easily in the future. The vision also helped to consider the general documentation manners so that the documentation would be as compatible as possible with the future changes.

8.3 Evaluation of the research

The constructive research was used as a research approach in this study. The ideal outcome of the constructive research is that it provides solution for originally find problems and proofs the found solution on practice. As it was discussed in Chapter 8.2, the actual proof of solutions suitability will be obtained for a longer period of time. However, the

transition plan was found to be working with different ways. The plan was evaluated by certification body and it got good feedback from them. Also, the implementation of the plan has been successfully started during the study.

A good constructive research also provides high practical and theoretical value. According to the evaluations and first experiences, the study will with great probability provide high practical value for the company. The weaknesses of the research can be identified on the theoretical side. Updating the management system to meet the new ISO requirements is a topical issue in many organizations. However, because the issue affects many organizations, it is already studied widely. Many findings related the ISO standard transition are also valid only for AUT, so the amount of scientific value is relatively low. Although, the transition process provides a good basis also for other organization.

However, the future scope can be seen to offer more scientific value. The study considers the future trends from the perspective of the management system. The main trends are identified and their impact in the management system have been discussed. The study finds that the information security is a great concern related to these trends. The study considers the role of information security in the management system. The study related to the future management system increases the scientific value of the research and rises many opportunities for further studies.

Different research methods were used in this study. The aim was to gather the information of the current state of the organization through the interviews. The interviews yielded good answers that led to a clear picture of the current state of the management system. The interviewees also made good suggestions for the future management system. The interviews were successful and they provided the aimed results. The layout of the questions and the interviewees were chosen so that possibility for misunderstandings was minimized, which also increased the reliability of the results. Although, the number of the interviewed persons could have been bigger and the variety of the different work positions could be wider. However, due to the schedule of the study, it had to settle for interviewing only the most relevant people. Also, the summer holidays during the study interrupt the arranging the interviews.

Overall, the study can be seen to have yielded reliable results and provided a great practical value for the case organization. The study also produced a theoretical value. However, the theoretical value remained at a fairly low level due to the scope of the study. Although, the study raises many options for further research, which are discussed in the next chapter.

8.4 Suggestions for further research

The study revealed many possibilities for further research. The study also raised issues that should be taken into account in the reformation of the management system. In this

study, the future trends were discussed from the perspective of the management system. It was examined, what future trends there are in automation industry and do they have an impact on the management system. The subject of future trends is broad, so it would be possible to explore as an individual study. The research could study in more deeply what trends there will be in the future in automation industry and what impacts they have on the whole industry. The future trends would be good to consider in order to develop the business and to achieve competitive advantages.

Chapter 2.6.1 discussed the change management. As it turned out, many great development projects are failing already at the beginning. The management system's developing is a rather large project, which is why it will need special planning and sufficient resources in order to implement the change. Therefore, the organization should study more how does the vision of the future management system affect to the organization and what risks does it contain.

The change management should be studied in more deeply before reforming the management system. Chapter 2.6.1 introduced Kotter's (1995) change management process. The process is a widely respected model and it can be a good basis for the change management.

Reviewing the change management process shows that the first three steps have already been made in this study. The first step, *the sense of urgency*, had been identified partly before this study was started, but it was examined more specifically in this study. The shortcomings and improvement proposals, which were found with current state analysis, form a basis for the development of the management system.

The second step, *forming a powerful guiding coalition*, has also been considered. The team for development of the management system has been formed at a corporate level, which aims to guide and manage the change into the common global management system. This corporate level team should work closely together with the AUT level's team, who will lead the change in AUT level. The AUT level's team has been formed to lead the transition from current ISO standards to 2015 versions. However, the team should be reconsidered when implementing the future management system, but it may be good to utilize the current transition team as far as possible.

The third step is *forming a vision*. The vision of future management system was created in this study and it forms a basis for the reformation of the management system. This study does not consider the implementation of the vision and the possible risks. The risks and the proper actions should be reviewed in order to complete the change successfully through. Also, Kotter's (1995) change management process should be reviewed and modified to suit to the process.

The organization should notice, as in Chapter 2.6.1 discussed, that the success of the change is highly dependent on personnel. Therefore, the organization should pay attention to training and motivating. In the context of training and motivating, it is important to take into account the individual needs of the employees, for example, to identify what training needs the employees have and how to motivate them. In this context, the importance of the leadership also emphasized, and the nearest manager is in the key position. It is good to pay attention to this in organizations operation, and to research further the training needs in the context of the reformation of the management system.

REFERENCES

- Alasoini, T. (2015). Digitalisaatio muuttaa työtä – millaista työelämää uudistavaa innovaatiopolitiikkaa tarvitaan? *Työpoliittinen Aikakauskirja*, (2/2015), pp. 26–37.
- Boden, T.A., Marland, G. & Andres, R.J. (2017). National CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory. pp. 1751–2014.
- Anand, G., & Kodali, R. (2008). Benchmarking the benchmarking models. *Benchmarking: An International Journal*, Vol. 15(3), pp. 257–291.
- Arachchilage, N. A. G., & Love, S. (2014). Security awareness of computer users: A phishing threat avoidance perspective. *Computers in Human Behavior*, Vol. 38, pp. 304–312.
- Barafort, B., Mesquida, A. & Mas. (2017). Integrating risk management in IT setting from ISO standards and management systems perspectives. *Computer Standards & Interfaces*. Vol. 54(3). pp. 176–185.
- Bessant, J., & Francis, D. (1999). Developing strategic continuous improvement capability. *International Journal of Operations & Production Management*, Vol. 19(11), pp. 1106–1119.
- Beyerer, J. & Usländer, T. (2016). Industrial Internet of Things supporting Factory Automation. *De Gruyter Oldenbourg*. pp. 697–698.
- Boiral, O., Guillaumie, L., Heras-Saizarbitoria, I., & Tayo Tene, C. V. (2017). Adoption and outcomes of ISO 14001: a systematic review. *International Journal of Management Reviews*.
- Casadesús, M., & Karapetrovic, S. (2005). An empirical study of the benefits and costs of ISO 9001: 2000 compared to ISO 9001/2/3: 1994. *Total Quality Management & Business Excellence*, Vol. 16(1), 105–120.
- CCPS. (2011). *Guidelines for the Management of Change for Process Safety*. John Wiley & Sons. 200 p.
- Cho, J. Y., Lee, D. Y., Lee, Y. J., & Lee, M. J. (2015). Effective Change Management Process for Mega Program Projects. *Journal of Asian Architecture and Building Engineering*, Vol. 14(1), pp. 81–88.

- Costea-Dunarintu, A., & Chitiba, C. (2015). Environmental Trends and Sustainable Business. *Knowledge Horizons. Economics*. Vol. 7(2), pp. 100–102.
- Crnkovic, G. (2010). Constructive research and info-computational knowledge generation. *Model-Based Reasoning in Science and Technology*, pp. 359–380.
- Di Noia, A. E., & Nicoletti, G. M. (2016). ISO 14001 Certification: Benefits, Costs and Expectations for Organization. *Studia Oeconomica Posnaniensia*, Vol. 4(10), pp. 94–109.
- Disterer, G. (2013). ISO/IEC 27000, 27001 and 27002 for information security management.
- DNV. The road to certification. Available (accessed 28.6.2017): <https://www.dnvgl.com/assurance/Management-Systems/the-road-to-certification.html>
- Fonseca, L. M. (2015). From Quality Gurus and TQM to ISO 9001: 2015: a review of several quality paths. *International Journal for Quality Research (IJQR)*, Vol. 9(1), pp. 167–180.
- Gibbon, P., & Henriksen, L. F. (2011). On the Pre-History of ISO 9000: The Making of a Neo-Liberal Standard. *Governing through Standards: Origins, Drivers and Limitations*. Basingstoke: Palgrave Macmillan, pp. 130–58.
- Gill, R. (2002). Change management - or change leadership?. *Journal of change management*, Vol. 3(4), pp. 307–318.
- Goetsch, D. L., Davis, S. B. (2010). *Quality Management for Organizational Excellence*. Pearson. Sixth edition. 634 p.
- Goldman, S. R. (1999). Issues for deeper understanding of visual learning processes and representations. *European Journal of Psychology of Education*. Vol. 14(2). pp. 295–300.
- International Labour Organization. Safety and health at work. Available (accessed on 6.6.2017): <http://www.ilo.org/global/topics/safety-and-health-at-work/lang-en/index.htm>
- ISO. (2015). Moving from ISO 9001:2008 to ISO 9001:2015. Available (accessed on 13.6.2017): https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/iso_9001_-_moving_from_2008_to_2015.pdf
- ISO. (2017). The ISO story. Available (accessed on 22.5.2017): <https://www.iso.org/the-iso-story.html#0>

- ISO (a). Management system standards. International Organization for Standardization. Available (accessed 23.5.2017): <https://www.iso.org/management-system-standards.html>
- ISO (b). ISO 9000 – Quality management. Available (accessed on 22.5.2017): <https://www.iso.org/iso-9001-quality-management.html>
- ISO (c). ISO 45001 – Occupational health and safety. Available (accessed on 5.6.2017): <https://www.iso.org/iso-45001-occupational-health-and-safety.html>
- ISO 45001:2016. (2016). Occupational health and safety management systems – requirements with guidance for use. Draft International standard.
- Johns, T., & Gratton, L. (2013). The third wave of virtual work. *Harvard Business Review*, Vol. 91(1), 66–73.
- Kirrane, D. E. (1992). Visual learning. *Training & Development*, Vol. 46(9), pp. 58–64.
- Kleinová, R., & Szaryszová, P. (2014). The new health and safety standard ISO 45001: 2016 and its planned changes. *International Journal of Interdisciplinarity in Theory and Practice*, Vol. 3, pp. 43–47.
- Kotter, J. P. (1995). Leading change: Why transformation efforts fail. *Harvard Business Review*. pp. 59–67.
- Krafcik, J. F. (1988). Triumph of the lean production system. *MIT Sloan Management Review*, Vol. 30(1). pp. 41–52.
- Lanubile, F., Ebert, C., Prikladnicki, R., & Vizcaíno, A. (2010). Collaboration tools for global software engineering. *IEEE software*, 27(2). pp. 52–55.
- Lindner, J. R. (1998). Understanding employee motivation. *Journal of extension*, Vol. 36(3), pp. 1–8.
- Luomala, A. (2008). Muutosjohtamisen ABC. Tutkimus- ja koulutuskeskus Synergos. Tampereen yliopiston kauppakorkeakoulu.
- Mansouri, N. (2016). A Case Study of Volkswagen Unethical Practice in Diesel Emission Test. *International Journal of Science and Engineering Applications*, Vol. 5(4), pp. 211–216.
- Melton, T. (2005). The benefits of lean manufacturing: what lean thinking has to offer the process industries. *Chemical engineering research and design*, Vol. 83(6), pp. 662–673.

- Mineraud, J., Mazhelis, O., Su, X., & Tarkoma, S. (2016). A gap analysis of Internet-of-Things platforms. *Computer Communications*, Vol. 89, pp. 5–16.
- Noe, R. A. (2002). *Employee training and development*. McGraw-Hill. Fifth edition. 584 p.
- Peña, I. (2002). Intellectual capital and business start-up success, *Journal of Intellectual Capital*, Vol. 3(2), pp. 180–198.
- Posada, J., Toro, C., Barandiaran, I., Oyarzun, D., Stricker, D., de Amicis, R., ... & Val-larino, I. (2015). Visual computing as a key enabling technology for industrie 4.0. and industrial internet. *IEEE computer graphics and applications*, Vol. 35(2), pp. 26–40.
- Psomas, E., & Antony, J. (2015). The effectiveness of the ISO 9001 quality management system and its influential critical factors in Greek manufacturing companies. *International Journal of Production Research*, Vol. 53(7), pp. 2089–2099.
- Pun, K. F., Chin, K. S., & Lau, H. (1999). A self-assessed quality management system based on integration of MBNQA/ISO 9000/ISO 14000. *International Journal of Quality & Reliability Management*. Vol. 16(6), pp. 606–629.
- Rahmani, B., (2016). *Industrial Internet of Things: Design and Stabilization of Nonlinear Automation Sysems*. Springer Science, Vol. 86. pp. 311–323.
- Rautiainen, A., Sippola, K., & Mättö, T. (2014). Perspectives on relevance: The relevance test in the constructive research approach. *Management Accounting Research*, Vol. 34, pp. 19–29.
- Sadeghi, A. R., Wachsmann, C., & Waidner, M. (2015). Security and privacy challenges in industrial internet of things. In *Design Automation Conference (DAC)*. pp. 1–6.
- Santos, G., Barros, S., Mendes, F., & Lopes, N. (2013). The main benefits associated with health and safety management systems certification in Portuguese small and medium enterprises post quality management system certification. *Safety science*, Vol. 51(1). pp. 29–36.
- Saunders, M., Lewis, P. & Thornhill, A. (2009). *Research methods for business students*. 614 p.
- Schallehn, M., Schertler, M. & Schorling, C. (2017). *Finding Europe's Edge in the Internet of Things*. Bain & Company.
- SFS-EN ISO 9001. (2015). *Quality management systems. Requirements (ISO 9001:2015)*. Finnish Standards Association SFS.

- SFS-EN ISO 14001. (2015). Environmental management systems. Requirements (ISO 14001:2015). Finnish Standards Association SFS.
- Sokovic, M., Paletic, D. & Pipan, K. (2010). Quality Improvement Methodologies – PDCA Cycle, RADAR Matrix, DMAIC and DFSS. *Journal of Achievements in Materials and Manufacturing Engineering*. Vol. 31(1). pp. 476–483
- Sower, V. E. (2009). *Essentials of Quality With Cases and Experiential Exercises*. Wiley. Sam Houston State University. 392 p.
- Summers, D. C. S. (2005). *Quality Management. Creating and Sustaining Organizational Effectiveness*. Pearson. 409 p.
- Stapenhurst, T. (2009). *The Benchmarking Book*. Elsevier. First Edition. 496p.
- Todnem By, R. (2005). Organisational change management: A critical review. *Journal of change management*, 5(4), 369–380.
- Valmet. Our businesses. Available (accessed on 20.6.2017): <http://www.valmet.com/about-us/valmet-in-brief/our-businesses/>
- Valmet Annual Review. (2016). Progress in operations and sustainability. 45 p.
- Valmet. (2017). Historia. Available (accessed on 20.6.2017): <http://www.valmet.com/fi/valmet-yrityksena/valmet-lyhyesti/historia/>
- Valmet. (2016). Quality Policy. Available (accessed on 14.9.2017): http://www.valmet.com/globalassets/sustainability/documents/quality-policy/valmet_quality_policy_a4_en_jul2016.pdf
- Wincek, J., Sousa, L., Myers, M. & Ozog, H. (2014) Organizational change management for process safety. *Process Safety Progress*. Vol. 34(1), pp. 89–93.
- Wollschlaeger, M., Sauter, T., & Jasperneite, J. (2017). The future of industrial communication: Automation networks in the era of the internet of things and industry 4.0. *IEEE Industrial Electronics Magazine*, Vol. 11(1), pp. 17–27.
- Womack, J. P., Jones, D. T. (1996). Beyond Toyota: How to root out waste and pursue perfection. *Harvard Business Review*. Vol. 74(5). pp. 140–158.
- Womack, J. P., & Jones, D. T. (2015). *Lean solutions: how companies and customers can create value and wealth together*. Simon and Schuster.
- Wortmann, F. & Flüchter, K. (2015). Internet of Things. *Technology and Value Added*. Springer. Vol. 57(3). pp. 221–224.

APPENDIX A: EMPIRICAL MATERIAL

Interviews

No.	Date	Interviewee
1	4.5.2017	Project Quality Manager
2	8.5.2017	Program Manager
3	8.5.2017	Environment & Sustainability Manager
4	10.5.2017	Information Security Consult
5	12.5.2017	R&D, Senior Manager
6	16.6.2017	Concept Owner
7	21.6.2017	R&D, Senior Manager
8	27.6.2017	Director, Services Development
9	27.6.2017	Senior Project Manager
10	11.7.2017	Chief Design Engineer
11	28.8.2017	Director, Industrial Internet
12	6.9.2017	Manager, Project Engineering
13	6.9.2017	Manager, Process & Machine Controls Engine

Valmet Flow

- Automation business line. Available (accessed on 14.9.2017): <https://valmet.sharepoint.com/sites/flow/Businesses-and-Areas/Automation>
- Health, Safety and Environment (HSE). Available (accessed on 14.9.2017): <https://valmet.sharepoint.com/sites/flow/InfoCenter/HSE>
- Lean. Available (accessed on 22.9.2017): <https://valmet.sharepoint.com/sites/flow/InfoCenter/quality/Lean/Pages/default.aspx>
- Valmet Industrial Internet. Available (accessed on 14.9.2017): <https://valmet.sharepoint.com/sites/flow/InfoCenter/IndustrialInternet/Pages/default.aspx>

Valmet Lotus Notes Databases

- AUT Instructions and Templates
- AUT Procedures

- Direction Handbook
- Valmet Instructions
- Valmet Risk Management
- Valmet Line Organization Charts
- Valmet Q&HSE Info

Information obtained from certification body

- ISO 9001:2008 and ISO 14001:2004 audits (12.9.2017 – 14.9.2017)