Tampere University of Applied Sciences

On the Road to Total Quality

A Multi-purpose Quality Handbook for the Sourcing Unit in Anticipation of ISO9001 Certification

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ABSTRACT

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A Multi-purpose Quality Handbook for the Sourcing Unit in Anticipation of ISO9001 Certification

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The motivation of this thesis is to produce a quality manual for OptoFidelity Oy's sourcing unit in anticipation of ISO9001-2015 quality certification. In order to produce the quality manual, it was essential to understand what the ISO9001-2015 quality standard is and what are the requirements to implement it. Since process are an integral part of the standard, the research focused on the sourcing unit's processes and ways of working.

To support and provide wider understanding of the connections between ISO standard and processes, the theoretical framework of this thesis provides information about quality management systems, processes, process analysis, and methodologies for continuous improvement and agile ways of working.

Research data was collected from semi-structured interviews, process descriptions and charts, as well as from internal meeting memos. The data was then analyzed and formulated into detailed accounts of the processes and their strengths, efficiency as well as weak points.

The output of this thesis is a quality manual for the sourcing unit to be implemented in day-to-day use as well as material for ISO9001-2015 audits and onboarding of new employees. Additionally, the authors provide their insights and suggestions for further improvements of the sourcing unit's processed and ways of working.

Key words: iso9001-2015, quality, quality management, processes

CONTENTS

ABBREVIATIONS AND TERMS

BOM	Bill of Materials
BPA	Business Process Analysis
BPMN	Business Process Modelling and Notation
DRI	Directly Responsible Individual
ERP	Enterprise Resource Planning
KPI	Key Performance Indicator
OSV	OneSightView
PO	Purchase Order
PR-code	Product Code
PQ	Purchase Request
QMS	Quality Management System
RFQ	Request for Quotation
TQM	Total Quality Management
UML	Unified Modelling Language

1 INTRODUCTION

In the highly competitive smart devices market, quality is an essential part of success. Companies innovating and manufacturing immersive, practical, and all the time more advanced technologies and solutions have a distinct need to test their products throughout the product life cycle. From the first prototypes to recycled and refurbished devices, ensuring functional and design quality is essential to survive. The commissioner of this thesis, OptoFidelity Oy is a company that enables the players in this market to test their products.

OptoFidelity Oy designs and manufactures testing solutions for various players in the smart devices market with a strategic focus on the artificial and virtual reality technologies, as well as refurbishment and recycling business. The company employs nearly 150 people in three locations in Finland. Additionally the company has a subsidiary in the United States as well as a sister company in China. In 2021 OptoFidelity generated 20,9 million euros in revenue with 975 000 euros profit.

In order to meet the high-quality requirements of their customers, the company prepares to obtain the ISO9001-2015 quality standard. The standard is probably the best known and most used quality certification in the world. In addition to reflecting quality and credibility of the certified organization, the ISO9001-2015 standard supports the continuous improvement of the organization.

In anticipation of the certification process, OptoFidelity Oy has commissioned two members of the company's sourcing unit to produce a quality manual for the sourcing unit. The research and work related to the quality manual lays the foundation of this thesis.

2 THESIS PLAN

2.1 Thesis topic

This thesis discusses the ISO9001-2015 certification from the commissioning company's sourcing unit's point of view. The related research is focusing on the theory and definition of ISO9001-2015, as well as the certification process. This thesis was commissioned to entail a quality manual for the sourcing unit, which is to be used as a guidebook for present and future employees in addition to being preparatory material for the ISO9001-2015 certification.

In order to retain scope and relevance, the discussion will be limited to OptoFidelity's sourcing unit's operations, and related cross functions, processes, and dependencies omitting deeper analysis of company level quality and processes. In parallel to ISO9001-2015 discussion and the quality manual, the discourse focuses on continuous development of quality and processes.

2.2 Thesis objective, purpose, and research questions

The objective of this thesis is to research the ISO 9001 certification and to understand its requirements to produce a quality handbook that can be used as material in ISO9001-2015 audit. To achieve the beforementioned objective the authors will observe, analyze, and describe the sourcing unit's processes, standards, and ways of working in appropriate detail.

Secondly, the research will be conducted to identify the company QMS aspects related to the sourcing unit that could be further developed. Any identified items are described and based on the research and the authors' expertise through experience in the company's sourcing unit, future developments actions will be proposed.

The purpose of this thesis is to provide commissioner accurate and relevant information about the ISO 9001 certification in anticipation of getting certified. As a part of the thesis, the quality handbook's purpose is to map out and describe the work of the sourcing team, as well as to serve as an onboarding material for future employees to achieve harmonization and quality across the function.

2.2.1 Research questions

The research questions this thesis seeks to answer are:

1. *What requirements does the ISO9001-2015 quality standard pose to OptoFidelity's sourcing unit and how well does the unit fulfill them?*
2. *How could the sourcing unit's quality and processes be developed before and after the ISO9001-2015 certification?*

2.3 Working methods and data

This thesis utilizes mainly qualitative research to obtain the needed data. The research is based on semi-structured interviews of OptoFidelity's employees. In addition, some quantitative data collection methods are used, such as process analysis and internal meeting minutes analysis.

To support the other research, the authors utilize their observations and expertise by experience, as they are both part of the sourcing unit. Furthermore, the data is analyzed by comparing current quality elements with the ISO requirements identified from the research.

2.4 Thesis process

The process of producing this thesis and the accompanying quality manual realized to become more complex than initially expected. The starting point for the process was the commissioning of the quality manual for the company's sourcing unit. The quality manual served as the basis of the thesis providing an

appropriate topic, as it was intended to become a preparatory document to support the coming ISO9001-2015 certification. However, at the beginning of the process, the authors were unaware of the certification project's timeline, as it was communicated to become relevant "sometime in the future".

The process progressed as initially planned with defining the goals and scope of the thesis, as well as planning. The topic and initial thesis plan were approved swiftly by the thesis commissioner, supervisor, and the thesis advisor. The approvals were followed by literature review and research for the theoretical framework.

In parallel to drafting the original theoretical framework, the authors crafted the used data collection tools and started gathering the data. During the data analysis phase and drafting of the first thesis revision, it came, without prior notification, to the authors' knowledge that the company had initiated the ISO9001-2015 certification process. This news meant a significant change in the approach of the thesis to the topic of preparing for ISO9001-2015 certification by a shift to assessing and analyzing the company's QMS from the viewpoint of the sourcing unit.

Luckily, the prior research and collected data were still relevant to the new approach and could be utilized in producing the quality manual and the thesis. However, some additional research and data collection were called for to provide relevant insights to the ongoing certification process as well as the proposed further development ideas, causing a delay in the process.

In order to collect relevant data, the authors turned to alternative sources, in addition to the conducted interviews. By utilizing various internal company meeting memos they were able to add value to the research and development ideas. Additionally, insights from the certification process were used to deepen the understanding of the topic.

The following process chart represents the actual thesis process that occurred.

2.4.1 Challenges in the thesis process

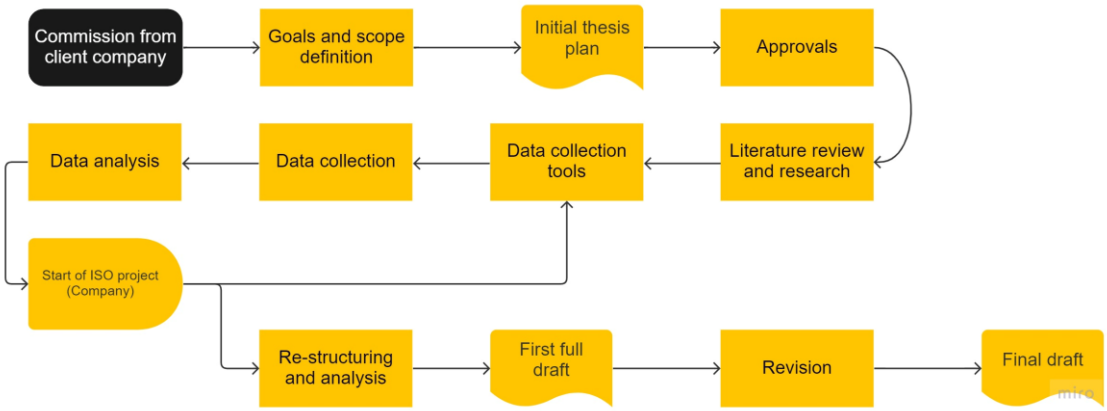


Figure 1 - Thesis process

In addition to the surprising start of the ISO9001-2015 certification project, the thesis process faced other challenges related to resource utilization. The commissioning company granted each of the authors 75 hours of paid work time to use for producing the quality manual and the thesis. The time was decided to be spent as 7,5-hour sessions each Friday, taking the authors away from their regular work at the company. As a result, the beginning of each week after the Friday sessions required extra effort and time from the authors as they were technically working 80% of their contractual work time but with 100% of the responsibilities.

Additionally, deciding to slice the allocated thesis time resources into sessions with at least one week apart from each other caused issues with continuity. It proved to be a laborious task to pick up the work from several days ago, consuming often more time on the reviewing of previously produced content than creating new. In retrospect, the time allocated by the client company could have been used more efficiently by taking multiple days off from regular duties and focus on the thesis process.

3 THEORETICAL FRAMEWORK

This chapter introduces theories associated with the topic of the research. It focuses theories about quality management of the processes and how to improve them.

3.1 Quality

The Cambridge dictionary offers several definitions for the term quality. In the context of this thesis, the term does not refer the characteristics or features of a person, object, or phenomena. A more applicable definition would be “how good or bad something is”(Anon., 2022b). This definition refers to a more common-sense approach to the term and is typical in day-to-day discourse. However, the definition does not comment on any metrics, only the perception of quality.

To give more specific parameters to the term quality used in this thesis, Cambridge Dictionary’s definition “of a high standard” (Anon., 2022b)offers additional detail how to determine what is good or bad. Yet, a problem arises as “a high standard” is very much open to interpretation. Standard can mean many things, depending on the perspective, leaving a lot of room for variation when measuring quality.

Perhaps the most apt definition of the term quality can be found in The Oxford Dictionary: “the standard of something when it is compared to other things like it”. (Anon., 2022c)This definition provides a more detailed metric that can be put in context when measuring two or more things with each other. By defining quality in this manner, we can better distinguish aspects that are measurable against a globally acknowledged metric. In the context of this thesis that metric is the ISO9001-2015 quality standard.

3.2 ISO 9001-2015 standard

The ISO 9001-2015 standard is the most used and respected certification for quality management. ISO 9001 defines the appropriate level and format of documentation. The standard emphasizes process approach, which requires detailed description of the organization's processes. (ASQ, 2022) The description must be included in the company's documented information, such as a quality manual, which was a mandatory document for ISO9001 certification until the 2015 revision. In the ISO9001-2015 a full quality manual is no longer required, as the terminology was changed from the previous ISO9001-2008 revision. The earlier terminology specifically named quality manual as mandatory documentation, whereas now in the 20015 version the terminology is simply "documented information" (ISO 9001:2015, 2015). Although the auditor must have clear view how the requirements for the certification are met, the standard does not define a specific form in which the information is presented.

Additionally, the documented information includes the organization's quality management principles, descriptions of the quality management system in place, organization's structure and context, leadership, detailed operations description, support mechanisms for resources and competence, performance evaluation plans and metrics, as well as improvement plans based on quality analysis (Vanguard Management Systems Ltd, 2021). All documentation must meet the criteria set by the ISO9001-2015 standard.

To ensure the adequacy, accuracy, and availability of the documented information, the standard mandates a certain degree of control of it. All of the required information must be available to whomever needs it in the company's operations, when they need it, as well las where they need it. Additionally, the documentation must be adequately protected against loss of confidentiality, and integrity, and improper use. In order for the documentation process and development to be transparent, that ISO9001-2015 standard requires version control for the documentation. In short, this means that each version of a document must have a tracking log of version numbers, summary of changes

made to the previous version, as well adequate information of the editor, reviewer, and approver of the document.(ISO 9001:2015, 2015)

This standard also aims to increase focus on risk management, awareness of the organization's context for ensuring relevant quality improvement, and performance monitoring through appropriate metrics and deeper analysis of the operations (Vanguard Management Systems Ltd, 2021).

Just as with the various QMSs, ISO 9001 standard is scalable following the QMS that is implemented. (Ikram, Zhang and Sroufe, 2021). The standard has been revised over the years to be aligned with any QMS that has adopted internationally recognized high-level structure and identical text for management system standards and common core management system terms and definitions, also known as the Annex SL guidelines (QSM Group, 2019).

A great clause of importance in ISO 9001 is that of continuous improvement, adaptation, and revision of the quality management, processes, and risk management. ISO 9001 requires documented plans and processes for improvement, so it is not enough for the organization to map out and describe their QMS and processes to get certified. The ISO organization also practices what they preach and revise the ISO 9000 family standard to be up to date with the rapidly changing global environment every three to five years (Lachapelle, Aliu and Bina, 2015).

ISO9001-2015 quality standard certificate is obtained by firstly defining the scope and goals of the certification. This sets the baseline for documenting the company's QMS, quality policies, processes, and other related aspects. Following the planning and documentation, is the implementation of the documented information. This phase typically runs in parallel to the documentation, as the recorded information is based on the operations taking already place. However, during the documentation, the company might notice a need for changes, and those changes are then implemented.(Anon., 2022a)

Before the company deems itself ready to be certified, they shall conduct an internal audit, where the proper implementation of the ISO9001 standard complying QMS is evaluated. Based on the internal audit the company might identify needs for corrections or changes to fully comply with the standard, which can be then adjusted before the certification.(Anon., 2022a)

Finally, to get the certification, the company must subject to an external audit conducted by a third-party independent auditor. The auditing process is twofold, the first audit round focusing on determining whether the organization and its documentation is on an acceptable level to undergo the second audit round which determines whether the organization can be certified or not.(Anon., 2022a)

The second audit round takes more time and dives deeper into the organization's QMS, policies, and documentation. During the second audit, as opposed to the first audit round, the auditor often interviews any members of the staff, not just process owners or top management, to establish whether the documented QMS and policies as well as processes are followed. The second audit round's purpose is to give the auditor an unobstructed view to the work processes and conformity. Minor nonconformities are not a blocking issue for the certification as long as they are addressed appropriately by the organization. In some cases of major nonconformities, the auditor can conduct a third follow-up audit before decision of certification is made.(Anon., 2022a)

Once the organization passes the twofold external audit, the auditor issues a recommendation to the certifying body. The certification will then be issued by an approved registration body, which are independent of the ISO organization and in order to be internationally recognized must be accredited by an IAF (The International Accreditation Forum) member.(Anon., 2022d)

3.3 Quality management system

Quality management systems are formalized and most often standardized systems that help organizations to plan and execute their operations to meet

customer and regulatory standards. QMS documents processes, practices, and responsibilities that aim to support and continuously improve quality policies and objectives (ASQ, 2022).

Different QMS's have different focuses and approaches to quality but they tend to share many elements. The most visible element is documentation which is also an integral part of any standardized QMS that can be certified. The certification process includes an audit conducted by a third-party auditor. For the auditor to approve the certification, they need to be able to evaluate how well the organization executes their processes compared to how they are described in the documentation. The documentation covers typically things like quality policies and objectives, quality manual which includes process descriptions, quality analysis, and data management, to name a few.

Quality management systems are scalable to any sized business, although the benefits are somewhat debated when implemented to smaller businesses. (Keen, 2019) The success of the implementation should always be measurable by selecting appropriate KPIs, hence it could be argued that the QMS itself does not yield poor or impressive results, rather the correct scaling, focus, and measuring of the implementation (Oakland and Oakland, 2004)

As mentioned above, any QMS could be certified to increase the credibility of the organization and its quality. To be certified, the quality management system is required to meet acknowledged and predetermined standards. For example, the ISO 9000 series of standards is globally recognized and the most used set of standards for quality management systems (Lachapelle, Aliu and Bina, 2015).

3.4 Total Quality Management

The need for quality control dates back to times when people got the ability to create things and since that time people have various tools and systems to help achieving the needed improvement. One of these systems is Total Quality Management (TQM) which is a holistic model for quality control and

management. By definition, Total Quality Management is improvements of processes and ways to do business(Williams, 1994a).

Basic approach of Total Quality Management can be divided in to five key principles which are discussed in next chapters.

3.4.1 Customer centricity

The idea on the first key principle of TQM is to put the customer into center on all the things you do and thinking how could this benefit the customer? TQM emphasizes on the importance of understanding on how the customer perceives the quality as well as identifying the distinct types of customers and their unique needs. (Kiran, 2016)

In TQM the customer centricity concept includes not only the external customer but also the internal one. Treating different departments and functions as an internal customer within the company is a key on making organization processes leaner and more effective as it is essential that all people of the organization are motived to work towards the common goal (Kiran, 2016).

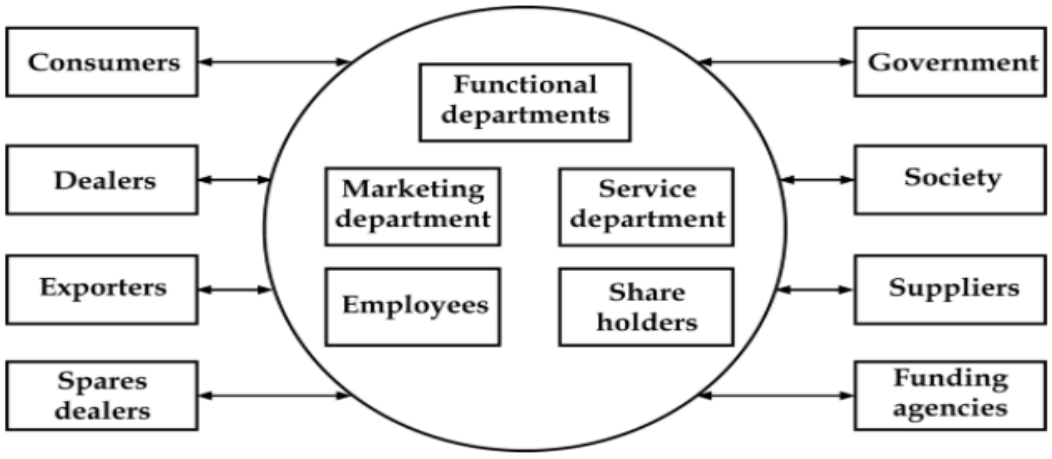


Figure 2 - TQM stakeholder synergy chart (Kiran, 2016)

3.4.2 Doing it right while constantly improving

The second key principle, doing it right means that things should be done correctly from the beginning to minimize the amount of faulty work and to be more effective. Focusing on all the steps of the process also helps to reduce the amount of time needed to complete the process and the risk of having to go back do the same steps again. (Deshp, 2021)

While “doing things right” it is also important to constantly reassess and challenge the process and the ways the things are done, doing this allows the gradual increase in the company’s performance. (Deshp, 2021)

3.4.3 Communication and education

Communication and education play a vital role in Total Quality Management. It emphasizes the importance of up-to-date and relevant education of the employees as well as the need for constant and open communication between the company and its employees. (Doney, 2019)

The idea behind the importance of education in TQM is that the well-educated personnel make less mistakes and are more versatile and skilled on what tasks they can do and are more likely to solve problems by themselves. (Doney, 2019)

The importance of the communication in TQM is based on belief that having open communication channels between the company, its employees and other stakeholders will improve the motivation and steer the company into common direction while reducing the number of harmful misunderstandings. It will also lesser the fear and uncertainty of the employees when supervisors and easily approachable and messages, strategies and processes are well communicated. (Padhi, 2010)

3.4.4 Measuring the work

Measuring the work as a part of TQM means that companies should have means to measure the performance of their work or process. By identifying the KPIs of certain process or work the companies can then base their decisions on facts, rather than estimates.

This will also gather valuable information for the companies on where the room for improvement is for the certain process or work and how to improve it. Combined with the open communication mentioned in chapter 3.1.3 in means of openly presenting the result of measurements it will provide the workers opportunity to quickly react if changes are needed, thus minimizing the waste in process or work. (Williams, 1994)

3.4.5 Holistic involvement of the people

The last of the five key principles of TQM, holistic involvement of the people is an approach that focuses on couple of key parts: participation of the work force on related decision-making processes. As workers on different departments and positions have varying view on matters this brings unique and more holistic point of view on the decision making. (Kiran, 2016)

Motivation, when workers are properly motivated, they feel like they are part of the organization making them work more effective and doing less mistakes. Motivated workers are also less resistant on change making them more open to new processes and ways of working. (Kiran, 2016)

Lastly, recognition of performance, If the organization or manager recognizes and awards the performance of the worker it is known to boost the morale of the workforce and work as a major contributor for the motivation. By reinforcing the reward, commitment of workers towards the organization will increase making the workforce more likely to work towards the common goal. (Kiran, 2016)

3.5 Processes

A process is a sequence of activities preformed to achieve a desired outcome. Typically, the sequence is initiated by an input, which may be the outcome of a different process or an independent occurrence. As the sequence advances, the input transforms to an output, or outcome, through the activities in the sequence.

All businesses have processes in place to ensure their operations. Operations can be defined by the same transformation model as processes (Brennan, 2011) and thus it can be logically deduced that the more efficient all the individual processes are, the more efficient the operation is as a whole. In order to optimize their processes, businesses need continuous process improvement.

Process improvement is an integral part of any quality management system and also included in the ISO9001 standard, both of which will be discussed in more detail later in chapter 3. Methodological process improvement requires a thorough understanding of the processes. Such understanding can be achieved through process analysis. Valuable and accurate process analysis calls for clear representation. The concepts and connection of process analysis and representation is discussed below.

3.6 Process analysis and representation

Process analysis is the study of processes, their structure, and efficiency. There are several process analysis theories and methodologies. (IBM Cloud Education, 2021). To make use of most of them, the processes must be described, or in other words represented, in a comprehensible and structured manner. Process representation is either verbal, written, visual or any of their combination of the beforementioned. One of the most typical ways of representing a process is a process chart.

3.6.1 Process representation

There is an abundance of diverse types of process charts, out of which the flow chart is probably the most used. It represents the process in a chronological and often linear visualization comprising of different shaped boxes that are connected by several types of lines, usually with an arrow indicating the direction of the process flow. Process representation models, process analysis models, and process improvement tools, and process theories, such as Unified Modelling Language (UML), Business Process Modelling and Notation (BPMN), and (Lean) Six Sigma have different standardized ways of notations. Nevertheless, they share the same principle of indicating inputs, outputs, activities, relations, and flow direction with specified shapes and symbols for process flow charts.

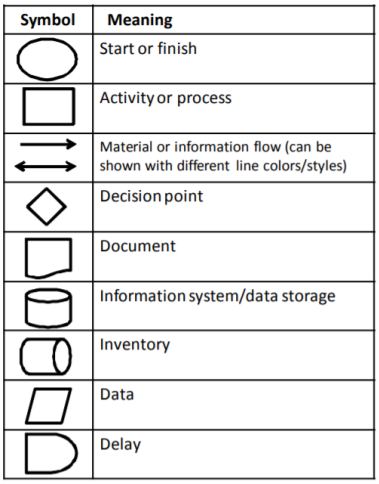


Figure 3 - Key symbols used in process mapping (Martinsuo et al., 2010)

3.7 Process optimization with the Six Sigma approach

Six Sigma is a process improvement concept developed in mid-1980's, which comprises of a set of tools to analyze, optimize, and standardize processes to ensure maximum quality. In a correctly executed Six Sigma approach, 99,9997% of opportunities to produce a feature, part, or any step in a process are statistically free of defects. In addition to virtually defect free production of goods or services, Six Sigma aims to lower operational cost and risk, improve culture of continuous development, increase the quality of customer service, and increase revenue (Shaffie and Shahbazi, 2012).

The Six Sigma approach utilizes a DMAIC methodology comprises of five crucial steps to improve processes: define (area of improvement), measure (process KPIs), analyze (process baseline, process objectives, and process variations), improve (on identified, measured, and analyzed improvement area based on ideas identified and defined by collected data from previous steps), and control (the improved process to ensure sustainable change) (Shaffie and Shahbazi, 2012). The approach is a process itself, and in contrast to most processes, it is not linear with one starting point and one ending point, but rather a cycle that repeats itself.

Figure 4 - DMAIC methodology cycle (Millard, 2017)

3.8 Scrum methodology

Scrum methodology is an agile framework for way of working developed by Ken Scwaber and Jeff Sutherland in the early 1990's. By definition from its creators Scrum is a: "lightweight framework that helps people, teams and organizations generate value through adaptive solutions for complex problems" (Schwaber and Sutherland, 2020). The chapter 3.8 focuses on explaining the theory and practice of Scrum methodology.

The theory behind Scrum methodology focuses on three key aspects which are tightly linked and cannot exist without each other: Transparency, inspection, and adaptation. All work and processes have to be visible for both doing and receiving parties of the work, making it transparent for all stakeholders to avoid miscommunication and misunderstanding in the scope of work. In Scrum, the

work should be inspected regularly to discover unwanted variances or problems. In practice the inspection is done in Scrum's five events: Spring planning, sprint, scrum daily, sprint review and retrospective. As Scrum welcomes the change, the last key aspect adaptation focuses on active adjustment of the processes and the work itself to ensure that further deviation would not happen. (Schwaber and Sutherland, 2020)

Scrum team consists of three roles; Product owner, Scrum master and developers and all these roles have their own distinctive functions and responsibilities in the team. The work itself starts by "sprint planning" which purpose is to lay out the work to be done and all team members are involved into the planning process. The actual work is done in "sprint's" which is the core of Scrum methodology. The sprint can be seen as a small project inside a larger entity, where the Scrum team members are all accountable for adding value to the product or process. A project can include indefinite number of sprint's and after each sprint follows a "sprint review" and "retrospective". This is the iterative phase of the events, where the sprint review concentrates on presentation of the sprints results and progress towards the goal. How the retrospective differentiates from the sprint review is that the retrospective focuses more on the past tense, what aspects of the sprint were successful, and which could be improved to push the continuous improvement. (James O. Coplien and Jeff Sutherland, 2019)

4 RESEARCH METHODS

4.1 Qualitative methods

Semi-structured interviews and process analysis were selected as qualitative research methods for this thesis and are discussed in next chapters.

4.1.1 Semi-structured interviews

Semi-structured interview is a qualitative research method that gathers data from either groups or individual participants. Interview starts by “warm up” where the purpose and background of the interview is explained and information about the organization and interviewees’ background is gathered. This is followed by assessment of present and future aspects where the information about the present knowledge is gathered along side with interviewees expectations, needs and improvement ideas. in final part of semi-structured interview, the interviewer summarizes the interview and if needed gives feedback for the interviewee. (Weßel, Weymann and Spreckelsen, 2006)

Semi-structured interviews have many benefits over other qualitative or quantitative research methods. As its structure is loose, flexible, and iterative it allows the interviewer to build trust and connection with the interviewee. As interviews are often scheduled in advance, the interviewee has more time to prepare themselves to the given topic, resulting in a deeper, open-ended answers. To benefit most from semi-structured interview, it is crucial to reach the participants who possess the information and experience needed for the given topic. It is also important to select interviewees from different point of views to the topic, leading to more in-depth and detailed understanding of the subject (Dejonckheere and Vaughn, 2019).

The semi-structured interviews conducted are expected to offer insight, not only to the processes under investigation, but also phenomena, issues, and points of improvement around the processes. Such insight is highly valuable for process

analysis as this kind of issues cannot be identified within the process itself although they can have a fundamental and direct impact.

4.1.2 Business process analysis (BPA)

Second part of qualitative research for this thesis is to analyze the purchasing processes of OptoFidelity Oy. BPA is a system which allows for detailed examination of every part of the process to help identify and document parts of the process which then can be developed. Six Sigma approach was chosen as a methodology for this thesis.

The BPA starts by definition and documentation of the processes and metrics in need of improvement. After defining the key processes and metrics, the next step is to measure and document the performance of the given part of the process relative to the defined metrics to gain better understanding on how the process is performing the first place. This is followed by the actual analysis, for the purpose of this thesis, a root cause analysis and value analysis were chosen. After the parts of the process has been analyzed, next step is the implement and communicate the improvements based on findings of the analyses to all the stakeholders. Last part of the BPA is to control and monitor the change in process to gain more knowledge of the effects of the change and if further improvements are then needed to reach the wanted outcome. (IBM Cloud Education, 2021)

4.2 Quantitative methods

For research in this thesis, we have chosen to use also quantitative data gathering methods. Quantitative research, as opposed to qualitative, utilizes numerical data that is analyzed using statistics. For the quantitative research to be valid and adequately accurate, the sample size of the data needs to be large enough to draw reasonable conclusions.

One quantitative method utilized in this research is descriptive research. In descriptive research the data is analyzed and organized to present a summary of

the study variables. In other words, the research aims to describe what the studied subject looks like in a current real-life situation. In addition to descriptive research, the purpose of the study is to determine possible cause-and-effect relationships between variables that reveal points of improvement in the researched processes and ways of working. This method of organizing and analyzing data is a combination of correlational and experimental research.

5 RESEARCH DATA

5.1 Interviews

Due to strict non-disclosure agreements and the principle of anonymity, the raw interview data cannot be published as an appendix to this thesis. The interviews were recorded, and the data was analysed by the authors directly from the recordings. The interview sample size was five interviewees.

5.1.1 Goods reception and quality control

Even though the interview plan did not include questions directly linked to the goods reception process and quality control (see appendix 1), the topic was raised in all discussions. The discussions became often lengthy and thus the subject was decided to be discussed in this thesis as a separate entity.

The most frequent logistic operation conducted at OptoFidelity is goods reception. By goods reception process we mean a sequence of inbound logistics actions entailing collection and inspection of goods, ERP actions, cross-checking of content and quantity of the goods with packing lists, and the final quality approval from the DRI. The process begins with receipt of goods from the office reception or directly from the delivering courier. The process ends once the goods have been correctly received in the ERP and approved by the DRI. The goods reception process is described in appendix 2.

Many QMSs, such as Lean Six Sigma, focus on the control and continuous improvement of quality through analyzing processes. By defining the prevailing issues, and determining appropriate metrics for measuring quality, the organization can begin to implement changes to the processes to increase quality. As can be seen from the figure in appendix 2, there is no separate process for quality control within the goods reception process, only individual actions that contribute to quality control on a general level. The quality control in this process relies on the conscientiousness of the individual conducting the process. This approach is very much in line with the TQM ideology of holistic involvement of people. Unfortunately, it is not enough here as the individuals currently in charge

of goods reception do not have the needed competences or tools to ensure quality of goods at the desired level.

The quality requirements defined by OptoFidelity depend on the type of components in question. There are three main categories of components used by the company in the manufacturing of their robots: mechanical, electrical, and optical components. Each category has different quality requirements, some embedded in the component selection, and some in the design made by OptoFidelity's designers. The feedback and insights from the interviewees focused mainly on the mechanical components as they are designed by the company and manufactured by subcontractors based on CAD drawings provided to them. The drawings entail the exact dimensions and other features of the component, as well as tolerances within which the dimensions and features must be. Ensuring the tolerances and dimensions requires appropriate understanding of the measurements, which the designers and subcontractors have. Therefore, the designer or other DRI with suitable competences should inspect and approve the components once they have been received.

According to all interviewees, there is a visible lack of proper quality control. This lack can be attributed to shortage of resources. The designers who have the expertise to ensure quality are tied up in other work that is prioritized over goods reception quality control. Ongoing projects receive such a number of mechanical components on a daily basis that meticulous quality control would be a full-time job.

As mentioned before, the DRI for goods reception does not have the competences to ensure quality at this detailed level, and even though they have the resources in terms of time, they lack the needed skill. Here one solution would come from the TQM key principle of communication and education, where the ideology is to provide the employees with a versatile set of skills to root our competence-based mistakes and increase flexibility in the tasks an individual can conduct.

Some of the most prominent issues rising from inadequate quality control is delays and increased costs for projects. The quality issues with mechanical parts become visible typically at the assembly face of the project. Here the mechanic who is assembling the robot might for example notice that the component is not the right size, has screw holes or other features in the wrong position, or the holes do not meet the tolerance requirements. It might also be that the component is not compatible with another, which could also be a design flaw and an internal quality issue as well. When these kinds of defects are noticed at such a late stage of the project the planned schedule is compromised. With the typical lead times for machined components the project could be delayed by several weeks. This problem is often mitigated by paying the subcontractors more for fabricating the components on overtime or moving the order up in the queue. Frequent issues as described here cumulate to costs multiple times higher than budgeted for a project, which gnaws away a sizable portion of the profit margin. Such quality issues also tie up resources that could be used to advance other projects, sometimes causing a backlog of other issues in need of resolution.

Another aspect of goods reception quality control that causes problems is the accuracy at which the deliveries are cross checked. The process flowchart clearly states that all deliveries must be cross checked between the order in ERP, the packing list, and the actual content of the delivery. The part of the process, according to the interviewees, is often overlooked and not followed on the required level. Most of the interviewees recalled instances where according to the ERP all the necessary components were received as ordered, yet they were nowhere to be found or the wrong components. After some investigation it had turned out that goods reception cross checking was not conducted, and the components were received in the ERP incorrectly and the discrepancies were therefore not reported to the DRI.

This aspect of quality control, much like the inspection of the components, relies also on the individual without any control points incorporated in the goods reception process. The process of quality control cannot be analyzed to identify points of improvement as the process does not currently exist.

5.1.2 Warehousing

OptoFidelity's inventory is divided into two different main types: general stock and project stocks. In general stock, the company maintains a level of availability for common and widely compatible components ranging from off-the-shelf mechanical components, such as servo motors, linear stages, screws, springs etc. to general electrical components. There are some long lead time items and rarely used parts also stocked to ensure project schedules will hold. One current issue is that many of the projects are ad-hoc solutions tailored to customer needs which negatively affects the compatibility of stocked components to the designed projects.

The project stocks entail all parts and components needed to complete the project (the test robots). Some of the components are transferred internally from general stock, although typically most of the parts are sourced and purchased externally by the sourcing unit. The so called "shopping list" is based on the BOM provided by the designers, which is often divided to smaller sub-assemblies that have their own BOMs. The components in project stocks are typically stored on a movable pallet (from here on "project pallets"), some of which are organized by subassemblies, some by component type (mechanical, electrical, optical etc.), and some are not organized at all.

All interviewees noted that the project pallet warehousing style is problematic for several reasons. Firstly, they are poorly or not at all organized, partially due to lack of space on the pallet, partially due to lack of standardized processes. Secondly, as the pallets are open and not containers, parts and components get lost easily when the overloaded pallets are moved around or the individual in charge of goods reception misplaces them onto a wrong pallet. Thirdly, the pallets are difficult to move safely when overloaded with goods and some fragile components might be buried under a mass of heavy mechanical components, creating a risk of damaging the components.

An ongoing development is being piloted with some projects where the components are divided into stackable plastic containers based on either

component type or subassembly BOMs. This practice is expected to make assembly work easier for mechanics, and to decrease the risk of components being damaged or lost.

In general, the project pallet warehousing is seen inefficient and risky. At times, due to lack of clear processes parts are taken from the project pallets without permission or appropriate ERP actions, causing a discrepancy between ERP stock level data and the actual content of the project pallets.

Despite the downsides of palletizing the projects, the practice has prevailed as the company's current facilities do not support more efficient production warehousing solutions. Also, the pallet system has been left intact due to resources not been allocated to design a more efficient solution that would fit the limitations of the facilities.

The theme of limited space causing problems echoes also to the general stock. The current warehouse used seems to have too little capacity to hold the currently stocked items. Cramped space and overloaded shelves make locating items very difficult, especially since there is no WMS in use, besides the ERP system that holds stock level data, goods reception, and transfer functions. According to one interviewee, the items have been organized inefficiently. The organization is based on component types, but an inefficiency is caused because similar parts within a category might be placed on the opposite sides of their section in the warehouse, making the inventory more scattered than it should be.

Insufficient warehouse capacity disables the company to stock all necessary and critical components as other items assume the space on the shelves. With the current component shortage, it is crucial that critical long lead time items are stocked to ensure schedules to be airtight on the hardware side of production. Due to low level of automation and scarce resources to conduct manual tagging in the ERP the visibility to crucial component lead times is low. Another issue affecting the accurate stocking of crucial components is high variance in the components used in the company's products. Low modularization and harmonization of the component range has inflated the ERP product catalogue

with one-time-use and ad hoc components. Due to this and low capacity of warehousing space there is no point of stocking long lead time machined and other mechanical components that often cause the project schedule to become tight with little room to unexpected delays.

There is an effort being made towards higher degree of modularization and harmonization of the designs, but the work is slow and requires more resources from all departments than they can spare.

Another point of improvement mentioned by all interviewees was the accuracy of stock level data maintained in the ERP. Stock moves and transfers are logged into the system manually, and even though there is a process in place to ensure all stock moves are logged there are many discrepancies distorting the stock level data. Based on interviews and observations, the issue is that mechanics, designers, purchasers, and other personnel picking items from warehouse do not follow the process. Currently, people, mainly mechanics, picking components should fill in a small tag/label indicating which item was picked and what the target project was, and the logistics assistant then creates the transfer in the ERP. The process does not seem to be efficient and lean enough to be followed correctly, and also lacks strong enough control. The control could be increased in numerous ways, either by moving the rights to pick items from mechanics to the logistics assistant or by other means, such as implementing a WMS that enables automated transfers in ERP and supports better warehouse infrastructure. Each of these solutions faces the frequent problem of resourcing, either monetary or personnel.

With the current process, the stock levels are not checked and updated to the ERP on a sufficient interval. The inventory is updated twice a year, which is not in line with the volume of transfers made, leaving a significant data gap. The low visibility created by this issue has a detrimental effect on purchasing accuracy and causes component shortages in the general stock. It also generates redundant work for the sourcing unit, as each component transferred in the ERP by purchasers must be physically checked to exist in the general stock.

Discrepancies between ERP data and real life leads to small batch purchases increasing costs per unit and shipping costs.

5.1.3 ERP

One of the main purposes for a company to have an ERP-system is to ease and increase the efficacy of the day-to-day supply chain operations. However, for the effective usage of the system it is crucial that all the stakeholders possess adequate knowhow to operate the system. (Finch, 2021). For this reason, it was seen important to ask the interviewees about their overall experience and competence to use the company ERP-system.

The interviewees were asked about their general experiences of using the company ERP-system and the answers varied mainly based on the position of the interviewee. Whereas project managers who use the ERP-system significantly less see it as a complex and non-user-friendly system, designers find it easier to use due to more exposure and user experience. All the interviewees also stated that all the ERP-system's functionalities are not fully know to them which raised a question if the full potential of the ERP-system is being utilized. According to the designers, different degrees of access rights for ERP's functionalities causes inefficiency to work, for example resetting purchase request must be done by the purchasers. Also, the project managers stated that some mandatory parts of the purchasing process are redundant for their effectiveness to work. The need to create purchase requests was seen difficult and inefficient by both responding project managers as they create them so rarely it takes more time to find the instructions than to create the PQ.

The interviewees were also asked about how they see their competence on using the ERP-system and even though all the interviewees had received some training for the ERP-system in the past, all of them stated that they would like to receive more training to increase their competence. Need for role-specific tailored ERP training sessions was also raised by all the interviewees.

5.1.4 Product management

In this interview, product management has a twofold meaning, one focus point being the components used in OptoFidelity's testing systems. These components are referred to as PR-codes, the term deriving from Odoo ERP which entails the component catalogue listing all components used in the systems.

The second focus point is the testing systems themselves. At the time of the interview, OptoFidelity had a handful of test systems designed and delivered that shared enough similar features, both in design and function, that they could be loosely referred to as products opposed to ad hoc or custom systems.

The interviewees were asked about how they see the product management in OptoFidelity, and two different points of view were clearly risen. Again, based on interviewees position in the company. Designers talk about product management on component level where project managers clearly view the bigger picture and see that the product is the whole testing system instead of single component. From both points of view, it was seen that the general product management is inadequate.

When looking at the ERP point of view of product management the interviews noted clear inconsistencies in a way of how PR-codes where created and managed. There has been varying degree of compliance with the instructed minimum information on the product card and for example how products are named. Both project managers and designers questioned the accuracy and availability of instructions in the matter.

On the testing system view of product management, one of the project managers pointed out that general ownership of the products is unclear as well as from the design point of view. It was also mentioned that the technical expertise of different testing systems is behind very limited number of people and ownership of design and structure is very unclear or inexistent which in case of absences or people leaving the company might cause problems.

While asking the interviewees about the responsibilities of the product management both designers and project managers felt that it is unclear how the responsibilities are divided and that the matter would require further discussion and clarification.

Both designers and project managers also raised a concern about state of BOMs in ERP-system. All of the interviewees felt like BOMs are not up-to-date and complete which impairs the traceability of the projects progression and causes incorrect purchases.

As a follow-up question to traceability, interviewees were asked how they feel about OneSightView which is a Odoo ERP tool that gives the user centralized view of the status of given project. While all of the interviewees felt that OSV is a good and useful tool, some concerns were raised if the full potential of the tool has been utilized, for example would it be possible to track subassemblies as well?

5.1.5 Subcontracting synergy

OptoFidelity has several subcontractors involved in their operations. The subcontractors can be divided into three distinct categories: subcontracted employees, subcontractors for component fabrication (machining, sheet metal, 3D print etc.), and manufacturing subcontractors. In the interview, the discussion focused on the last category.

The company is in cooperation with three different subcontractors that manufacture the testing system either completely or partially. Two of the subcontractors are in Estonia and the third in Finland. There are distinct levels of synergy between each of the subcontractors and OptoFidelity. With the Finnish subcontractor, OptoFidelity has a long history, and the companies have a very robust relationship. This is partially also because they are located physically in adjacent buildings and share some of the premises. With one of the Estonian companies, OptoFidelity has also had a long-lasting relationship and many of the testing systems are manufactured completely by the subcontractor. The other

Estonian subcontractor is a new partner, and the transfer of certain testing systems manufacturing to them is ongoing.

Based on the interviews, the synergy between each of these subcontractors and OptoFidelity is on a good level. Communication works well and there is a bilateral trust between the stakeholders. As mentioned, there are various levels on synergy. Not all of the subcontractors have access to OptoFidelity's ERP system, which has created a need for effective transfer of data between the companies. Not so long ago, a new reporting tool was taken into use with one of the Estonian subcontractors. It is a weekly updated excel-based "manufacturing plan" that provides up-to date visibility on ongoing projects. The plan has an overview sheet with all open projects listed with projected delivery schedules. Additionally, each open project has their own sheet for open component orders with their projected delivery dates to the subcontractor. Problematic components (long lead time, faulty components etc.) have been flagged so that OptoFidelity's sourcing unit can support sourcing of those components when necessary. This reporting tool has been highly praised by the sourcing unit, project managers and several mechanical and electrical designers.

The manufacturing plan described above has proven to be effective way of transferring data when the subcontractor has no access to OptoFidelity's ERP system. An effort is being made to implement a similar solution with the other Estonian subcontractor. This implementation would be beneficial to all stakeholders and would promote standardization of reporting and processes within OptoFidelity's sourcing unit.

Some of the interviewees raised an issue with the synergy of the Finnish subcontractor and OptoFidelity relating to the visibility of goods flow. Even though the subcontractor has access to OptoFidelity's ERP, they do not follow the same goods reception process that was described earlier. Additionally, the goods are mostly delivered to OptoFidelity's premises from where they are transferred to the subcontractor on demand. The subcontractor also orders components by themselves, and a problem arises as OptoFidelity does not have visibility to their purchases. These logistic and data related issues have caused components to

be misplaced and missing at the time of assembly, causing at times significant delays. There is a current development effort made to redesign the purchasing and logistic processes with the subcontractor to eradicate these inefficiencies and ensure better visibility between the stakeholders.

A common unclarity noted by the interviewees was the division of sourcing responsibilities between OptoFidelity and its subcontractors. The same principle with the division of responsibilities applies to all subcontractors, where the subcontractors have full sourcing responsibility in general, but OptoFidelity's sourcing unit supports and sources components when needed. This is usually done by sending long lead time components and certain circuit boards or other components designed, modified, or fabricated by OptoFidelity to the subcontractors. Alternatively, OptoFidelity utilizes their own vendors for ordering components, as they have better agreements with some vendors. Also, OptoFidelity uses different vendors than its subcontractors, which in turn results in different lead times. This knowledge of vendors, agreements, and responsibility division is not communicated clearly enough with OptoFidelity's designers and project managers, causing unnecessary communication, misunderstandings, and other inefficiencies during the projects.

Another point of improvement, especially applying to the synergy between OptoFidelity and their newest Estonian subcontractor, is consistency and quality of documentation. As this new subcontractor is in the start of manufacturing somewhat intricate testing systems, it is OptoFidelity's responsibility to provide accurate and up to date manufacturing documentation. The documentation involves mechanical and electrical BOMs, CAD drawings, and assembly instructions. Not all of this documentation has been at the desired level, which has caused delays in manufacturing schedules and quality issues with the fabricated systems. The problems with BOMs have been tackled to an extent by providing the subcontractor access to OptoFidelity's PDM where the structure and drawings of the systems are up to date and changes update in real time. This has not eradicated all problems as the designs might not always be fully completed by OptoFidelity's designers.

One of the interviewed project managers noted that the process of commissioning manufacturing of newly designed systems to subcontractors has often been backwards. By this they meant that the design was made partly in tandem with the manufacturing, causing design flaws to be noticed too late. This in turn has caused some redesigning of already manufactured sub-assemblies which sets the schedule back significantly. The project manager stated that the process should be reversed and the designs along with the appropriate documentation need to be as fully finalized as possible before commissioning the work to the subcontractor. The interviewees also stated that a higher level of standardization in the process is called for as different PMs have diverse ways of undertaking and planning the projects. This inconsistency is often reflected to the work of the subcontractors.

5.1.6 Processes and standardization

At the time of the interviews, projects managers stated that standard processes related to project management are not unified or strictly followed amongst the managers. It was even said that there are no processes whatsoever. This statement is based on experiences of lacking unity in the ways of working. It was argued since there are no standardized nor documented processes or roadmaps for project execution. The company has provided some higher-level guidelines and project management tools, such as Jira software, with project planning templates. However, there is no single standard template that would be used across all projects and accounts, the responsibility of either choosing or drafting a template lies on the shoulders of the project manager.

According to all interviewees, the processes that are somewhat in place are not commonly followed. Everyone also noted that the processes themselves call for improvements and updates but above all there was a clear consensus that the underlying issue in not following the processes is the company culture.

5.1.7 Unity in ways of working

When asked if the interviewees knew how their colleagues organize and execute their work, all the interviewees stated that they do not know and felt their work is rather compartmentalized with low visibility to their colleagues' ways of working. It also became apparent from all interviews that each team had not benchmarked their ways of working, at least not in a structured and appropriately facilitated manner.

As an exception to other departments, mechanical designers have an active group of people raising issues that they feel need attention. These individuals are acting on their own initiative rather than developing their ways of working through organized and structured models, such as DMAIC for example. The development ideas and actions are heavily depending on the individual motivation of the designers. Active implementation of ideas is typically left on a discussion level as the designers would have to make changes without resource allocation mainly on a volunteer basis.

The interviewees felt that even though there is a clear need and, to an extent, motivation to actively develop and implement improvements, they have no resources to act on their ideas. Continuous development, and the lack of it, is seen as a resourcing issue by the interviewees.

5.1.8 Other discussions

During the discussions, material traceability rose as a topic with all interviewees. The participants noted that with the current tools and processes the transparency of material flow calls for improvements. OneSightView was mentioned in all discussions, and it became apparent that everyone was not as familiar with it as they should be. The tool enables users to, as the name suggests, follow project related material availability in one view in the Odoo ERP interface.

OSV was implemented in the ERP system to make following material flows easier for stakeholders but as the interviews indicated, it is very underutilized. The

interviewees circled back to the point of not having all BOMs and structures on the level they should be as the main reason OSV is not commonly used in projects. This reflects as an alarmingly high number of incorrect or duplicate purchases which has a notable effect on the profitability of the projects.

These discussions raised a question whether the OSV tool could be better utilized in projects by making it a part of a standardized project execution process and planning. As mentioned above, all participants mentioned they would find additional training in the use of Odoo ERP and its functionalities helpful. Additional training with focus on the use of OSV would most probably increase the level of OSV utilization significantly, according to the interviewees.

5.1.9 Sourcing unit and processes

The participants who had several years of experience in OptoFidelity noted that the sourcing related processes and ways the sourcing unit operates have improved in the past couple of years. However, all interviewees agreed that further improvements, especially in terms of transparency and traceability of purchases and material flow are called for.

One notable aspect of transparency was raised as a pivotal point of improvement: sourcing unit's internal communication and handover of tasks. During absences and vacations, sourcing team members take over the tasks of their absent colleagues and especially in cases where the absence has been known in advance, the interviewees felt like the tasks were not handed over very well. This lack of communication has led to several situation where the project team members have had to explain and instruct sourcing team members on the same tasks several times. In effect, this has consumed valuable resources of both, the sourcing team, and other members of project teams.

In addition to internal communication, many of the participants made a note of the external communication. In these volatile times in the component market, many orders placed by the sourcing unit have changes over the exceptionally long delivery times. The interviewees felt that these changes should be brought

to the project's attention more effectively and above all actively. Although the order data is stored in the ERP and is visible to all stakeholders, the interviewees felt that the current ERP system does not support transparency and ease of following up in a way that the system alone would suffice. Hence, the participants made clear that they would prefer more direct communication regarding the subject from the sourcing team. This view was shared by most of the interviewees, although a minority of the participants stated that the current level of external communication is enough. Based on answers to some follow-up questions, it could be concluded that the experiences of communication effectiveness were also, to an extent, dependent on the member of the sourcing unit the participant had worked with.

When asked about their knowledge of the sourcing team's work, responsibilities, and processes, the interviewees depicted variable levels of understanding. All participants were able to describe the purchasing process on a level that is appropriate to their position and works description, although none were able to describe the process on the level of detail it is represented in the quality manual.

None of the participants had a complete understanding of all the tasks the sourcing unit is responsible for. For example, some of the admin and logistics related tasks came as a surprise to some of the interviewees. They had significantly lower level of understanding of the division of these responsibilities within the sourcing unit, such as that the sourcing unit works based on customer accounts. The interviewees were asked would they find useful to have better understanding of the work division, and the general view was that it would be helpful, as it would reduce the number of times as well as points of contact to the sourcing unit. According to the interviewees, clarity to who is responsible for each account would increase the efficiency of project purchases and communication.

All interviewees made positive remarks of the approachability and response time of the sourcing unit. They felt that all team members are easy to approach, helpful and friendly. Every one of the interviewees also praised the sourcing unit's response time to their PQs and felt that there is not much room for streamlining

the response time as their requests are addressed typically within the same workday with only a handful of exceptions.

5.2 Purchasing process

By purchasing process, we mean the sequence of actions that take place for various sourcing and acquisitions of components used in the manufacturing of our products. In this context the purchasing process begins with the creation of a PQ and ends when the goods are received correctly in the ERP and approved by the responsible stakeholder.

The goods reception process is included as a part of the purchasing process but will be described, discussed, and analyzed separately later in this chapter.

In OptoFidelity's ISO9001-2015 documentation the purchasing and goods reception processes are sub-processes under the umbrella terms "sourcing process". The input for sourcing process is sales targets and received customer orders, and the output is requested materials received.

5.2.1 Current purchasing process

The purchasing process chart can be found in appendix 2.

The current purchasing process is designed mainly based on the activities flow of Odoo ERP. The input for project purchases process is a need from design department and the output is correct components in the correct place at the correct time. This process represents only project purchases, although for example stock replenishment purchases follow the same logic. Indirect purchases are mostly done outside the ERP environment and therefore do not fall under this process. This thesis focuses on project purchases process (purchases process from hereon) as stock replenishment and indirect purchases processes do not fall under the scope of ISO9001-2015 certification.

The purchasing process can be divided into three distinct stages which are the PQ that serves as the process initiation, the second stage is the actual procurement, and the final stage consists of order follow-up, goods reception, and purchase closing.

The first stage, as in indicated in , involves the PQ creator , who most often is an electrical or mechanical designer, or optical engineer. After the purchase request has been approved, the purchase representative takes over the activities by firstly checking component availability from the ERP and if needed carrying out the internal stock transfer process.

The second stage partially overlaps with the first stage, as the purchaser, in addition to checking internal stock availability, inspects the requested PR codes for known vendors and data accuracy. As OptoFidelity designs but does not manufacture some components, the buyer must gather needed technical drawings and other related documents to provide the vendor with them. At this point the buyer must make the first decision in the process, which is determining whether the requested components should be tendered.

Should the buyer decide to tender the purchase, they send an RFQ document together with the technical drawings to one or more vendors. After receiving quotes, the buyer typically consults the PQ creator to establish the parameters for making the best purchase decision. In practice this means weighing which is more important, the delivery time or the costs of the components. Of course, other factors must be considered, such as the vendor’s capability to provide measurement reports for example. After possible consultation, the buyer comes to the second decision of the process; purchase decision. Alternatively, the buyer can choose to make the purchase decision without tendering, which means that instead of an RFQ document they would send the selected vendor a PO document directly.

The purchasing process mandates that for each purchase, there must be an order confirmation. The order confirmation, provided by the vendor, acts as the data source. It contains all essential information that needs to be logged in the ERP

system. In order for the buyer to confirm the purchase in the ERP, they must have physical evidence, i.e., the order confirmation, of confirmed delivery date, pricing, vendor's sales order number, and vendor contact information. The order confirmation is to be stored as an attachment in the ERP system under the purchase order it is related to.

In the final stage, the buyer is responsible for following up and communicating with the vendor and relaying any essential information to the PQ creator and the project team. Once the ordered goods arrive, they are received physically and also in the ERP environment according to the goods reception process. After the goods have been received and an invoice is available, the buyer performs factual verification to the invoice and submits it for approval by finance department, which will organize payment. After the factual verification and required ERP data inputs the buyer will lock the PO in the ERP and the purchasing process has finished.

Some crucial steps can be identified in the purchasing process that have an imminent impact on the project execution. One of the most prominent one is the data input. As it stands, Odoo ERP does not offer automation in the data input, and it is done manually by the buyer. In effect, the human factor has an integral role in the accuracy and availability of the data projects use to support planning. Should the buyer neglect their responsibility of upkeeping the data in the ERP, the projects will be relying on information that is incorrect. This can, in worst cases, cause significant delays in project deliveries, as for example assembly resources are reserved based on the availability of materials and in OptoFidelity's tight schedules the assembly resources might not be available if the materials are available later than the project expected.

Related to the data input is the order confirmation, an integral factor in the data accuracy. At times, accuracy of the order confirmations is an external risk, should the vendor fail to provide an order confirmation or not communicate changes to it. The role of the buyer here is to follow up on the purchases and verify the accuracy of the order confirmation. This is most often done only with long lead time orders or components gating further project activities, for example assembly or testing.

Finally, a crucial step in the purchasing process is checking the available stock. In these exceptional times where even standard components might have a lead time up to a year, OptoFidelity stocks some essential items. The stock is replenished based on forecasted needs and projected lead time to reduce the risk of delays caused by material unavailability. If the buyer does not check available stock in the beginning of the purchasing process, the project faces a risk of delays, unnecessary re-design work, redundant purchases and in effect unnecessary costs.

The current purchasing process together with the ERP environment poses a number of risks and challenges that must be considered. As mentioned before, the current component market is unstable and subject to rapid changes in pricing as well as lead times. These external risks can be mitigated with careful warehousing and stocking of essential components, which itself is challenging to upkeep with current ERP features. Odoo ERP theoretically supports automatic stock replenishment and forecasting, as well as alarm thresholds for stocked components. In practice however, these features are largely unavailable due to the complexity of the environment, caused by excessive tailoring and ad hoc solutions that create unanticipated dependencies in the parameter logic.

The ERP environment, as can be seen from the process analysis and description, requires an abundance of manual labor to upkeep data accuracy. As this accuracy derives from the individuals operating in the environment, errors are unavoidable. This poses yet another challenge for the sourcing unit, as the complexity of the ERP environment makes error correction extremely difficult, sometimes even impossible.

When such errors are identified, it crucial that the buyer can effectively communicate and provide transparency to the actual situation. There are many communication channels where the buyer can inform the related stakeholders but due to low level of unity in project execution and practices, no standardized way of transferring information has been established.

As the OptoFidelity's projects are often time consuming, yet on a tight schedule, and require tens, sometimes hundreds of purchases to be completed, it is very challenging for the buyer to prioritize which purchases should be followed up. This work could be automated or transferred to a vendor if the ERP environment allowed it. As stated, Odoo ERP does not support such solutions, so therefore it is up to the buyer and the project team to define crucial purchases that need to be monitored.

Scheduling of projects reflects directly to the work required from the sourcing unit. At times, the buyers are requested to source components in a time frame that I virtually impossible as the designs might take longer to be finalized than what the component lead times are. This can cause a situation where component purchases are requested with technical drawings that are not completely finalized or require last minute modifications due to other design factors. In these cases, buyers are put into a pressing situation where time is of the essence to provide updated documentation to vendors before the originally ordered components are manufactured. Such tight schedules also lead to challenges in organizing and consolidating the purchases to reduce overall costs.

Despite the challenges, the purchasing process has been honed to a manageable and as streamlined form as possible. From ISO9001-2015 point of view, the process has documented mechanisms in place that help to mitigate the risks that the challenges generate. The ISO9001-2015 standard does not require the process to be perfect and free of risks, rather than that the process is clearly documented, and risk management has been considered.

To develop and improve the purchasing process, the sourcing unit must actively share best practices and make the most of the current ERP environment to further mitigate known risks. The authors' proposed actions and improvements are further discussed in chapter 6.

5.2.2 Goods reception process

By good reception process we mean a sequence of inbound logistics actions entailing collection and inspection of goods, ERP actions, cross-checking of content and quantity of the goods with packing lists, and the final quality approval from the DRI. The process begins with receipt of goods from the office reception or directly from the delivering courier. The process ends once the goods have been correctly received in the ERP and approved by the DRI.

5.2.3 Current goods reception process

The goods reception process chart can be found in appendix 2.

Similarly to the purchasing process, the goods reception process is constructed to reflect the ERP environment. However, the characteristics of OptoFidelity's facilities have an impact on the process design.

The process, much like the purchasing process, can be divided to three distinct phases, the first one being the physical collection of goods from either the warehouse backdoor or the building reception. Each option requires some form of acknowledgement of the collection, either on a pen-and-paper type of list or an electronic receipt. The collection of goods is closely linked with organizing the received packages so that the reception and inspection becomes as smooth as possible.

The second phase, following the collection and organizing, consists of ERP activities, inspection, and quality control of the goods. The first step is to open each package and perform a visual inspection to ensure that the packages and their conditions are in acceptable condition. Any defects or damages must be reported to the purchaser and the quality tracking list at once.

Once the visual inspection has been done, the PO corresponding to the shipment being received will be searched from the ERP. The PO will be cross-checked with the packing list accompanying the shipment, as well as with the actual contents

of the package. Any discrepancies in part numbers or quantities are clearly marked on the packing list which will be delivered to the buyer responsible for the order after the goods reception process has been finished.

After cross-checking the PO, packing list, and actual contents, the goods are received in the ERP system. This ERP reception is always done according to the actual contents of the package received. The ERP will then record the goods as received in the location determined on the PO and the items will instantly show up in the inventory of that location.

The final phase of the goods reception process focuses on making the items physically available in the correct location. Firstly, the good will be labeled with the correct PR-code to help engineers and technicians to identify the parts. Secondly, they are packed in a way that, for example small items, the gods are easy to store on project pallets. In some cases, if previously instructed, the parts are measured for pre-determined aspects, such as dimensions, distance between holes, or size of threads. Any required measurements can be found on the technical drawings of manufactured components, or they are otherwise instructed in writing, for example in an email.

Once the goods have been labeled, measured, and packed appropriately, they are delivered to the location determined on the PO. The locations vary depending on whether the order was for a project or a stock replenishment. Project materials are mainly stored on project pallets. Project pallets consist of a EUR pallet base and pallet collars, and the pallet is clearly marked with the project number. The pallets are typically placed near the assembly area where the tester is being built. Alternatively, the pallets are stored in the workshop on pallet shelves, which is typical for projects that are in an early phase and no assembly work has been done yet.

If the project does not have a pallet, the goods will be delivered to the shelf in the mail room where goods reception is conducted. If the received goods are stock replenishments, the logistics assistant places them in their correct positions in the general stock storages.

Finally, when all of the goods for the day have been received according to the process, the packing lists, with notations of either everything being as ordered, or with discrepancies, are delivered to the buyers for archiving.

Even though the goods reception process is relatively simple when represented as a process chart (see appendix 2), the actions require keen attention to detail, and is mainly manual in the ERP environment. The material flow in OptoFidelity's goods reception is disproportionate in comparison to the available floor space in the mailroom, posing a challenge in the organization of the work.

Crowded shelves and work benches cause mistakes in the goods reception process on regular basis. With little room available to inspect and cross check the packages increase the risk of mixing up orders, missing items, and misplacing components. This combined with the human factor that comes with extensive manual data input causes more mistakes in the reception than wanted.

As the current ERP environment requires the goods reception to be manual with every order line having to be separately clicked and validated as received, the work is very time consuming. Any mistakes during the process cause on estimate double time consumption, as the mistakes are extremely difficult to correct in the complex ERP logic. Even if a mistake has been corrected, the data is often distorted in a related ERP interface due to high customization of the environment that causes interruptions in data transfers and dependencies within the system.

The goods reception process also faces challenges related to competences. With the objective of identifying and reducing quality issues, the process entails the beforementioned quality inspection steps. However, at the moment not all of the aspects of the quality can be inspected by any employee receiving goods. Even with measurements required to check being in writing or especially in the technical drawings. In order to take the measurements and understand the results, the individual performing the inspection must have some understanding and competence on how to decipher the technical documents.

Additionally, for high precision measurements, the receiver of goods should have access to high precision measurement instruments. Currently, OptoFidelity is in the process of determining and acquiring the needed instruments. In addition to acquiring the instruments, people conducting the goods reception process must also be trained to use them.

5.2.1 Correlation to ISO 9001 standard

As earlier stated in this thesis, the ISO9001-2015 standard does not require a full quality manual. However, the standard mandates that the processes and practices in place must be documented and made available to all necessary stakeholders and auditors. OptoFidelity's sourcing related processes have been designed and represented to reflect the real world. In other words, the sourcing unit practices what they preach, and project purchases as well as goods reception follow the above-described processes. The process charts are included in OptoFidelity's quality and processes documentation in their intranet, where they are available to anyone with access to intranet. This material is also used in the first and second ISO9001-2015 audits conducted by a third party. The processes are also included in the quality manual produced as a part of this thesis, as commissioned.

The ISO9001-2015 standard places a notable emphasis on continuous improvement. The quality and process development plans must be clearly documented and made available, same as the processes themselves. As a part of this plan, sourcing unit's processes, both purchasing and goods reception, will be reviewed twice a year by the process development team consisting of company management and all process owners whose processes are in the scope of the ISO9001-2015 certificate. Additionally, the sourcing unit actively observes the efficiency of the processes in their day-to-day work, and raises issues, development ideas, as well as best practices in team meetings and workshops.

6 DISCUSSIONS

6.1 ISO 9001-2015 certification

OptoFidelity is currently in the process of being certified with ISO9001-2015 quality standard. A third-party consultant has been mapping out the status and needed changes in documentation, processes, and quality management principles function by function. At the moment, the certification process has passed the first audit round, which evaluates the company's readiness for the actual audit, followed by the certification itself.

In the workshop where the sourcing unit's readiness for ISO9001-2015 certificate was evaluated, the consultant, who has previously worked as an ISO certification auditor, pointed out three things that required actions: process ownership, quality issues monitoring and reporting in the goods reception process, and vendor evaluation form scoring.

As the output of the purchasing process, and the related goods reception process, becomes visible for the end customer in the lead time of deliveries as well as quality of the products and services, it is essential from ISO9001-2015 point of view to name a process owner for these processes. By doing that, the company has an individual who is directly responsible for monitoring the quality and efficiency of these processes. Additionally, the said individual is also in charge of making sure the processes are evaluated, updated, and developed continuously. Continuous quality and development plans have been documented to the company intranet, and for the sourcing unit this means that the processes, vendor evaluation forms, and the quality manual are available to be used for the ISO9001-2015 audit, as well as any employee. Furthermore, the sourcing processes owner will participate in a process development meeting twice a year, where the management and process owners review and decide on any development needs or actions regarding the company processes.

The second point of action identified by the consultant was the need for quality issues reporting. Quality monitoring is already included in the current goods reception process, and it is being developed further by OptoFidelity. However, there is an apparent lack of reporting of identified quality issues. The sourcing unit has thus far utilized an Excel sheet where vendor based and design flaw quality issues causing project delivery delays to have been listed. Based on internal team discussions, the list has not been actively used by all members of the sourcing unit. Therefore, the consultant proposed to devise a different reporting tool where any and all quality issues identified in the goods reception are reported. This tool would include essential information related to the issues, primarily the vendor. This way the frequency of quality issues per vendor would be easily tracked and used to support future vendor agreement decisions. The proposed actions were reacted to by creating a quality monitoring sheet and implementing an action point into the goods reception process. The process was reviewed and approved by management, and it passed the first ISO9001-2015 audit round.

Finally, the third point made by the consultant was the way the current vendor evaluation form is supporting vendor decisions. Currently, the form gathers information of vendors' perceived quality. The vendor filling the form is asked to describe their quality principles and provide information of possible certifications, for example ISO9001. As it stands, the form only gathers information but does not provide a clear metric. Hence the form, according to the consultant, should be changed so that a scoring element would be incorporated. Additionally, a clearly defined metric should be decided to support vendor agreement decisions, so that a minimum score limit would determine whether the vendor meets OptoFidelity's quality requirements or not. The vendor evaluation form update and scoring system are work in progress but not yet finalized. The work is to be completed well enough before second audit round so that the management can review and approve the tools.

Besides these three points, the consultant did not identify any further actions to be taken and described the sourcing unit's readiness for ISO9001-2015 certification to be on a satisfactory level. This statement was proven correct in the

first audit round by a third-party auditor. The initial audit gauged the company's documentation of their QMS and readiness for the second, actual audit. Based on the feedback from the first audit, sourcing unit's processes and documentation were on an acceptable level and ready for the actual audit.

6.2 Proposed further improvements

This chapter discusses about proposed actions for further improving sourcing unit's ways of working. The proposed actions are based on information gained from observation and interviews. The authors are experts through experience in the sourcing unit's operations and this expertise is utilized in proposing future development points. Additionally, the authors base some of the following arguments on day-to-day discussions with their colleagues as well as their insights.

6.2.1 Onboarding & continuous training

As previously mentioned in introduction chapter, OptoFidelity has rapidly grown in past years while the onboarding process has remained the same. As a part of OptoFidelity's ISO9001 project need for updated onboarding process and continuous training was identified.

The research showed a need for two different onboarding paths: one for part time and short-term employees such as summer trainees, and one, more extensive, for permanent or long-term fulltime employees. This is due to the vast amount of tasks sourcing unit is currently responsible for. Having the summer trainees and seasonal workers focus on more routine tasks, such as basic purchasing and factual verification of purchase invoices, would free time for more experienced sourcing unit members to focus on more demanding tasks.

The interview data also stated that training across different functions would be beneficial for the whole company, meaning that for example designers could teach sourcing unit members about basics of mostly used commercial electric components and how to interpret technical drawings. This would save time from

both sourcing unit members and designers decreasing unwanted interruptions caused by double checking and consulting.

Lastly, personal workflow management of sourcing unit could be improved by holding internal ‘tips & trick’ sessions from time to time. These could include discussions how for example different members of the sourcing unit track their purchases in the ERP-system and how they handle to-do lists and disruptions. Furthermore, to support and add value to the internal sessions, a retrospective debriefing would be called for. In the debriefing, a particular project or aspect of the sourcing unit’s work would be examined and analyzed based on the team members’ experiences and leanings. Additionally, the authors propose workflow management workshops facilitated by third party experts to better support the sourcing unit in the hectic and ever-changing work environment they operate in.

6.2.2 Sourcing unit’s tasks

For the sourcing unit’s tasks, the research indicated a need for narrowing down the number of tasks carried out by team members due to company’s growth and increased number of projects, to advocate focus, to increase the expertise, and lessen the number of overlapping tasks of different team members. (Anon., 2022)

During the writing process of this thesis several changes has been made to the roles and responsibilities of the sourcing unit’s members. As the amount of subcontracting has been steadily increasing, one of the unit’s members has taken a role of a subcontracting liaison acting as a link between OptoFidelity and its manufacturing partners. Second clear addition to responsibilities has been the harmonized components system where standardized list of components to be used in all OptoFidelity test-systems were compiled to deal with challenges in component availability. A member of the sourcing unit is facilitating bi-weekly meetings with colleagues from different technology teams and management. And finally, the role of vendor management and frame contracts has been elevated to help to meet the requirements of the ISO 9001 and further tackle the component availability issues. Although all the roles are eventually meant to ease the overall

workload of the whole unit, they are still addition to the existing list of tasks of individuals directly responsible of them (Anon., 2022).

OptoFidelity has already taken actions towards this proposal and for example handing over finance related tasks, i.e., factual verification of purchase invoices and sales invoicing has been made and are in progress.

Also, gradual shift towards product-based purchasing instead of project-based purchasing has already initiated as well. Products in this context refer to standard test systems OptoFidelity manufactures for their customers. This shift in purchasing is to enhance certain purchaser's knowledge and understanding of the product in question and to increase the cost-efficiency of the purchases when multiple copies of the same test-system are built simultaneously. Previous way of account-based purchasing has caused overlapping in the purchases partly due to lack of knowledge of the manufactured test system and inadequate internal communication in situations where several accounts have ordered the same product around the same time.

To further streamline and make the sourcing unit's tasks more efficient, the authors suggest utilizing the DMAIC method to target specific tasks, parts of processes, and ways of working. DMAIC would enable the team to continuously improve their work in increments that can be carried out amidst day-to-day work, thus saving resources as opposed to a more extensive reform of processes and ways of working.

6.2.3 ERP Upgrade

As the interview data indicated, the current Odoo ERP is not anymore sufficient for OptoFidelity's use. Many points have been made as to why the ERP system needs to be changed and most importantly updated.

From design, both electrical and mechanical, point of view, one of the main issues has been that Odoo does not have a direct integration with the company PDM

SolidWorks. Earlier a decision was made to move from SolidWorks to Aras PLM, which better supports the company's ongoing modularization project. OptoFidelity is designing various modules that can be combined in several variations to reduce ad hoc design work and redundant, repetitive re-selection of used components.

Several other functions have made their case to upgrade the ERP system with arguments varying from lack of system integrations to limited features, disproportionate tailoring and upkeeping hours in relation to the generated added value, and the amount of manual labor required to keep data up to date.

From sourcing point of view, the upgrade is called for due to extensive manual data input work in current ERP, rigid data transfer from PDM, and difficulty of providing transparency and traceability to purchases and material flows. (Anon., 2022) As indicated previously in chapter 5, the ERP environment's extensive ad hoc solutions cause interferences in data transfers, dependencies, and general data management. Due to these interferences and complexity, correcting errors and mistakes in made during various ERP processes is very difficult, resulting in discrepancies and inaccuracies in the data.

During the process of writing this thesis, the company decided to change the current Odoo ERP system to another system, and the selection process is ongoing. Two members of the sourcing unit are actively participating in the selection process by relaying the sourcing unit's requirements, needs, and wishes regarding the features of the ERP. It has also been agreed that these individuals will be engaging in the implementation of the new system once it has been ordered. This has been received with positive feedback as sourcing is one of the unit's most heavily using the ERP and is also responsible for training other functions to its use. A member of the sourcing team is also named as the admin user for the ERP system which also advocates their active participation in ERP selection and implementation.

The sourcing unit has provided the ERP project team with three tier functionality and feature requirement list. The tiers are minimum viable product, preferred

features, and nice to have. All requirements are mainly related to reducing manual data input through connected interfaces, supplier access to the system, and some degree of artificial intelligence utilization. Another prominent aspect in sourcing unit's requirements is increased automation for purchases, logistics, and warehouse management.

Based on preliminary quotes and demonstrations from different ERP service providers, nearly all of sourcing unit's requirements can be met with the proposed solutions. The ERP project team, which sourcing unit representatives are a part of, has been active in discussions to settle on a solution that would meet every function's requirement without bulldozing over any unit's needs.

6.2.4 Minimum requirements to begin project purchases

From a sourcing point of view, the minimum requirements to start the projects purchases have a clear need in sense of saving time across the different departments of OptoFidelity. This chapter focuses on discussing these matters.

To begin the project purchases it is important to have the purchaser well enough briefed into the project in question, for example by attending the project kick-off meeting, will help to understand the full scope of the project and see the similarities in past projects. In the past this has been part of the standard protocol but not actualized in reality due to miscommunication and lack of initiative from the project managers.

The second important aspect raised from the research data is the readiness of the BoMs and the design structures. All projects should start by creation of analytics accounts for all the needed sub-assemblies in the company ERP-system to match the design structure. Analytic accounts are essentially accounting identifiers in the ERP that link projects, their purchases, and warehouse locations within the system. The sub-assemblies would work as roadmap for the material flow, meaning that the incoming goods would be stored according to the sub-assembly they belong to. This is currently on piloting phase in OptoFidelity and has reduced the number of missing components and time of

assembly. The BoM readiness is also crucial if the manufacturing subcontractors are planned to be used in the future.

Lastly, all the purchases should come through the purchase requests and be linked accordingly to the analytic account in question to further ease the traceability of the purchases and the material flow.

6.2.5 Commitment to following processes

OptoFidelity started out as a start-up with three guys and a camera, as the management often tells the story. Given the starting position, the company has grown significantly, especially in the past few years. In the midst of the rapid growth, processes, optimization, and standardization has taken the backseat while the main focus has been on growing accounts and satisfying customers' demands. With high volume of orders and tight schedules majority of efforts have been directed at finding solutions to making test systems complete and ready for delivery.

Now, with high number of recruitments and the ISO9001-2015 certification, the focus has shifted more towards developing processes and ways of working that enable the company to keep up with the current pace of orders and growth. However, throughout the years spent on working with the technology and fulfilling with orders, the company culture has molded into one where processes are outside many employees' comfort zone.

The culture in OptoFidelity, up until recently, has not demanded, nor supported, adhering to processes on a level that would be satisfactory to the company's current needs. Especially supporting functions, such as sourcing, have suffered from this lack of commitment to processes. (Anon., 2022) There is an imminent need for culture reform and actions to ensure sourcing can serve their internal customers in a way that enables projects to reach their goals, especially in terms of schedules.

Given the growth in the number of purchases over the past years, sourcing has become much more integral part of project success. Through this shift in the role of sourcing unit, the team is finding themselves in a position where they have more leverage to demand, rather than submit to, a level of adherence to processes.

Actions have been taken to ensure the purchasing process (see appendix 2), is followed, starting with a clear and strict demand to receive PQs for any and all project purchases. The enforcement of this rule started a year go and although majority of stakeholders adhere to it, there are still some employees not committed to the process.

As a starting point to change the culture, sourcing unit should be much stricter in approving deficient PQs, as well as refuse to purchase any items that have not been requested through the ERP system according to the process.

Secondly, the sourcing unit, which is responsible for ERP training, has already taken actions to promote and offer more training to ensure all stakeholders have the competences to create PQs. Training sessions were previously held in bulk for all designers and optical engineers, as well as other functions and positions. A change was made to the training session structures, so that training is offered as separate sessions for any newcomers, electrical designers, mechanical designers, project managers, and optical engineers. By tailoring the structure and content of the training sessions, the participants are gaining more targeted and focused competences related to their job descriptions and needs. In order to effectively broadcast and make the information stick to all technology teams and other stakeholders, the sourcing unit requires support from team leaders and management to add emphasis on the message.

Finally, a point can made of the company’s need to improve internal communication regarding the sourcing processes. By disseminating clearer information about the processes, as well their impact on project success, the sourcing processes would most likely be better adhered to. Additionally, sourcing

unit could better communicate the importance of ERP features utilization and the requirements for using them.

Some steps have been made to bring the sourcing processes to other units' attention, such as the sourcing and design teams' collaboration workshops. However, these workshops have not been structured to support active engagement from either side. The sessions have rather been based on announcements and some questions, most of which have been spontaneous. The authors propose to give the workshops more structure as well inform the participants of the agenda, so that they can prepare and present their views, concerns, and ideas. (Anon., 2022) Such structuring would facilitate and encourage active conversation, which in turn would increase understanding and collaboration of different functions.

6.2.6 Delivery teams & work balance

As described in the introduction chapter of this thesis, the sourcing unit's work is mainly divided based on the customer accounts. This manner of organization has worked in the past better as the accounts have been closer to each other's in size. (Anon., 2022) However, in the present situation, some of the accounts have much more volume in order and revenue than others, creating an imbalanced workload on the team members.

The team, as mentioned before, is divided to delivery teams, a practice originally deriving from the software team's Scrum approach to organize work. In the sourcing unit, the delivery teams have a distinct imbalance, as on delivery team is responsible for the unit's work related to two of the biggest accounts in the company, whereas another team is in charge of accounts that are low in order and revenue volume, some even close to being or becoming inactive. Even though the delivery team with smaller volume accounts have a greater number of accounts to cover, the workload still remains smaller compared to the other delivery teams.

In order to balance the workload, the authors propose redistributing the accounts between the delivery teams as a possible solution. By moving one of the two biggest accounts to another delivery team and in turn replacing it with one or two of the smaller accounts, the workload between delivery teams would become closer to equal. Combining different volume accounts in the delivery teams enables the team members to better support each other, as well as act as substitutes in case of absences and vacations. However, this solution focuses only on the delivery teams' overall workload. In any case, the delivery team members would still have their workload according to the account they are responsible for.

A question has been raised whether the sourcing team should reorganize and move away from account-based work division completely and find another way to divide tasks, responsibilities, and workload in a more balanced way. The question remains open without any refined proposals for an alternative solution. (Anon., 2022)

Since the organization of the team seems to remain as it is, the authors propose another way to balance the workload and improve efficiency in the sourcing unit. Even though the organization of the sourcing unit is based on the software team's model, there is one fundamental difference: scrum masters. Scrum masters, as earlier explained, are team leaders, not supervisors, responsible for organizing their team's work by prioritizing and assigning tasks to team members. The proposal is to create either one or two scrum master positions into the sourcing unit and adopt the work division methods, either fully or partially, from the software team. This solution would promote transparency, information flow, and equal workload in the unit. By providing one or two people with full view of the whole unit's ongoing activities, there would always be some who has a good view of the big picture, enabling them to prioritize tasks and support their team in their work.

Adopting the scrum master method from the software team has a proven track record of good results. Earlier this year the hardware delivery teams were assigned their own scrum masters. Based on the feedback and success stories

shared within the company, the hardware team is pleased with the solution. Furthermore, some hardware team members have, in a short period of time, committed to the new process of assigning tasks, and refused to carry out work that hasn’t been assigned through the scrum masters. This commitment to process indicates that reforms in organization advocate also positive development of company culture if the reform solution supports the employees.

7 CONCLUSIONS

This thesis was meant to determine the requirements posed to OptoFidelity's sourcing unit by the ISO90015-2015 standard as well as provide suggestions for further improvements. Additionally, as commissioned by the company, there was an intention to produce a quality manual for the sourcing unit.

We conclude that the goals of this thesis were met, as the research and ongoing ISO certification process clearly determined what the sourcing unit's processes need to cover in order to meet the standard's requirements. The documentation produced for the quality manual was used for the first audit round and was deemed sufficient with only recommendations for minor changes. During the audit no distinct non-conformities were recognized.

Through the analysis of the research data and the sourcing unit's processes, the authors provided insights with concrete suggestions to further improve the sourcing unit's processes and ways of working. These suggestions are brought to the team's supervisor's, process owners' and management's attention for review.

The quality manual was produced as intended and approved by the commissioner to be implemented as part of the official documentation of the company's quality management system. It was a well appreciated as supporting documentation for the ISO audit and will be used in the upcoming onboarding as the official guide for new employees joining the sourcing unit.

REFERENCES

Anon. 2022a. How to Get ISO 9001 Certification | Step-by-Step Guide. [online] Available at: https://www.9001simplified.com/learn/iso-9001-certification-steps.php [Accessed 28 October 2022].

Anon. 2022. OptoFidelity Sourcing bi-weekly meeting minutes January 2022 - October 2022.

Anon. 2022b. QUALITY | English meaning - Cambridge Dictionary. [online] Available at: https://dictionary.cambridge.org/dictionary/english/quality [Accessed 28 October 2022].

Anon. 2022c. quality_1 noun - Definition, pictures, pronunciation and usage notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com. [online] Available at: https://www.oxfordlearnersdictionaries.com/definition/english/quality_1?q=quality [Accessed 28 October 2022].

Anon. 2022d. Who is Eligible to Grant ISO 9001 Certification? - 9000 Store. [online] Available at: https://the9000store.com/iso-9001-resources/iso-9000-tips-selecting-a-registrar/iso-9000-iaf-approved-registrars/ [Accessed 28 October 2022].

ASQ, 2022. WHAT IS ISO 9001:2015 – QUALITY MANAGEMENT SYSTEMS? Available at: https://asq.org/quality-resources/iso-9001 .

Brennan, L.L., 2011. McGraw-Hill 36-Hour Course: Operations Management. First edition. ed. [online] New York: McGraw-Hill Education. Available at: https://www.accessengineeringlibrary.com/content/book/9780071743839 .

Dejonckheere, M. and Vaughn, L.M., 2019. Semistructured interviewing in primary care research: a balance of relationship and rigour. Fam Med Com Health, [online] 7, p.57. https://doi.org/10.1136/fmch-2018-000057 .

Deshp, A., 2021. A Step-By-Step Guide to Improving Business Processes. Available at: https://www.frevvo.com/blog/improving-business-processes/ .

Doney, J.A., 2019. Total Quality Management (TQM): Concepts, Implementation and Applications. [online] New York: Nova. Available at: http://libproxy.tuni.fi/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=e000xww&AN=2156011&site=ehost-live&scope=site .

Education, I.B.M.C., 2021. What is Business Process Analysis? Available at: https://www.ibm.com/cloud/blog/business-process-analysis .

Ikram, M., Zhang, Q. and Sroufe, R., 2021. Future of quality management system (ISO 9001) certification: novel grey forecasting approach. Total quality management & business excellence, 32(15–16), pp.1666–1693. https://doi.org/10.1080/14783363.2020.1768062 .

ISO 9001:2015, 2015. ISO 9001: 2015 Quality Management Systems-Requirements. International Standard Organisation, 2015.
James O. Coplien and Jeff Sutherland, 2019. A Scrum Book. Pragmatic Bookshelf.

Keen, R., 2019. Is ISO 9001 Certification Worth It? (8 Pros and Cons). Available at: https://www.iso-9001-checklist.co.uk/is-ISO-9001-certification-worth-it-8-pros-and-cons.htm .

Kiran, D.R., 2016. Total Quality Management. [online] Butterworth-Heinemann. Available at: https://learning.oreilly.com/library/view/total-quality-management/9780128110362/ .

Lachapelle, E., Aliu, F. and Bina, L., 2015. ISO 9001:2015 Quality Management Systems - Requirements. [online] Available at: https://pecb.com/whitepaper/iso-90012015-quality-management-systems—

requirements#:~:text=ISO%209001%3A2015%20specifies%20requirements,to%20all%20types%20of%20organizations. .

Ltd, V.M.S., 2021. Quality Manual Template ISO 9001:2015 Quality Management System Quality Manual Template ISO 9001:2015 Quality Management System. Available at: https://www.iso9001help.co.uk/ISO-templates.html#ISO%209001:2015%20quality%20management%20system%20templates .

Martinsuo, M. and Blomqvist, M., 2010. Process modeling for improved performance. [online] Available at: http://urn.fi/URN:ISBN:978-952-60-3379-2 .
Oakland, J.S. and Oakland, J.S., 2004. Oakland on quality management. 3rd ed. ed. Oxford ; Elsevier Butterworth-Heinemann. https://doi.org/10.4324/9780080479781 .

Padhi, N., 2010. The Eight Elements of TQM. Available at: https://www.isixsigma.com/methodology/total-quality-management-tqm/eight-elements-tqm/ .
Schwaber, K. and Sutherland, J., 2020. The Scrum Guide The Definitive Guide to Scrum: The Rules of the Game.

Shaffie, S. and Shahbazi, S., 2012. McGraw-Hill 36-Hour Course: Lean Six Sigma. First edition. ed. [online] New York: McGraw-Hill Education. Available at: https://www.accessengineeringlibrary.com/content/book/9780071743853 .

Weßel, C., Weymann, F. and Spreckelsen, C., 2006. Streamlining Qualitative Research Methods for Medical Informatics-A Methodological Approach.

Williams, R.L., 1994a. Essentials of Total Quality Management. [online] New York: AMACOM. Available at: http://libproxy.tuni.fi/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=e000xww&AN=2464&site=ehost-live&scope=site .

Williams, R.L., 1994b. Essentials of Total Quality Management. [online] New York: AMACOM. Available at: http://libproxy.tuni.fi/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=e000xww&AN=2464&site=ehost-live&scope=site .

APPENDICES

Appendix 1. Interview structure and questions

OptoFidelity Purchasing Process Quality

Introduction

This interview is conducted as a part of a thesis project commissioned by OptoFidelity Oy. The topic of the thesis is quality management, process description and analysis. The thesis studies the purchasing process in particular and the goal is to produce a quality handbook, and to find points of improvement in processes and ways of working.

Background information

This interview has three sections: the first maps out your basic information, role in the organisation, and your experience level. The second section focuses on your understanding, view, and experiences of the sourcing unit in general. The third and final section focuses on the purchasing process.

By purchasing process, we mean the sequence of action that take place for various sourcing and acquisitions of components used in the manufacturing of our products. In this context the purchasing process begins with the creation of a purchase request (PQ) and ends when the goods are received correctly in the ERP and approved by the responsible stakeholder.

Purpose

The purpose of this interview is to gain insights to the efficiency of the sourcing team and the purchasing process, synergy between stakeholders, and to identify points of improvement.

Data management

The interview will be recorded, and all the responses will be anonymized into the data analyses

Questions

Interviewee basic information

1. What is your job title and position in the organisation?
2. Do you work full time or part time?
3. Are you an employee of OptoFidelity or a subcontractor?
4. What is your level of experience in this job position in OptoFidelity and/or other organisations?

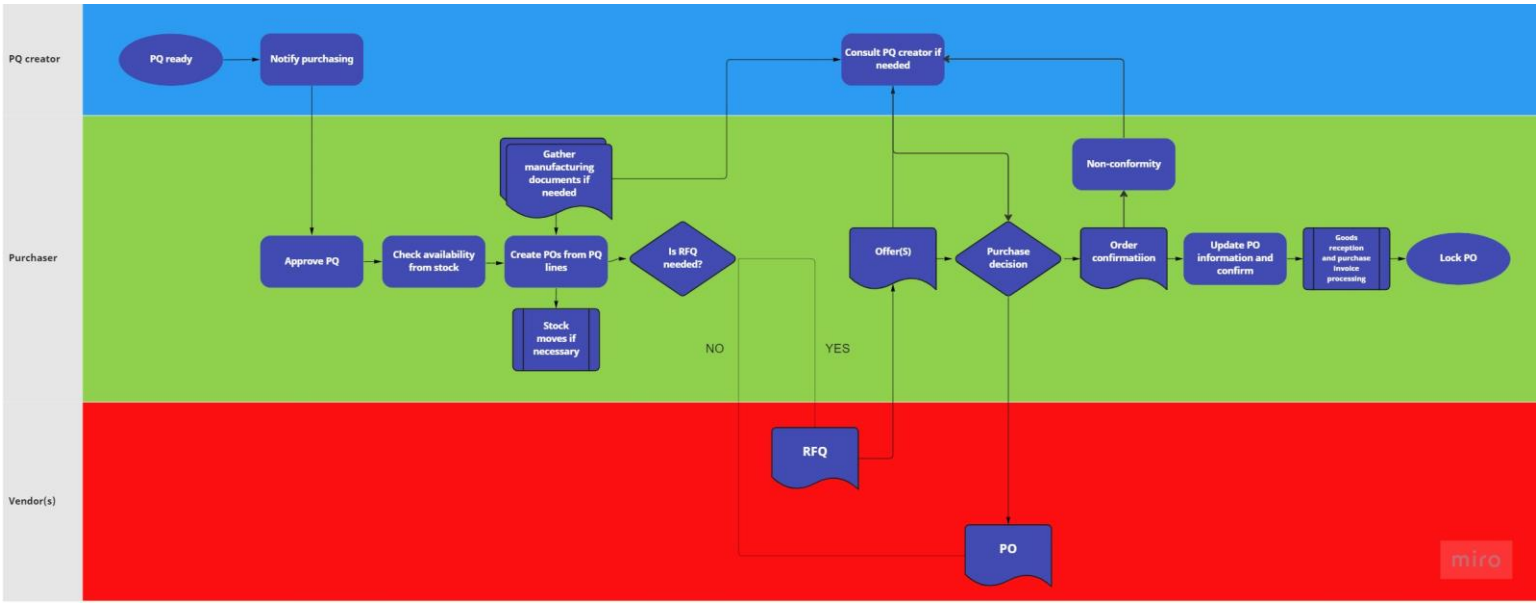
Sourcing unit in general

5. How well do you know the role and responsibilities of the sourcing unit?
6. How would you change the division of responsibilities?
7. What is your experience of the interaction between yourself and the sourcing unit?
8. What is your experience of the communication between yourself and the sourcing unit in terms of quality and quantity?
9. How would you describe the efficiency of the sourcing unit?

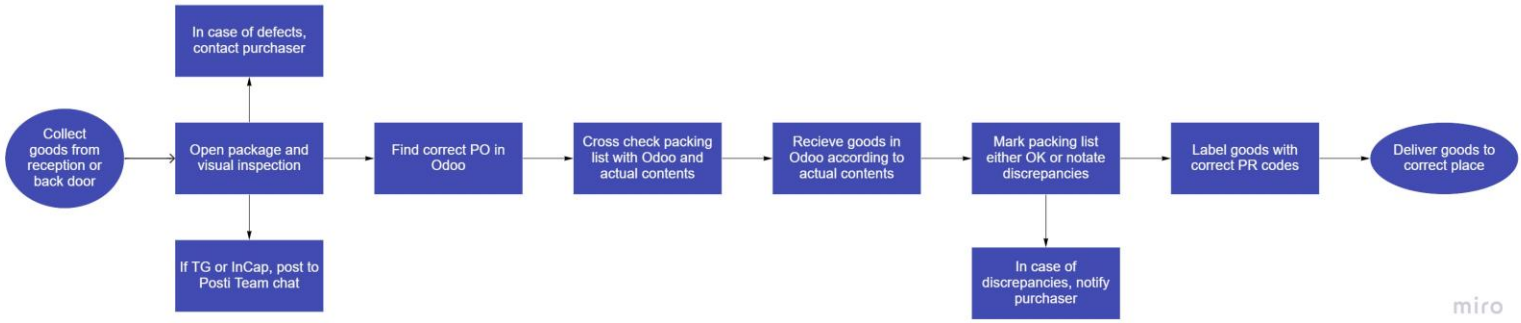
The Purchasing Process

10. Can you describe the current purchasing process?
11. Are the roles of different stakeholder in the purchasing process clear to you?
12. Do you think the roles and responsibilities of different stakeholders in the purchasing process are appropriately defined?
13. How would you change the division of responsibilities?
14. How well do you think products are managed in our ERP?
15. Are the roles and responsibilities of product management clear to you?
16. Would you change anything regarding product management in our ERP?
17. How would you describe the unity and consistency of the ways of working of the stakeholders in the purchasing process?
18. How would you describe the efficiency of the purchasing process?
19. What is successful about the current purchasing process?
20. How could the purchasing process be improved?

Appendix 2. Process charts



Process 1 - Purchasing process



Process 2 - Goods reception process