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# Quality Management: Process assessment challenges

Case Company: Space Systems Finland Ltd.

Sajid, Sonita

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Quality Management: Process assessment challenges  
Case Company: Space Systems Finland Ltd.

Sonita Sajid  
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Sonita Sajid

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Thesis discuss quality management, quality related standards and process assessment roles in the quality management system. Development of products and services are also presented where the quality related standards are implemented and the company level development processes are used which capability levels have been assessed.

The objective is to describe process assessment and its impact on working in space software industry and to analyze the ways to develop and improve processes. Case company for thesis is Finnish software designing company Space Systems Finland Ltd.

The method chosen is qualitative. The data is collected by interviewing company's managing director, sales director, finance and administrative director, project manager and quality manager. The theoretical part is based on literatures of quality management, quality assessment and improvement. The conclusions are made by analyzing the theoretical part, interviews, findings and empirical part of the study.

**Keywords:** Quality management, processes, measurement, improvement

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## 1. Introduction

### 1.1 Background of the studies

Product quality has become the most important for modern enterprises. How to meet or even exceed customers' expectations and requirements of quality product is to have a well-organized and functional quality management system. (Goetsch, 2010)

Quality management system (later on referred as QMS) is the company level management tool for the acting management. (Goetsch, 2010) QMS does not only provide good products and services for the users, it is also a tool for organizing and managing the product and business processes. One of the quality aspects is to make company level processes cost saving, accurate and effective in every phase. Just having quality management system as a guideline does not, unfortunately, always bring success to the company. Implementing, regular measuring and improving the quality management system is a key factor for qualified production to increased sales in the global and competitive market areas. (Goetsch, 2010)

Quality concerns not only high quality products and services satisfying end users needs but also applicable qualified processes to be used in product development and manufacturing phases. (Niemitalo, 2014) Naturally preconditions for this are well educated, creative and committed staff improving continuously their skills and working methods.

In Finland quality is highly appreciated by most people. Everyday consuming products have to pass strict quality standards to assure their safety and healthiness before coming to market for purchase. One rather buy bit more expensive quality product which fulfills her/his expectations and needs than a product which does not fully satisfy. Finland is internationally well known for its quality in fields of advanced technology, paper industry and the mobile phone sector. Not yet so famously known is that Finland also provides qualified software's used in various fields.

Finnish company Space Systems Finland Ltd (later on referred as SSF) is used as the case company in this study. SSF is located in Espoo and has recently established a sister company in Czech Republic. Space Systems Finland is a systems and software designer for space, defense, nuclear, medical and machinery fields. The sister company in Czech Republic is very young therefore main office and work is developed in Finland.

SSF has to meet international quality standards and requirements specific for the software products and assessed processes. The quality management systems is based on the ISO standard 9001. The ISO standards has been implemented well in the company level management and in producing products. In addition to the product and service specific standards are followed to satisfy both Finnish and international customers requiring high qualified services.

The company's success is based on their ability to maximize the added value to their customers by delivering cost-effective and world-class solutions to satisfy the customers' needs. (Space Systems Finland 2015, Accessed 15.8.2015) SSF's mission is to always deliver high quality services by long and short term consultancy and providing a complete solution. SSF seeks for long-term partnerships as the developing is performed as project based principle and probably extended as maintenance phase of a product. Projects may last from few months to years depending on their features and contractual agreements. (Space Systems Finland 2015, Accessed 15.8.2015)

The motive of this study is to find the elements which can develop the processes to maintain and probably increase still the capability levels if required for more critical projects in the future and to add more value from the company's business point of view.

As Space Systems Finland is a producer of highly critical solutions which are very meaningful for human society, it is absolutely important for products to be high quality, effective and functional. Maintaining the capability levels of processes and qualified working in production is very important as a small defect can cost loss of sales and damage in reputation. Therefore it can be considered that quality measurement to support the business and continues development of processes is necessary for business survival.

## 1.2 Research questions

This thesis discuss about quality management, ISO standards, process assessment and challenges in process assessment and development in space software developing field. The main research questions are considered to be:

1. What assessment and developing challenges there are in quality management processes?
2. How to overcome assessment and development challenges in processes?

Thesis study will analyze the assessment and developing challenges in processes, what tools are used to measure processes and how process measurement can be developed. Also study

will overview the case company's quality management system and how ISO 9001 standards are implemented in the processes.

The case company's directors, project manager and quality manager were interviewed to ascertain the issues of assessment and need of development. All the data used in this thesis is from reliable sources.

### 1.3 Research process

Various sources have been used for collecting reliable data on this subject such as quality management literature, internet and articles in internet. The quality manager of the case company has given excellent literature sources of company's quality management which has been used in this thesis as well. The company's management level interviews are the primary source of information for analysis. The interviews were carried out in September and October of 2015.

Data from literature formed the theory overview to the subject. Interview data deepen the topic. Findings of analyzed data and empirical studies developed the overall overview of the quality system of the case company.

#### 1.3.1 Structure of the thesis

Structure of thesis has been divided into seven major parts with sub sections. Introduction part includes the background of the studies, research questions and research process. Theory overview leads the reader to the definition of quality and the quality related standards. Third part introduces the case company and its quality management processes. Fourth part, methodology, justifies the theme interview selection among qualitative method. Analysis of data part, introduces the interviewees and interview questions than analysis the interview data. Sixth part, findings of empirical studies gathers the information from open discussions and other material given by case company. Final part, conclusion and discussion, talk about the interview data and empirical studies as well as reliability and credibility of the thesis. References of material and literature are listed after the final part.

## 2 Theory Overview

### 2.1 Definition of Quality

Quality word originates from Latin word 'qualis' which means 'such as the thing really is' (Dale&iwaarden, 2003). Quality is defined in many ways but for many the concept of quality



is difficult to understand. Dictionary defines quality as a 'degree of excellence of something'. (Cambridge University Press 2015. Accessed 2.9.2015) It can be defined from customers or organizations perspectives. It is assimilated with excellence or perfection but for ordinary people quality can mean something they can feel, taste, instinct or smell. (Dale & Iwardeen, 2003)

According to Dale and Iwardeen (2003) quality can be described in an abstract way or in a concrete way. For example quality can be used to describe how good writing paper is, 'This is a quality paper' but quality can be also used in an abstract form, 'This is her only bad quality'. In other way it can be said that focus is more on comparing components with each other. Terms such as reliable, maintainable and sustainable are used to describe quality product. An item that has quality is expected to perform flawlessly and fulfills its purpose given.

In business world quality word is used to distinguish one organization and its products or services from another. (Montgomery et al. 2010) For organizations quality can mean having a vision and mission for being the best in field. To produce or improve a product or service which outstands from others and is one of a kind maybe the purpose for the organizations but eventually it is the quality which builds the image of the company. (Montgomery et al. 2010) Nowadays quality has become the most important decision making factor among competing products and services.

Quality demanding consumer can be anyone from any field an individual, organization, a hospital or even a bank. Therefore Dale and Iwardeen (2003) agree that quality word to have its desired effect and to prevent misunderstandings in the communication one should have clear understanding of its meaning and there should be a similar understanding of quality between audience and the communicator. Also organizations should agree on definition of quality to ensure that the personnel are focused on the same objectives. For organizations maintaining all the employees' commitment in every process each and every time can be difficult. Also focusing too much on conformance standards can lead to neglecting on customers' views. Overall, it can be said that in any way quality is defined, it always lead to fulfilling the customers' requirements and satisfying the needs of the customer (Dale & Iwardeen, 2003).

Especially in manufacturing, quality can be defined as something free from faults and defects (Montgomery et al. 2010). It is also defined as conformance to standards for example the ISO 1900-2003 standards. One can define quality as specifications or requirements of customer as well as meeting or exceeding customers' expectations. Also delighting the customer is considered as quality act. The act can be a high level of value or how good or bad something

is. Quality items are perceived as increase of sale therefore they are becoming more of need than a want. It is obvious that a person will buy a pair of jeans which will last at least six months rather than jeans which will rip in a few weeks (Montgomery et al. 2010).

But how would we know if the high price pair of jeans is better quality than average price pair of jeans as they both maybe produced under the same standards. One of the weaknesses of quality is that it is difficult to measure. There are several ways to describe and evaluate product quality therefor it is important to differentiate different dimensions of quality.

## 2.2 Six Sigma

Six Sigma was created in mid 1980s. Its main purpose is to improve the performance of key processes, quality and productivity in low costs. Its goal is to create value threw quality improvement. Sigma is an indication of how good a product or service is. Designers use the sigma to evaluate part specification. According to Dale the sigma metric is to understand that it is the result of a multiplication of the quality levels of all the steps in a process. More sigma's used the fewer defects per million opportunities. (Dale& Iwaarden 2003)

### 2.2.1 Qualifications

The success of Six Sigma depends on four factors. Firstly, commitment and involvement is demanded from management level as six sigma requires statistic understanding and consumes high amount of time. Secondly, it is adherence between different tools and methods. Once major processes are identified and organizations different levels work together as well as some degree of control are there, six sigma can be adopted. Thirdly, it is all about reducing defects. Improvement can be only done when opportunities for failure or defects are measured and defined. Fourthly, six sigma should always start from strategy. Strategy should have future plans and concentrate on its improvement drives. (Dale& Iwaarden 2003)

### 2.2.2 Core elements

Six sigma has various improvement methods which have been considered to be effective. They are shortly described below.

Method	In practical terms
Focusing on customer	Understanding customers' expectations and requirements by measuring customer satisfaction.
Data and fact management	Data analysis and management's decisions based on facts develop understanding of internal processes.

Accurate training	Clear infrastructure of trainers, trainees and part-time project owners and their tasks in processes
Approaches	Two problem solving approaches, for existing processes DMAIC (define, measure, analyses, improve and control) and for new processes DMADV (define, measure, analyses, design and verify)
Quality Engineering	Every tool and technique used is written in application in every stage of problem solving approaches
Focusing, controlling and improving	To do this three tools, first have to examine potential defects, root causes, correctives and long-term actions
Pro-activeness	Understanding why things are done in certain way and managing the time and pressure caused by six sigma
Teamwork	Every level is working together
Perfection	Goals cannot be always achieved, understanding the reasons of failure and learning from mistakes is highly important.
Savings	Financial targets are reached with verifiable results.
Short-term improvement projects	Usually projects last few months therefore improvements time is relatively short.

Table.1 Six Sigma improvement methods (Dale& Iwaarden 2003)

### 2.3 ISO 9001 standards

ISO 9001 standard was established in 1987. Then it mostly focused on product checking. In year 2000 major changes were made in ISO 9001 standards, proceeding, resourcing, process performance and process planning became mandatory. Some changes were also made in 2008, organizations were required to take responsibility of subcontractor's requirements. Major changes will apply in 2015 (Inspect).

The quality management system is considered as strategic decision of an organization. Quality management system of organization is inspired by organizational environment, needs, objectives, products, processes, size and organizational structure. ISO 9001 International standards are a guideline to build organizations quality management system (Suomen standardisoimisliitto SFS, 2008).

ISO 9001 standard is one of the standards of ISO 9000 standard family. ISO 9001 standard is developed for all sizes and type of organizations in any sector. It helps organizations to improve their management processes and to compete better with local and global competitors. For becoming an ISO 9001 certified company, quality management system should be imple-

mented in areas of organizations facilities, people, training, services and equipment. (ISO9001 2010, Accessed 1.9.2015)

Implementing ISO 9001 standards will provide maximum benefit for an organization and its customers. Organizational benefits are: efficient management process for senior management, divides responsibilities among organization, better communication between staff and customers, time saving in processes, accent the problems, reduces cost, increases marketing opportunities and continuously improves and assess. Customers benefits with better quality and service, on time delivery, less complaints and independent auditing demonstration to assure product quality. (ISO9001 2010, Accessed 1.9.2015)

There are three main reasons why monitoring, measurement, analysis and improvement processes are needed. Firstly, to assure that the product meets the requirements. Second reason is to ensure conformity of the quality management system. Thirdly, to improve the effectiveness of quality management system (Suomen standardisoimisliitto SFS, 2008).

### 2.3.1 Monitoring and measurement

Customer satisfaction along with auditing is one of the measurements of the processes performance. Customer satisfaction information reveals the requirements customer has set and if the product has met the requirements (Suomen standardisoimisliitto SFS, 2008).

Internal audits are essentials for the organizations as they determine if the quality management system meets the requirements of International standards and the objectives which company has determined for its quality management system. Audits also demonstrate if the requirements are been implemented and maintained (Suomen standardisoimisliitto SFS, 2008). Auditing should be well planned under consideration of the importance of the processes to be audit and the previous results of the audits. Well defined areas should be the criteria, scope, methods and frequency of auditing. Auditors should be selected and the audits should be performed base on audit processes objectivity and equality. One cannot audit its own work (Suomen standardisoimisliitto SFS, 2008).

Organization is responsible of creating a guideline manual which defines auditing planning, implementation, recording and reporting, results, responsibilities and requirements (Suomen standardisoimisliitto SFS, 2008). All the records and results should be maintained. If needed, corrective actions should be taken without a delay to eliminate unwanted causes. The management team records and reports the corrective actions, results of the actions and follow-up activities (Suomen standardisoimisliitto SFS, 2008).

According to Suomen standardisoimisliitto SFS, organization is responsible for applying proper methods and tools for monitoring and measuring quality management system processes. The tools and methods should be capable of achieving the planned results of the processes. If not so, corrective actions should be taken immediately.

### 2.3.2 Analysis of data

When the appropriate data has been determined, collected and analyzed, it imparts if it has been suitable, effective and what improvements can be done in quality management system. Data is the result of monitoring and measurement of the processes. Data to be analyzed should provide information of customer satisfaction, product requirements, characteristics of products and processes, opportunities for preventive action and suppliers (Suomen standardisoimisliitto SFS, 2008).

### 2.3.3 Improvement

Quality management system therefore process improvement can be effectively implemented if the quality policy, objectives, audit results, data analysis, actions and management reviews are used. Corrective and preventive actions are essential parts of the improvement (Suomen standardisoimisliitto SFS, 2008).

Corrective actions shall be taken immediately to eliminate the causes of nonconformities and to prevent recurrence. Company is responsible for documented procedure draft which will define the requirements for reviewing nonconformities and customer complaints, determining the causes, evaluating the need for actions to prevent nonconformities, implementing action needed and recording and reviewing the result and effectiveness of the action taken (Suomen standardisoimisliitto SFS, 2008).

Preventive actions must be taken to prevent occurrence of potential nonconformities. As for corrective actions, preventive actions need documented procedure guidelines as well. Guideline requirements shall define the causes of potential nonconformities and evaluate the need for action to prevent occurrence of nonconformities. Implementation, recording and reviewing of the actions taken must be done as for corrective actions (Suomen standardisoimisliitto SFS, 2008).

## 2.4 ISO/IEC 15504 standards

ISO/IEC 15504 standards are result of SPICE (Software Process Improvement and Capability determination) project which started in 1993. They were created to assess software process.

By 2006 ISO/IEC 15504 had five parts and then later on updates were made and five more parts were included (Sfsedu, Accessed 6.9.2015).

The update in 2006 led the standards to capability and maturity level standard family. ISO/IEC 15288 standards of life cycle process of system planning were included into the standards (Sfsedu 2015, Accessed 6.9.2015).

Many enterprises have implemented the standards with other process assessment standards and models such as with ISO 9001 as business process assessment and IT service management processes ISO/IEC 15504-8 (Sfsedu, Accessed 6.9.2015).

The standards are required for process assessment, process reference models and assessment models. The standards are going to be changed completely too new standard series ISO/IEC 33000. Seven new standards of the series have been published and other is under development. The new series will contain informative models, normative requirement, guidelines and examples of processes and their capability (Sfsedu, Accessed 6.9.2015).

Table 2 shows on the left side ten parts of ISO/IEC 15504 series and in brackets the year when the part has been added into the series. On the right side new ISO/IEC 33000 series and the standards which have already been replaced some parts from ISO/IEC 15504.

ISO/IEC 15504 ten parts	ISO/IEC 33000 series
Concept and Vocabulary (2004)	Concept and terminology (2014)
Performing and Assessment (2003)	Requirement for performing process assessment (2014)
Guidance on performing and assessment (2004)	Requirements for process measurement frameworks (2014)
Guidance on use for process improvement and process capability determination (2004)	Requirements for process models (2014)
An exemplar Process Assessment Model (2012)	Guide for process improvement (2014)
An exemplar Systems Life Cycle Process Assessment Model (2012)	Body of Knowledge for Process Assessment (2014)
Assessment of Organizational Maturity (2008)	Measurement framework for assessment of process capability and organizational maturity (2014)
An exemplar Assessment Model for Service Management Processes (2012)	

Target Process Profiles (2011)	
Safety Extension (2011)	

Table 2. ISO/IEC 15504 to be changed to ISO/IEC 33000 (Sfsedu, Access 6.9.2015)

### 3 Space Systems Finland Ltd.

#### 3.1 Space Systems Finland Ltd. in general

Space Systems Finland Ltd (later on referred as SSF) is a software developing company which was originally established in 1989 (Space Systems Finland 2015, Accessed 15.8.2015). Company is located in Espoo and is registered as a small-medium enterprise. It is currently owned by its operative management. The company has nearly 60 personnel including subcontractors. The staff consists of different roles such as software engineers, managers and directors.

SSF's products and services are composed of System and Software Design, Outsourced R&D, Test environments, Navigation Solutions, IEC 61508 Software Development, System Assessment, Gap Analysis, Process Improvement and Reliability analysis (Space Systems Finland 2015, Accessed 15.8.2015). The company has entered into domestic and international markets in fields of medical, nuclear and space (Space Systems Finland 2015, Accessed 15.8.2015).

##### 3.1.1 Mission, vision and values of SSF

SSF's mission is to be a reliable research and development partner (Space Systems Finland 2015, Accessed 15.8.2015). Systems are designed and implemented from the very beginning to achieve reliability. Conformance to relevant rules and standards is highly important for the company. SSF serve the customer in chosen area where company pursues technology leadership. Company's many years of experience in working with safety critical development ensures that the project estimates are realistic and development quality is based on regulatory standards. Continuous improvement is part of the way of work to better serve the customers and achieve the company goals (Space Systems Finland 2015, Accessed 15.8.2015).

Company's first aim is to be the most known provider in the Nordic area in the fields of safety critical systems development and GNSS technology (Space Systems Finland 2015, Accessed 15.8.2015). Second aim is to add value to customers through delivering excellent quality in the most advanced and challenging projects, and always bearing in mind the customer orientation. In order to achieve their aims, SSF focuses in employee collaboration, quality and in professional and successful sale (Space Systems Finland 2015, Accessed 15.8.2015).

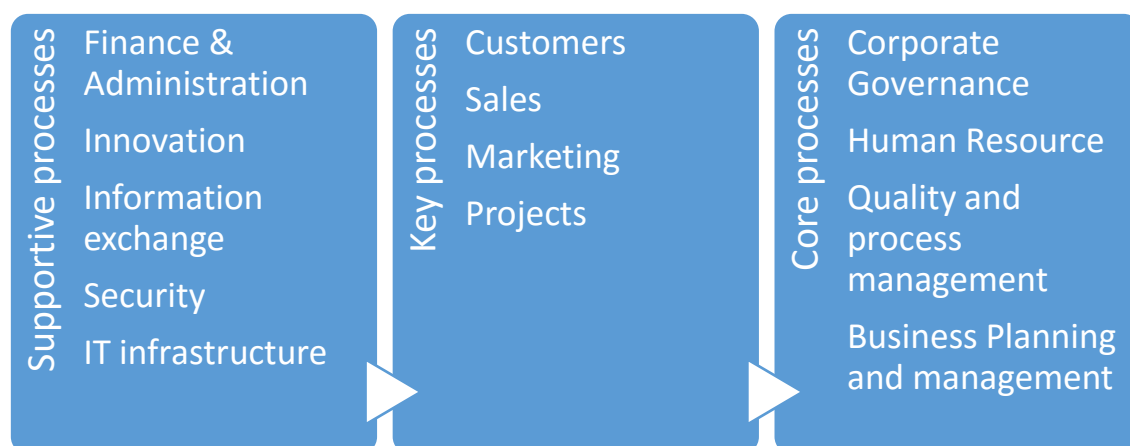
Company's three main values are integrity, excellence and enthusiasm (Space Systems Finland 2015, Accessed 15.8.2015). As the first value, integrity is very important for the company and it is expected from employees, employer as well as from the customers. It is the base for every contract of sales.

Excellency is highly demanded in SSF. Excellency in work is considered to be the key element for the high quality which company aims and focus on.

Work enthusiasm among employee's shows in accepting new challenges and excellently coping from those challenges (Space Systems Finland 2015, Accessed 15.8.2015).

Great employee policy can be also seen as company value. Therefore SSF rewards employees for good performance and overall company success. Continues employee skills and experience developing is highly recommended. Health and wellbeing of the employees is privilege therefore company provides healthcare and various physical activities after work to increase quality of life. (Space Systems Finland 2015, Accessed 15.8.2015)

### 3.2 Quality management processes of SSF



#### 3.2.1 Core processes

Corporate governance refers to the mechanisms, processes and relations by which company is controlled and directed (Investopedia 2015, Accessed 10.9.2015). Structure of governance distributes rights and responsibilities among the board of directors, managers, shareholders and other business critical factors. Structure also includes decision making rules and procedures in company's matters. Corporate governance consist the processes through which cor-



porations' objectives are set and pursued in the context of the social, regulatory and market environment (Niemitalo, 2014).

One of the goals in business practice at SSF is to apply and support sustainable development related to human rights, labor standards, the environment, and anti-corruption as defined in Global Compact organization in United Nations. Belief in SSF is that businesses should support a precautionary approach to environmental challenges and responsibilities encourage the development of environmentally friendly technologies and work against all forms of corruption, including extortion and bribery. These principles will be achieved by being committed to obey the Finnish Law (Niemitalo, 2014).

Quality and process management is the Quality management system handbook which is created and updated by the company's Quality manager and reviewed and approved by the SSF Directors as part of the regular (yearly) Quality Management Review. The book is made under the rules and norms of ISO 9001. The handbook answers all the main issue regarding quality management at SSF and traced against ISO standard and processes. It is the guide book which helps to understand the structure supporting the company's aiming high quality products and services and what is needed to achieve the goals. It also includes practices used in process development and assessment (Niemitalo, 2014).

Human resource management is an important core process in SSF. Employees are the heart of the company therefore employee's well-being and professional skill improvement is priority for SSF. The company's personnel are highly educated and professionals. Personnel are constantly trained in new and updating of skills which is also hoped to improve the work motivation. Working culture at SSF is open-minded, therefore any issue can be immediately intervene with directors. Need of personnel surveys have decreased due to immediate intervene but are still done as company policy requires it. Personnel surveys give assistance in directors' evaluation, improvement ideas of company operations and developing ideas of work experience at SSF (Niemitalo, 2014).

### 3.2.2 Key processes

The goal of the marketing and sales processes is to find potential customers. Carefully prepared marketing material ease the search of potential customers and further sales actions. The Business Managers select potential tenders that fulfill SSFs business goals. SSF responses to a tender with its specified proposal. The Business Manager assigns a team to prepare the proposal and leads the proposal preparation. After checking, approve and signature of authorized personnel, a proposal data packet forms an input for a project contract negotiation performed with a customer. Successful negotiation closest the sales phase and lead to signing of

cooperation in a form of negotiation / Kick off minutes and contract after the contractual baseline is mutually agreed for project (Niemitalo, 2014).

The project starts when; the SSF management assignees a Project Manager to set up the project and related facilities based on the contractual agreement signed at kick off. The Project Manager is responsible of the project to the SSF management and a customer and he / she manages and reports the project status regularly as agreed internally and externally (Niemitalo, 2014).

### 3.2.3 Supportive processes

Supportive processes support company's key processes. These processes are information exchange and documentation, finance and administration, innovation, IT infrastructure and security. Each process has a responsible person that provides needed instructions and documentations (Niemitalo, 2014).

Information exchange and documentation is to support the marketing and customer. Main tool for information exchange is telephone but as modern technology is developed, free internet applications such as skype and emails are also key communication tools in informal communication. Formal communications (i.e. agreements, action defined) are recorded into minutes or other signed and controlled mean like web based tools. Documentation helps the company to improve and evaluate their marketing and customer service. Each action in process is documented according to company's documentation rules and applications (Niemitalo, 2014).

Finance and administration process is to support the sales process. It includes monthly reporting, preparation of material for proposal and subcontractor selection and evaluation. Monthly reporting is done monthly and includes cash and invoice management and all other financial matters concerning the company and projects (Niemitalo, 2014).

Innovation creates new ways for company to act. Process evaluations can find the errors and areas to improve in. An innovative idea keep the company up to dated and improves working and also the key processes of the company (Niemitalo, 2014).

IT infrastructure process allows the realization of projects. SSF is a software system provider, it is essential that all the IT systems are secure, reliable and working probably incessantly. IT manager co-operate closely with the IT support in case of maintenance breaks or systems failure (Niemitalo, 2014).

Security process guidelines are to protect company, product and customer. Security assures that companies and customers Company secrets cannot be abused. Management level has to act in cases when security is under threat according to the guidelines defined as part of the Quality Systems (Niemitalo, 2014).

#### 4 Methodology

Methodology used in this thesis is justified below. Also the reasons why this certain approach was chosen is explained.

Qualitative approach was chosen to view thesis. Data is collected from theory of the topic, empirical studies and from interviews of directors, quality manager and project manager. Also additional data was given by quality manager. Given data was quality manual of the company, ISO 9001 standards and Power Point presentations on process assessment.

##### 4.1 Justification of the interview method

Theme interviews are intermediate to form interview and open interview. Interview is carried out in a sense that all interviewees are familiar with the topic or theme but the questions are not strictly formal. Theme interview is more or less like a discussion session therefore it is a popular interview type. This interview type is good when themes are not widely discussed with every interviewee. Purpose is to take into consideration ones importance and interpretation (Saaranen-Kauppinen&Puusniekka, 2006. Accessed 19.11.2015).

To carry out theme interview, one should gain knowledge of the theme and also know the situation of the interviewees. Themes are selected after the topic is well knowledge. Research question should be formed in a way that they are possible to analyze by it themes. Also the interviewee should be carefully selected, probably the one who can give the most information and is connected to the theme (Saaranen-Kauppinen&Puusniekka, 2006. Accessed 19.11.2015).

Theme interview was chosen because interviewees are in different management levels, have different tasks and their responsibilities varies. Atmosphere at case company is relaxed and open minded therefore theme interview seemed to be appropriate. Interviewees were already familiar as second internship is completed at the case company. Also during the internship empirical study of the topic was knowledge. Theme interview gave the freedom to ask additional questions which were not planned beforehand. The data of the interviews was analyzed by themes which added value to the study.

## 5 Analysis of interview data

Managing Director Veera Sylvius, Sales Director Timo Latvala, Finance and Administration Director Tuomas Talvioja, Quality Manager Sirkka Niemitalo and Project Manager Victor Bos were interviewed to gain knowledge about process assessment, development and challenges. Interviews were carried out in September and October 2015. Questions were formulated so that interviewee would base her/his answers on facts and own knowledge. Project Managers interview questions were based on space project as he is responsible of space project.

### 5.1 Interview questions

Ten questions were asked:

1. For which processes are you responsible?
2. How essential those processes are for business survival?
3. How ISO 9001 Standards are implemented in those processes?
4. What tools are used to measure processes?
5. Is Six Sigma used in any phase of process measuring and developing?
6. What measuring challenges there are?
7. Which of the processes need the most developing and why?
8. What development challenges there are?
9. What factors need to be considered when developing that the quality will remain high standard?
10. How does one poor quality process effect on other processes?

### 5.2 Findings of interview data

#### 5.2.1 Process responsible

Answers to questions one and two can be seen in a table below. The key elements why the process is important is written in the brackets.

Responsible	Core Processes	Key Processes	Supportive processes
Managing Director	<ul style="list-style-type: none"> <li>• Corporate Governance (to create solid management system)</li> <li>• Business Planning and Management</li> </ul>	<ul style="list-style-type: none"> <li>• Marketing (in terms of reaching the big audience and communicating the brand of the</li> </ul>	

	(strategic decisions, arguments, differentiation) <ul style="list-style-type: none"> <li>Human Resources (sustainable leadership practices)</li> </ul>	company)	
Sales Director	<ul style="list-style-type: none"> <li>Human Resources (key for ensuring the companies delivery capability)</li> </ul>	<ul style="list-style-type: none"> <li>Sales (key revenue generator for the company)</li> <li>Project baseline (sets the scope of each project)</li> </ul>	
Finance Director			<ul style="list-style-type: none"> <li>Information exchange (connects personnel and customers)</li> <li>Documentation (the baseline for the projects, hard copy of customers requirements, easy to predict)</li> <li>Finance and Administration (company profitability, predictions)</li> </ul>
Quality Manager	<ul style="list-style-type: none"> <li>Responsible for establishing, implementing and maintaining the quality management system</li> <li>Quality management system audit plan</li> </ul>		

Table 3. Responsibilities and importance of processes

### 5.2.2 Implementation of ISO 9001 and Six Sigma

According to Quality manager ISO 9001 certificate is essential for the business. In software engineering field ISO 9001 certificate is required by many customers. ISO 9001 certificate ensures the quality status of the company's working. Because of ISO 9001 certificate there is no need of external audits and it shows that company has fully implemented ISO 9001 standards. SSF achieved its ISO 9001:2008 certificate of computer software in April 2010 which covers

Quality System and the specification, design, development, verification, validation and maintenance.

In SSF all the action and results are documented and stored. Documentation of actions and decisions are done according to ISO 9001 standards. SSF project baseline process is a reflection of ISO 9001 Contract Review requirement. Company's Human Resource process implements the competence management requirements of ISO 9001.

Six Sigma is not used in any phase of the process. SSF is not yet familiar with Six Sigma. Quality manager points out that SSF does not produce manufactured products and all of its products which are the outcome of their projects and are owned by the customer. The number of product developed and manufactured at SSF is in practice one software with documentation having required and very customer specific features. The software version can be multiplied within the frame of the contractual agreement but the production is not unique with a mass production. However the development of so called general components usable in different products would decrease development costs but at this moment that has not been the goal of business.

### 5.2.3 Measurement tools

Tools to measure marketing process is by number of events that have been organized and participated to, number of technical seminars have been participated and the level of the marketing material. Sales process is managed and measured with CRM tool and the main Key performance Indicators are revenue, calls and meetings with customers and sales pipeline. No specific tool is used to measure project baseline process.

There are some specific tools used in supportive processes. Finance matters such as accounts receivable and payables managed by accounting tool Digitalous. SSF Wiki pages are a tool for internal information and project specific practical instructions. Skype is used as a tool for fast connecting with staff and with customers located abroad. These tools are not measuring tools as supportive processes do not have any specific measuring tools.

In Core processes Human Resource process uses excel for skill matrix and resource allocation. Recruiting process is followed via emails and development discussions, test period discussions and exit discussions are held face to face, afterwards improvement ideas are documented in archives. In Corporate Governance and business planning and management process number of management meetings, board meetings and strategy off sites are documented as well. Project specific tools are defined for each project. However, SSF has set up also general tool used in every project that provides harmonized processes and automation between projects

and assess their usage like DOORS, JIRA, and VECTOR CAST. One of the most important tool is the issuing tool JIRA, used in all projects and also at the company level management (recording and management, findings, actions, defects, tasks improvements, etc).

#### 5.2.4 Measurement challenges

SSF find that most complicated measurement challenges are to recognize which processes are the most important to be measured and improved at the moment. Early recognition can add value to the business, identifies early risks and helps in foreseen future needs, this improves customer service and better satisfy customer needs.

Second great challenge is that there is not such system which can react in real time on risks and important issues. As every project is different with its specific needs and requirements to be fulfilled there for one system cannot identify all ongoing projects risks in real time.

After second challenge, third major challenge can consider to be that the measures are not well defined in the sale phase or in the project starting point. As there are number of issues to be measured in a project therefore measures should be analyzed and they should be up to dated, if not this might lead working to wrong direction. Project Manager find collecting and processing measurements to be time consuming and that the value of the metric does not really tell much about the quality of the metric. Sales director find measurement challenges of his own processes to find good Key Performance Indicators to measure sales performance, forecasting training need and to measure accuracy of outsourced work.

#### 5.2.5 Underdeveloped processes

Human resource processes is considered to be most under developed process as well. Company monitors and updates each employee's skills and curriculum vitae. Only monitoring does not help in planning training needs, staff planning and assessing the suitability of an employee to a specific task. All new staff should be trained into company's quality system as SSF is adopting the new ISO 9001&2015 standards.

In projects estimation of workload is in need to be improved which means that methods, tools and experience gained should be documented in more detail. Progress and schedule control process in project does not go in hand to hand with project milestone and status of team members tasks. Because of this it is very difficult to predict when the milestone is accomplished. Impact estimation process is based on guessing therefore not accurate and objective. The metrics and other results of the project are not automatically recorded and have to be done manually which overloads project managers and team leaders.

When it comes to quality, monitoring subcontractors and suppliers quality system is in need of improvement. Subcontractor's commitment to tasks is not well assessed. As SSF is responsible for all subcontractor and suppliers' outcome, minimum requirement should be ISO certificate to avoid the situation SSF has to audit them regularly increasing also costs.

Other processes which need some development are marketing and finance. Marketing is not visible at the moment although the company does representing in its own field seminars around the world. Finance matters are mainly outsourced therefore finance matters cannot be directly developed but evaluate threw feedback.

#### 5.2.6 Development challenges

Project manager and Managing Director find additional time to be most challenging when defining and implementing improvements and developing processes. Second challenge is to evaluate if there really was an improvement which is also time consuming process. According to Sales Director finding solutions to get the tasks done without increasing the amount of work is challenging. The most work load is founded to be in maintaining the process rather than getting it started. Quality manager believes that customer specific definitions and opinions are not equal with SSF practices. Employees are not willing to use someone else's methods and only prefer their own due to their own experience gained. Finance Director would rather give more authority to the quality manager to intervene into employees work to prevent mistakes. This is considered to be challenging as employees might find it to be lack of trust or insulting.

SSF has realized that there are few most important factors to consider while developing that the quality remains high standard. Firstly all the directors agreed on that all processes have to be taken into consider. Processes are linked together which means that one process cannot be developed without take into account the impact on other processes. Therefore paying attention to the processes and being realistic is very important as processes have to describe what has been done. Second important factor is how to motivate and encourage staff to use their own best practices. It is challenging to ensure that new ideas and improvements are taken into use without losing the harmony between processes and projects. Staff motivation is important factor as work at SSF is not routine like.



## 6 Findings of data and empirical studies

### 6.1 Purpose and benefits of process measurement

J Moisio (2009) believes process measurement is simple when the processes are defined clearly and known what the goal of the process is. Every company has its own measurement tools and reason. The results of measurement can be eye opening experience. But why measure the processes?

Measurement; controls the behavior (negative and positive), illuminate what works and what does not, focuses on the important issues, predicts if the expectations are going to fulfill, enables the setting of the objectives, supports the achievement of the goals, enables the feedback giving, supports the decision making and problem solving, enables the anticipation, increase the understanding of issues, enables the preparation of forecasts, directs the liabilities, supports the motivation and innovation (J Moisio, 2009).

According to J Moisio, the benefits of process measurement can be detected in four areas; business effectiveness, increasing the decision making authority, developing the speed of response and transparency.

Business effectiveness helps employees to work better with the management. Also it helps employees to understand how strategy and goals are linked to operational measures (J Moisio, 2009).

Increasing the decision making authority helps employee to take the agreed measures set derived from the strategy objectives within the framework until the end and to cooperate with the management (J Moisio, 2009).

Developing the speed of response helps employees to react rapidly on various changed situations from customers, suppliers and organization (J Moisio, 2009).

Transparency helps the management, organization and individual to see visually how the strategy and business processes function together and how the measures are affecting (J Moisio, 2009).

### 6.2 Key process metrics at SSF

Process metrics is a tool for the company to monitor, evaluate and improve their operational performance (The Hackett group, Access 2.9.2015).

Metrics provide information of the process effectiveness and efficiency. Internal and external customers get useful information of process through effectiveness. Efficiency provides information about added value produced for the customer and SSF (Niemitalo, 2014).

At SSF assigned responsible personnel are maintaining metrics as part of their tasks. Status of the metrics is reviewed regularly with the management. Marketing and sales metrics are reviewed weekly, project and quality management system monthly, strategy twice a year and yearly reviewed are skill and competence metrics (Niemitalo, 2014).

#### 6.2.1 Marketing and sales metrics

Marketing and sales metrics are done by assessment model SugarCRM. Object to be measured are numbers of calls and meetings, number of proposals and their value in euros and business volume of exact turnover in euro's (Niemitalo, 2014).

#### 6.2.2 Project metrics

Project are measured and kept in under control to achieve good company financial result as they are the major items in the cash flow of the company.

Projects are divided in two categories. Small projects require three or less persons per month and customer manages the consulting working time and material basis. Large projects requires more than 3 persons, consulting work can last longer and requires heavier control and metrics (Niemitalo, 2014).

Each project metrics are reported by project manager to management group. Reporting issues are:

- Schedule of the project
- Profit in percentage
- Estimated project costs monthly or as a work package
- Work performed in working hours
- Completion of the work in percentage from work package
- Cost variance
- Status of payments and invoices
- Current situation of the project costs

In monthly review meeting with the management level, project manager also updates the issues of project risks and control of the risks, quality issues, customer satisfaction, findings of audits and process improvements. All metrics and issues are documented through out the project (Niemitalo, 2014). In addition to the company level metrics, each project - called also

as a product - has its own specific metrics (quality sub characteristics) monitored during the development phase to satisfy a customer needs ( defined as quality characteristics) as defined in a project specific quality model (Niemitalo, 2014).

### 6.3 Process audit assessment

The management of SSF is responsible for defining the audit program and schedule for a certain period of time. Auditing itself is performed by Quality manager or her assigned engineer dependent on the audit target. The internal long term audit plan is reviewed on a yearly basis by management. Each specific audit defined in the long term audit plan is planned and reported separately. To solve problems and improve quickly infected processes, plan can be reviewed more than once a year (Niemitalo, 2014).

The SSF Board defines the process for audit and Quality manager manages the audit. Quality manager has the authority to allocate needed resources but schedule and resources as well as the audit goals have to be approved by the Board (Niemitalo, 2014).

Quality manager record the outcome of the audits and monitors the action status, improvements and corrective actions. For this company-level issue tracking and management tool JIRA is used. The tool is designed to notify automatically the corrections needed to be done in processes to the responsible personnel. If corrections are made, Quality manager approves and closes the actions after they have been ensured. Overall status is recorded for management review meeting for close-out actions (Niemitalo, 2014).

### 6.4 SSF customer feedback

End of every year the Quality Manager carries out a customer and supplier survey to assess SSFs services and customer experience. In the survey there are seven multiple choice questions. Questions are to assess sales and management team, Project management team, technical staff and characteristics of the company. In 2014 customer number who answered all questions were 34 and in 2015 customers were 48.

Two most important questions concerning quality are how likely customer would recommend SSF to a friend or colleague and to pick three attributes which best describe SSF. First question is to assess on the scale of 1-10 as one being would not recommend at all and ten being would definitely recommend. For the second question, three from sixteen attributes were to pick.

Figure below shows that in both 2014 and 15, 80% of customers are willing to recommend SSF services. Less than ten percent might or will not recommend SSF.

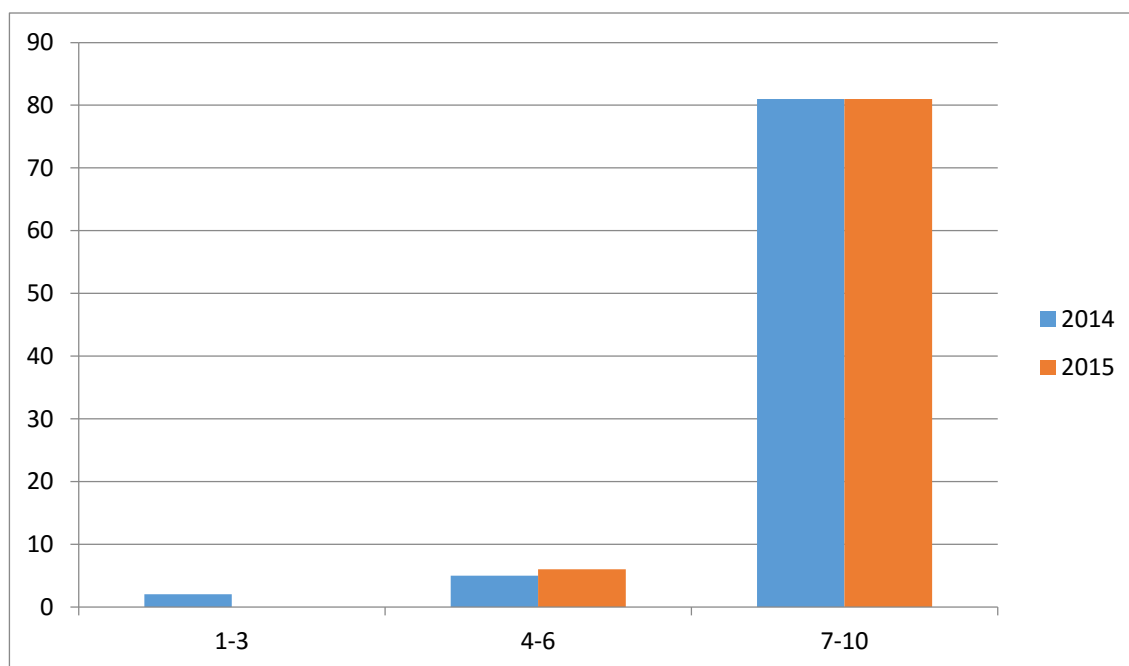


Figure 1. Customer recommendation score 10 is high, 1 is low

Figure 2 shows that the customer five most selected attributes were reliable, enthusiastic, intelligent, high quality and successful. In 2014 SSF has been more reliable, intelligent and had higher quality than in 2015. In 2015 company was more enthusiastic than in 2014 but as successful as in 2014.

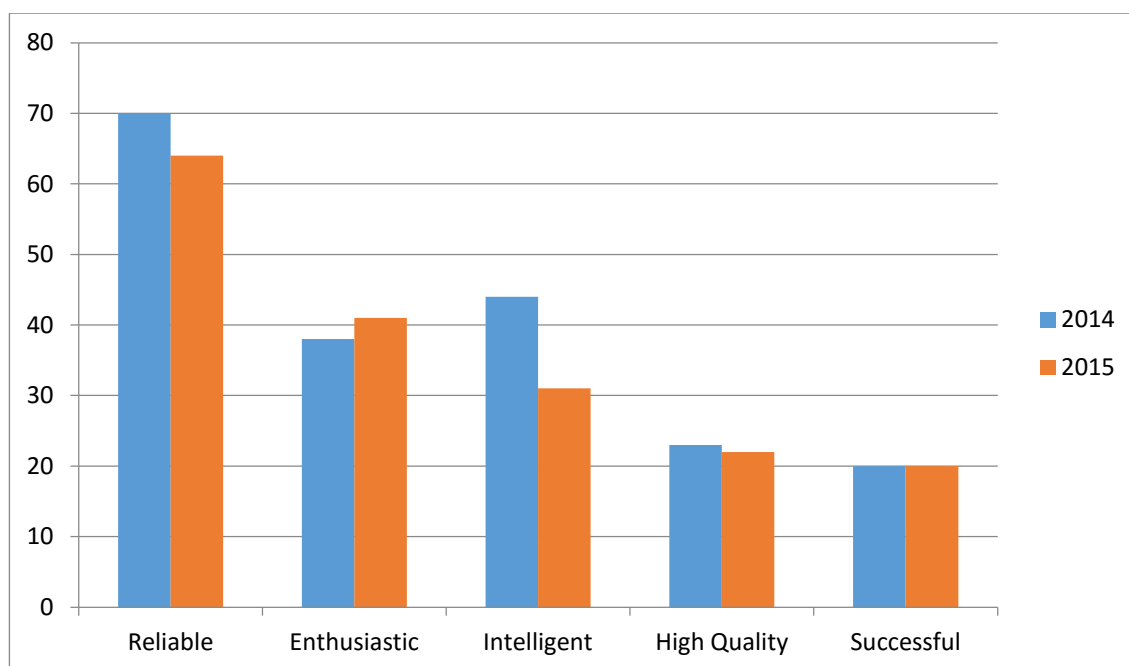


Figure 2. Customer scoring of SSF 2014 and 2015

The result of these two questions and any other questions from the survey are not directly comparable because the amount of answered customers is not equal. Nevertheless, one might think that almost all bars of 2015 are lower or equal than bars of 2014 that SSF got better ratings in 2014 than in 2015. Although in 2014 there were only 34 customers who answered the survey.

#### 6.4.1 Improvement ideas

Improvement ideas were gathered from the customer and supplier surveys which were carried out in October- December 2014 and October 2015 by the Quality manager.

The main issue which occurs in most of the improvement ideas was that accuracy in timeliness of the deliveries. One of the customers' feedback was that "I would suggest to do something to improve the timeliness of the deliveries and try to train new staff ", second customer just simply comment "schedule commitment". Other issues were concerned about the lack of training of the staff and lack of communication.

One of the improvement ideas to the timeliness accuracy was for example schedule tool to manage tasks. A customer suggested that in challenging projects need of senior experts support should be provided to the working person as it is unreasonable to assume that only one person can manage with challenging project. This may help in delivering on time. Also if the projects were dimensioned adequately, necessary resources could be provided on time. Other ideas were to better train to usability issues and more tools and techniques for requirements visualization.

In 2014 improvement ideas were not concentrated on one issue like in 2015. There were many ideas such as:

- Adding ISO 13485 standard in Quality Management
- Better communication between project team, status of the work updated more frequently and less process orientation from project management
- Advertising and developing JIRA issue tracker
- Review the business strategy as unclear what is the primary role and activities, seems to be too conservative at the moment and is not creative in identifying new markets.
- More detailed product and test result documentation

As it can be see that improving in communication was also suggested in 2014

## 6.5 Future implementation of ISO standards

Quality manager of SSF mentioned in her discussion that ISO standards 9001:2008 are going to be renewed to ISO 9001:2015 standards. SSF is going to implement these new standards starting in 2016 (transfer time ca. 3 years). Quality management system standard is going to be changed to Context of the organization standard. There will be two new requirements: Understanding of the organizations and Expectations of interested parties. Quality management system and processes requirement will have some minor changes. Such as Quality manuals will not be mandatory. Quality management will stay as process oriented as it is now and products/services will be produced as a result of processes.

## 7 Conclusions and discussion

Focusing on one company was because of quality management is implemented differently in every organization. Second of all, Space Systems Finland Ltd. has been growing financially but because of increasing competition on the field, company need to put even more focus on its uniqueness and quality. Company was very willing on research of their quality management system process measurement and the challenges what can occur when measuring and developing the process.

Interviews with the directors and quality manager seemed to be appropriate as they are the main responsible of the quality management system processes. Unfortunately because of incompatibility of only Finance director's interview was carried out face to face. Interview questions were sent by email and one week time was given to answer the questions. Many additional discussions were held with the Quality Manager and Finance Director who guided and gave empirical data on this topic.

Challenges faced during thesis were first of all finding mutual time for interviews and discussions. Challenge was overcome by discussion on issues every possible chance getting for example at the coffee break. Second challenge was that few interviewees found the interview questions bit difficult and out of their knowledge range. Therefore some answers were short and not so informatics. For getting more out of the question, additional questions were asked and questions were explained in bit different terms. Third challenge was that few interviewees could not participate due to lack of time in their schedules. This of course affected on the data to be analyze.

SSF seems to be obeying strictly ISO standards as company's services and products are outcome of processes which are customized and tailored into each project separately to satisfy the customer when needed. Implementation of new standards will give more value to the company from the business point of view by evaluation more thoroughly possible risks and

focusing on minimizing their negative impact more systematically. Additionally, of implementing new ISO standards, company should consider using some improvement methods from Six Sigma.

In interview data it has been mentioned by all interviewees that Six Sigma is not in use. Subconsciously company has been using the Six Sigma improvement methods such as focusing on customer in manner that company does yearly basis customer survey and measures customer satisfaction as well as teamwork in every level is good. The improvement methods which company could implement and which are one of the measurement challenges is accurate training and pro-activeness. Accurate training improvement method could help company to define and manage clear infrastructure of trainers, trainees, training needs, roles and responsibilities. Pro-activeness would help if task understanding is complete therefore time and pressure management can be controlled. As time issues were most of customers concern.

Data also shows that there are underdeveloped processes such as human resource, marketing and monitoring subcontractors and supplier's quality system. SSF should concentrate in near future to monitor and improve these processes, maybe appoint a responsible whose task would be to concentrate on these processes and find solutions to improve processes.

Data also shows that SSF faces measurement and development challenges. Most important is that SSF has recognized these challenges and has started to improve these. The company has hired new employees which will ease the workload so that work can be more precise and accurate. This will help SSF to solve its challenges even though it might be time consuming and will not provide solutions and results at the moment but maybe in near future. Also company's customers and suppliers have given SSF excellent improvement ideas from which SSF should start its improvement implementation.

Reliability and credibility (Silvermann, 2001) of thesis is based on the theory and the interviews. Theory is from the reliable sources. Literature used was from Laurea University library. Additional material was given by company with their own will. No additional or doubtful source was used. Interviews were carried out with interviewees on their own will to participate. Interview method, theme interview was chosen because it was appropriate considering the above mention challenges faced. Quality Manager has analyzed the reliability of the data and has found it to be reliable and credible.

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## Figures

Figure 1 Customer recommendation score 10 is high, 1 is low

Figure 2 Customer scoring of SSF 2014 and 2015

## Tables

Table 1 Six Sigma Improvement methods

Table 2 ISO/IEC 15504 to be changed to ISO/IEC 33000

Table 3 Responsibilities in processes

## Interviews

Managing Director, Veera Sylvius interview date 05.10.2015

Sales Director, Timo Latvala interview date 08.10.2015

Quality Manager, Sirkka Niemitalo interview date 28.09.2015

Finance and Administration Director, Tuomas Talvioja interview date 12.10.2015

Project Manager, Victor Bos interview date 30.10.2015