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ISO9001 QUALITY MANAGEMENT SYSTEMS; BENEFITS AND REQUIREMENTS

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ABSTRACT

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The purpose of this thesis was to find reasons and justifications for the ISO9001 certified quality management system.

The major part of the case work was establishing QMS for Dedicated Networks Partners Oy. The other parts were literature and theory research about ISO9001 certifications. The third part was the case survey about quality expectations among customers of Dedicated Network Partners Oy.

The results of this thesis were an ISO9001 certification and an analysis of certifications process. Another outcome was comparing of the results of the case work to published research papers about ISO9001 and its certification.

The conclusions show that similar benefits of ISO9001 can be found from different countries and different industries. In addition ISO9001 is only a tool for high quality, it has to be used in a correct way to achieve benefits to the business.

Keywords:
ISO9001, Quality Management System, Quality Manual, certification, Quality Survey

TABLE OF CONTENTS

ABBREVIATIONS

CCTV   Closed Circuit Television, surveillance cameras

EMS   Environmental Management System

FAT   Factory Acceptance Test

HW   Hardware

ISO   International Organization for Standardization

KPI   Key Performance Indicator

MTBF   Mean Time Between failures

QA   Quality Assurance

QMS   Quality Management system

SW   Software

TQM   Total Quality Management

1 INTRODUCTION

The high quality is an important and interesting topic in many different industries and even among ordinary people. Quality as a word has transformed from the final product quality to the quality of work processes, and finally through processes to the quality awareness in all levels of the companies. To achieve the nowadays required high quality, quality management systems have been developed. To set quality management systems in different countries to the same level there are global standards and certifications for QMS.

What is QMS and processes behind the system? Product quality is many times easier to understand than quality systems. Are there any mandatory tools for the high quality? And is the ISO9001 certified quality management system a key to the world class quality? This thesis answers to these questions.

This thesis tries to find reasons and justification for the ISO9001 based quality management system. Establishing QMS is an important way to get right experience about QMS and certification process. It is many times difficult to say what the real benefits of QMS are. Does QMS boost the business with a higher product quality and a well defined operating model? Or does QMS have a negative impact on the business because of higher bureaucracy and higher costs? In final conclusions of this thesis there are answers to these questions based on three different approaches to this subject.

This thesis is based on research and two case work parts. The research part is an analysis of literature and research papers. Establishing Quality management system is case work part one. A survey questionnaire about quality expectations is another part of the case work.

1.1 Structure of thesis

This thesis is divided to seven chapters including the final conclusions. The chapters are theory of quality, literature study, ISO presentation, establishing quality managements system and my own research survey. The final conclusions summarize five sections to one quality study. All five sections use the author's own experience during the 15 years' in the utility telecom business to conclude different points of view

The description of the quality, and how the definition has been changed during the years, is defined in Chapter 2. In addition two theoretical viewpoints are presented for the quality cost.

Chapter 0 is a literature study about the effects of the ISO9001 quality management systems. Students and researchers over the world have published several different levels of research papers about ISO9001 and QMS. The main question of these questions is effects and benefits of QMS. Chapter 3 uses some of these published research papers and surveys behind these researches. These papers are made in different locations and different business areas, but with these papers it is possible to find similarities and links to the author's experience.

The ISO organization, the structure and history of the ISO9001 are presented in chapter 4. This chapter includes the ISO defined requirements for certification.

Chapter 5 describes establishing of the quality management system and ISO9001 certification for the case company, Dedicated Network Partners Oy. The actual work is described step-by-step to establish QMS and writing of the quality manual of the company. The quality manual is the main guidance for the internal processes of the company and it is the key document of QMS. Establishing ISO9001 QMS is strongly related to ISO standards, guidance and instructions, but typically they are only higher level instructions. A company can select its own focus related to its business environment in many areas of QMS. In addition the ISO9001certification process is covered

in this chapter. Experiences from this practical part are used together with theoretical parts to make the final conclusions.

Chapter 6 is the author's own research of the quality expectations in telecom industry. This part includes a survey to find quality expectations of the customers of Dedicated Network Partners Oy. Because high quality is more than only quality of products, it is always important to map the expectations. Individual surveys are needed to find out the importance of products, services and reliability and other aspects among customers. There can be found similarities between the case survey and published research surveys. This shows that there is generic quality thinking globally over totally different kind of business environments.

2 THEORY OF QUALITY

This chapter presents different views to the quality. What is the definition of the quality and how others than quality professionals understand quality. Evolution of quality thinking from the quality assurance to the total quality management is presented, as well as introduction to the fundamentals of the quality cost awareness.

Quality as a term is used widely, but it is difficult to explain what the quality really is, and where the line between good quality and luxury exists. But in the common thinking quality is typically quality of the products and, also quality of the services. When the quality is approached more professionally, it also includes processes and the mode of the operation.

According Oxford Dictionaries quality is defined; "The standard of something as measured against other things of a similar kind; the degree of excellence of something". This definition tells everything in the one sentence, quality is something better than others. (Oxford dictionary, 2014.)

Sometimes people could think that high price is the same thing as the high quality, but this is not true. Products or services can be categorized as the luxury if they exceed all normal standards and expectations but their price is much higher than average. Quality products or services have to be beneficial from economical point of view of manufacturer and customer. If a company manufactures and sells high quality products but does not make revenues its operation is not on good quality level. So it is because quality covers the way of working and the internal processes.

A short conclusion for the definition of the quality is that the high quality satisfies customers' expectations. The quality company is, also profitable within local laws and common well known business practices. If processes of the company are not well defined or controlled it could affect to the profits .As well as direct cost of the quality must not have negative affects to the profitability.

2.1 From QA to TQM

The Quality Assurance (QA) is a traditional approach to improve and control quality. Nowadays approach has moved from the QA to the Total Quality Management (TQM) and one driver for this change is the evolution of the ISO9000 standards.

According to ISO the Quality Assurance is a way of preventing mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers. For example in manufacturing plant this is mainly checking and testing of the products before delivery. The cost of the quality defect is higher when it is found in later phase and this has been the motivator to develop the QMS and move towards the TQM.

There has not been any major change in the published versions of the ISO 9000 family standards issued after year 2000. There was a more generic process based structure in the year 2000 version. It identified notable changes in the elements of "customer satisfaction" and "continual improvement". In addition it assembles a limited amount of total quality management elements. (Andrew W.T et.al. 2009.)

The Total Quality Management has many definitions in several sources. BS 7850 (BSI, 1992) defines TQM as the management philosophy and company practices that aim to harness the human and material resources of an organization in the most effective way to achieve the objectives of the organization. Another definition of the TQM, which is used by the Department of Defense in USA, is a philosophy and a set of guiding principles that represent the foundation of a continually improving organization (Tingey, 1997). Common to the all TQM definitions is overall quality thinking and commitment to the quality over all personnel from the top management to the youngest trainee and all functions from sales to logistics.

2.2 Cost of quality, manufacturing process

The cost of the quality is difficult to show as exact figures but there are theories about the quality cost. Costs can be shown as a target level of the quality and the cost to achieve that level.

Like in the classical model shown in FIGURE 1 the cost of preventing defects is higher when the targeted quality level increases. A reason for the higher cost could be for example more working hours used in final testing or a new expensive tool needed in the quality assurance. In addition the cost of failures is lower when quality level is higher. The cost of failures could be caused by a material scrap or need for re-work. In the worst case, the cost of poor quality comes from a customer complaints and warranty costs.

This model presents what is the optimal level for the quality control. In this model the cost of the quality control is presented as the prevention cost curve and the cost of defects is shown as failure cost curve. The sum of these two cost elements is shown as the total cost curve. It can be used as the total cost including quality costs and cost of non-conforming products. At the lowest point of total cost curve is optimal situation when failures and quality assurance are in the balance.
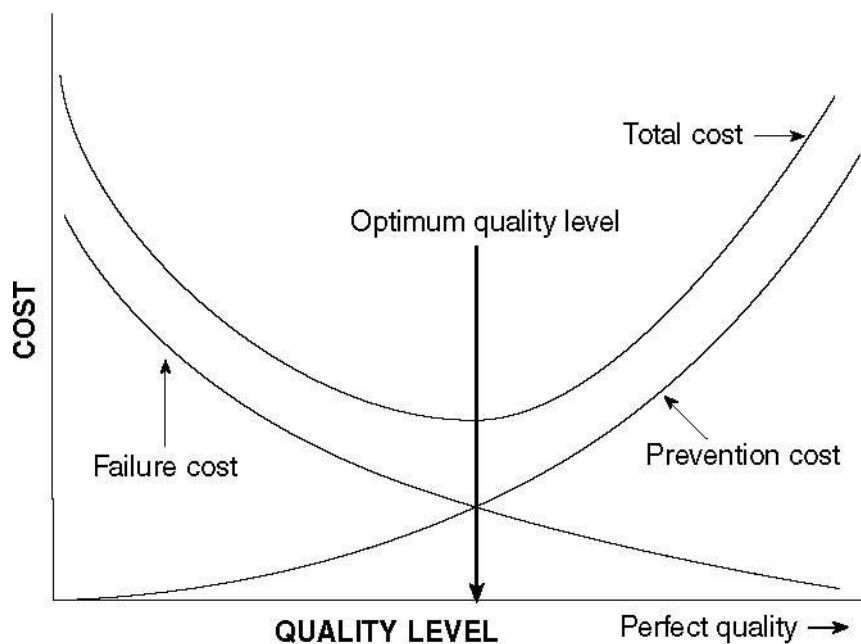
FIGURE 1. Classical model of optimum quality costs (Juran 1988)

The classical model is simplified presentation in which the direct costs only are calculated and it shows clearly that too high quality should not be the target. It does not care about the indirect quality benefits like marketing needs for high quality brand image. But this model is useful for simple high

volume products like mechanical parts or other basic components. This model is not usable for complex products with several parts and sub-assemblies.

2.3 Cost of quality defects

In the development projects there could be different approaches to the cost of the quality. The quality costs at different phases from design through manufacturing to customer's field installation vary significantly. This can be presented as in FIGURE 2, relative costs of correcting an error. This figure presents errors in the software projects, but the same principle can be elaborated to the other industries as well. The main principle is that early findings save cost and time.

In the worst case, the error is found in the field operation and reason for error is a mistake in product requirements. Then fixing the error means that all phases have to be repeated before fixed product can be deployed to the field operation. (Pressman, 2001.)

This model has been divided to six phases:

- Requirements: Definition of product requirement before actual implementation.

- Design: Detailed specification of product.

- Coding: Actual implementation of specified product.

- Development testing: Testing of single blocks.

- System testing: Testing product as part of larger environment.

- Field operation: Customer uses product in actual application.
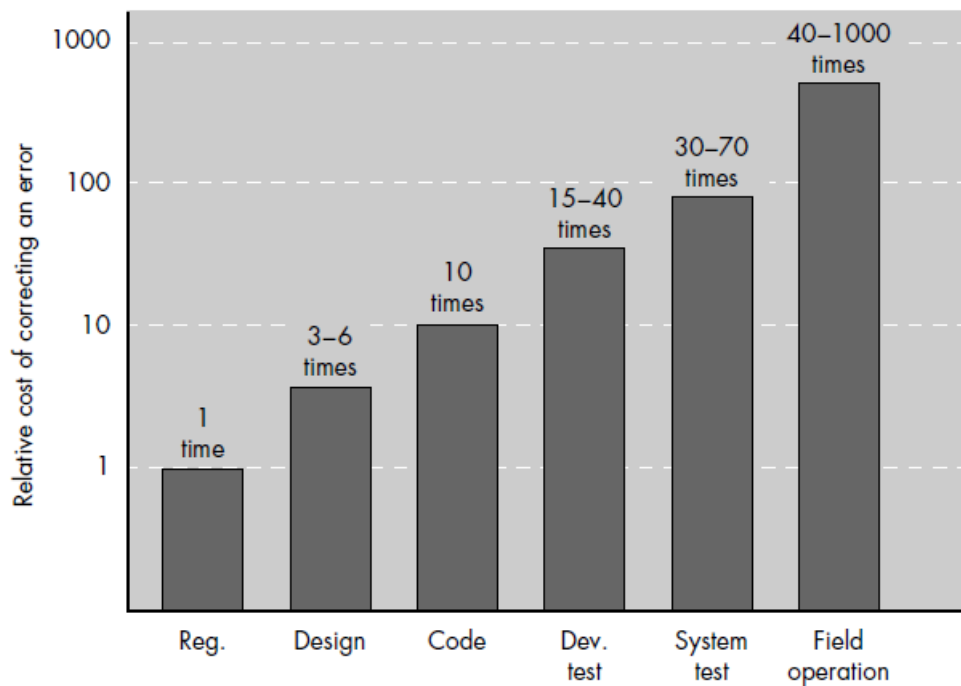
FIGURE 2. Relative cost of correcting an error (Pressman, 2001 p198)

In the telecommunication equipment development project there are few more phases and content of phases is larger because it includes, also HW development and field installation. Model follows the same fundamentals as Pressman presents and can be easily transformed to any other industry.

In the telecommunication equipment development project are these phases:

- Requirements: Definition of product requirement before actual implementation.

- Design: Detailed specification of product.

- Implementation: Actual implementation of specified product, like SW coding, HW circuit design and mechanical drawings.

- Development testing: Testing of single blocks and HW prototyping. This phase can be called as verification.

- System testing: Testing product as part of larger environment. This phase is can be called as validation.

- Manufacturing: Ramping up production is typically phase when some quality issues could affect all phases before production.

- Customer approval: Customer FAT and governmental approvals.

- Field operation: Customer starts using product in real application.

- Long term operation: Product reliability in long term field operation like too optimistic MTBF figures.

These kinds of models are always theoretical models based on an assumptions and averages. Quality personnel cannot use these as a single truth. However, the basic principle is definitely true and good guideline for all developing projects. It is always better to find errors sooner than later. One method to find defects as early as possible is the formal reviews of specifications and plans. Also testing in early phases is essential to find possible quality issues in time.

3 ISO 9001 QMS EFFECT

Many times benefits of the quality management system are under investigations. Is QMS really needed and what are the benefits of the ISO9001 certification? Cost of the ISO9001 certification can be calculated relatively easy. Working hours and cost of the Certification Company are main cost elements of the process.

It is much more difficult is estimate what the operating cost of the quality management system and what the benefits of the certification are. ISO9001 could cause higher operating costs, if the QMS defines time consuming and expensive processes. Also the non-direct benefits of the ISO9001 are very difficult to calculate. The direct cost of poor quality can be many times identified and it can be calculated as cost of non-conforming products before and after the ISO9001 certification. There are available several research studies about the ISO9001 certified quality management systems and how they effect to operation of company and its products or customers. This chapter referrers to some published quality surveys and compares their results.

3.1 Benefit of management system in U.K.

The benefits of implementing ISO9001 are confirmed by several academic studies. According to a large-scale national survey conducted by WM To, Peter Lee and Billy Yu solicit views from UK's firms on their motivations and perceived benefits from implementing ISO standards. Standards in survey's scope were ISO9001 quality management system, ISO14001 environmental management system and OHSAS18001 occupational health and safety management system.

Profit improvement, process improvements, and marketing benefits were the most important benefits from the certification found in 157 returned questionnaires. The marketing benefits included gaining new customers, using the standard as a promotional tool, increasing market share, increasing growth in sales, and improving customer satisfaction.

This research about the benefits of the implementing management systems clearly shows that ISO9001 and ISO14001 certified companies perform better than companies with only ISO9001 management system. The observed areas were: Corporate performance, Quality performance and Marketing performance. A combination of quality and environmental management systems gives best results. Especially in the marketing performance category there are best results in companies having the both QMS and EMS. Results graphics are visible in FIGURE 3 (W.M. To et al., 2012)
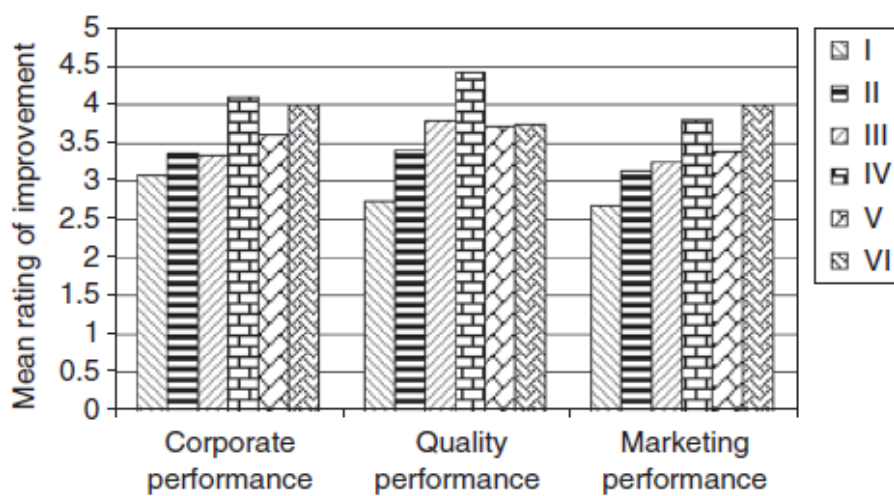

FIGURE 3. Mean ratings of improvement (W.M. To et al., 2012)

Different groups and their sizes are shown in TABLE 1. The clearly largest group was companies having ISO9001 and ISO14001, and only 3 companies were without any certification. ISO14001 and OHAS18001 are introduced in the chapter 4.2 of this thesis.

TABLE 1. Legends for Mean ratings of improvement graph

Group	Standard(s)	Sample size
I	None	3
II	ISO9001	36
III	ISO14001	6
IV	ISO9001 and ISO14001	75
V	ISO9001 and OHAS18001	34
VI	ISO9001, ISO14001 and OHAS18001	3

The environmental management system effects to companies marketing performance and it shows that ISO14001 is important in marketing perspective. On another hand companies having the certified QMS and EMS typically have strong quality culture and they could success in this kind of research, also without certifications. Sample size of companies without ISO9001 was very small, only 5,7%. That's why the comparison between certified and non-certified companies cannot be made based on this survey.

3.2 Customer satisfaction after certification

A research by Vahid Nabavi, Majid Azizi and Mehdi Faezipour finds a clear relationship between customer satisfaction and implementing the ISO9001 Quality management system. The QMS was established to the kitchen furniture manufacturer in Iran. The customer satisfaction was followed monthly over 11-month-period. Three months before and eight months after starting the QMS.

The customer satisfaction was measured in five different areas; Technical features, the quality of the consumed raw material, after sales services, delivery time and the price of the sales items. All these five areas did show improvement after the QMS was taken in the use. Overall satisfaction did increase after certification in April 2011. The improvement in customer satisfaction can been seen in FIGURE 4 where the summary of the five measured areas is. (Vahid Nabavi et al., 2014)
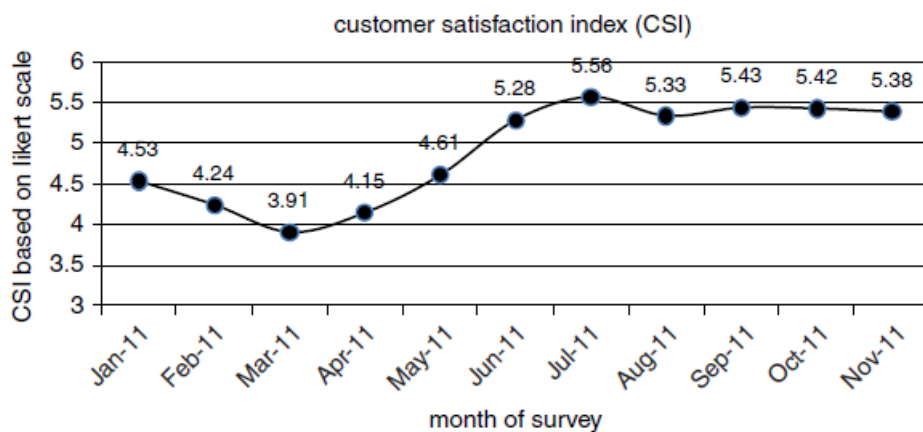
FIGURE 4. Customer satisfaction index (Vahid Nabavi et al., 2014)

In this study the cost of the better and more costly raw material was not taken in account. In many of cases using better raw materials can increase quality of products and customer satisfaction. This surveys show anyhow that operating according the ISO9001 improves company performance in many areas. The higher material cost could be acceptable, if benefits compensate higher costs and company can still operate in profitable way.

Few months of after taking the QMS in use, the CSI index remains in better level than starting point. Improvement in three months after certification is fast and it would be interesting to see what the level is after one and two years. Could the company remain at a better level or do a results collapse after the years when initial enthusiasm has disappeared?

3.3 Certification benefits

Several surveys have been made among the ISO9001 certified companies about how companies see the benefits of the ISO9001. These surveys are

not made exactly the same way, but there are still enough similarities to make conclusions between surveys.

3.3.1 Benefits in Greek

Katerina D. Gotzamani and George D. Tsiotras have made widely cited survey in 2002 among the ISO9001 certified companies in Greek. 84 companies answered to the survey with response rate 57%. One part of the survey was internal and external benefits or positive results that certified companies achieved as a result of their certification. This survey calculates mean score for each benefit. Score indicates the degree to which certified companies witnessed it as a result of the ISO9001 implementation. Certification benefits survey results are presented in TABLE 2.

TABLE 2. Certification benefits (Katerina D. Gotzamani et al., 2002)

Rank	Certification benefits	Score
1	Improvement of internal organization and operation	3,89
2	Development of quality culture	3,77
3	Final product quality improvement	3,7
4	Improved customer satisfaction	3,62
5	Better communication with customers	3,58
6	Improved competence position	3,56
7	Development of teamwork	3,48
8	Improved employee-management relationships	3,39
9	Less rework and waste	3,29
10	Improved suppliers' performance	3,28
11	Better relationship among employees	3,28
12	Easier penetration to new markets	3,21
13	Less customer complaints	3,17
14	Less customer returns	3,04
15	Increased employee satisfaction	3,03
16	Increased employee participation	2,95
17	Higher sales	2,86
18	Increased productivity	2,75
19	Higher profits	2,65
20	Reduction of absences	1,73

The change of culture boosts quality awareness and commitment through the company, and increases possibilities to long term success. Significant improvements are achieved in relation to the competitiveness improvement, the customer communication and the customer satisfaction. Also moderate improvements were achieved regarding the teamwork development, the employee communication, the employee-management communication, the suppliers' performance, the new market penetration and the reduction of the rework and waste.

Less significant benefits (score lower than 3) were for example achieved in the employee satisfaction, the productivity and the increase of the profits and sales. Although the ISO9001 implementation was significantly related to a number of positive business results, it was not significantly related to the employee satisfaction. (Katerina D. Gotzamani et al., 2002.)

The most significant top 2 benefits were found in internal operations and quality culture. This is a clear benefit of certification because the ISO9001 standard defines internal processes and internal promotion of quality. The third significant benefit was improved product quality. It could be result from improvements in the processes and culture. The customer satisfaction and communication are both in top 5 benefits. One reason for improved customer operations could be highlighted customer focus in the ISO9001 guidance.

Using factor analysis the certification benefits were grouped based on their correlations. Benefits were then grouped to four categories. The exact benefits in each category and mean scores of these categories are presented in FIGURE 5. The score of each category shows that certification benefits effect mainly quality improvement and internal organization and operation. Score is lower in the competitive and financial performance and much lower in the productivity improvements. (Katerina D. Gotzamani et al., 2002.)

Certification benefits factors	Certification benefits
I. Internal/operational benefits Mean score: 3.43	Improvement of internal organisation and operation Development of quality culture Employee-management communication improvement Employee communication improvement Development of teamwork Increase in employee satisfaction Increase in employee participation Customer communication improvement
II. Quality improvement Mean score: 3.35	Less rework and defectives Improvement of final product quality Improvement of suppliers' performance Increased customer satisfaction Less complaints Less returns
III. External/competitive benefits Mean score: 3.05	Improved competitive position Sales increase Profits increase Easier penetration in new markets Reduction of absences
IV. Productivity improvement Mean score: 2.74	Productivity improvement

FIGURE 5. Certification benefits factors (Katerina D. Gotzamani et al., 2002)

These categorized results show that quality management system itself defines many internal processes. In addition, the certification clearly improves the product quality.

3.3.2 Benefits in Saudi Arabia

Hesham A.E. Magd has made similar kind of research as Gotzmani in 2002. His survey has been made in Saudi Arabia in year 2006 about the benefits of the ISO9001 implementation. Survey was conducted with 175 ISO9000 certified companies and response rate was 60%. Also this survey was asking benefits of ISO9001 for company itself.

TABLE 3. Benefits of ISO 9001 implementation in Saudi Arabia (Hesham A.E. Magd, 2006)

Rank	Saudi-Arabia	Score
1	Improved the efficiency of the quality system	4,93
2	Better documentation procedures	4,89
3	Increased quality awareness in the firms	4,76
4	Improved the quality of products and customer services	4,36
5	Clear working instructions or procedures	4,33
6	Effective communication among employees	4,23
7	Improved the quality of incoming materials	4,11
8	Reduced defective rate and wastes	4,09
9	Helped in continual improvement	4,04
10	Expansion to international market	3,95
11	Greater opportunity for export	3,87
12	Improved productivity	3,66
13	Reduced customer complaints	3,61
14	Increased market share	3,54
15	Improved process design	3,43
16	Greater competitive advantage	3,33
17	Decline in business costs	3,12
18	Improved profitability	3,08
19	Better corporate image	2,87
20	Increased sales	2,65
21	Improved supplier relations	2,61
22	Clear job responsibilities	2,45
23	Improved staff motivation	2,40
24	Positive cultural change	2,39

The quality system itself was number one. That is obvious, because the ISO9001 defines the quality management system. Also rank 3 can be connected to implementation of the QMS. When the QMS is taken in the use,

typically there is quality promotion campaign in the company. The ISO9001 requires quality information sharing inside organization. The documentation of the processes is number two and it is also easy to agree. ISO9001 requires for QMS a well defined documentation process. The location of the documents has to be defined and several records have to be saved as the evidence of the operation according the QMS.

The quality of products was on the fourth place. It is the most interesting meter for quality. Product quality was not number one but this result was very good. According to this survey companies think that implementing the ISO9001 QMS really improves their product quality. The main reason for improved product quality could be improved quality system. But the most probable reason is the combination of several aspects defined by the ISO9001. (Hesham A.E. Magd, 2006.)

3.3.3 Common benefits

In Gotzmani and Tsiotras survey year 2002 in Greece can be found similarities as Madg's survey 2006 in Kingdom of Saudi Arabia. The questions were different but the same issue can be asked by different words. FIGURE 6 presents all results in top to low order side by side. Six similar topics can be found from the both surveys and matching topics are highlighted with the same colour. The matching topic pairs are presented in TABLE 4

Rank	Saudi-Arabia	Score	Greek	Score
1	Improved the efficiency of the quality system	4,93	Improvement of internal organization and oper	3,89
2	Better documentation procedures	4,89	Development of quality culture	3,77
3	Increased quality awareness in the firms	4,76	Final product quality improvement	3,7
4	Improved the quality of products and customer serv	4,36	Improved customer satisfaction	3,62
5	Clear working instructions or procedures	4,33	Better communication with customers	3,58
6	Effective communication among employees	4,23	Improved competence position	3,56
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8	Reduced defective rate and wastes	4,09	Improved employee-management relationships	3,39
9	Helped in continual improvement	4,04	Less rework and waste	3,29
10	Expansion to international market	3,95	Improved suppliers' performance	3,28
11	Greater opportunity for export	3,87	Better relationship among employees	3,28
12	Improved productivity	3,66	Easier penetration to new markets	3,21
13	Reduced customer complaints	3,61	Less customer complaints	3,17
14	Increased marked share	3,54	Less customer returns	3,04
15	Improved process design	3,43	Increased employee satisfaction	3,03
16	Greater competitive advantage	3,33	Increased employee participation	2,95
17	Decline in business costs	3,12	Higher sales	2,86
18	Improved profitability	3,08	Increased productivity	2,75
19	Better corporate image	2,87	Higher profits	2,65
20	Increased sales	2,65	Reduction of absences	1,73
21	Improved supplier relations	2,61		
22	Clear job responsibilities	2,45		
23	Improved staff motivation	2,4		
24	Positive cultural change	2,39		

FIGURE 6 Comparison of results

TABLE 4 lists similar or almost similar benefits of certification from the both surveys. There can be found that the same benefits are ranked similarly in the both surveys.

TABLE 4. Similar benefits

Rank	Saudi-Arabia	Greek
1	Improved the quality of products and customer service	Final product quality improvement
2	Improved the quality of incoming materials	Improved suppliers' performance
3	Reduced defective rate and wastes	Less rework and waste
4	Improved productivity	Increased productivity
5	Improved profitability	Higher profits
6	Increased sales	Higher sales

The number one in common benefits of the certification was improved quality of products and services. This is obvious and shows effect of the quality management system. Even though this is not necessary based on any measureable figures and it could be only subjective thinking inside the company.

Number two in common benefits is improved incoming materials. Incoming materials can be linked to the performance of suppliers. The ISO9001 quality management system has to define the logistics management and the management of the material flows. Also several ISO9001 requirements are related to selection criteria of new suppliers. These requirements affect supplier performance or guides supplier selection processes to better sources.

The third common benefit that is clearly improved in both surveys is the reduced waste and rework. One clear link from reduced rework to the certification is control of the documents. When work instructions are managed well, number of non-conforming products and rework decreases. There can be found a relationship to the top benefits "Better documentation procedures" and "Improvement of internal organization and operation". Reduced waste is related to the ISO14001 environmental management system more than to the ISO9001. But many times ISO9001 and ISO14001 are overlapping and they can be included in the same quality manual.

The improved productivity is not so clear benefit of the certification. In Saudi-Arabia it was almost the same as average of all results, 3,66 vs. 3,61. But in Greece it was clearly below average with low score. An exact reason for different results in Greece and Saudi is impossible to say according published research papers. One reason could be totally different kind of cultures in these two countries, and culture has always some affect to these surveys. Another reason for these differences could be year of surveys, 2002 vs. 2006. In the year of 2002 the new version of the ISO9001 (2000) was newly published and most probably some companies did still use older version or taking use of the year 2000 version was fresh.

In these surveys the profitably of the company was number five of the common benefits. The profitability was not improved because of the ISO9001 certification. One main reason is that the ISO9001 QMS does not directly guide to better financial processes. The focus is typically in the products and product related processes in this kind of subjective surveys. It is, also possible that certification and implementing of the QMS could affect negatively to profitability. Definitely it is not the target of the certification. Even though some costs increase the decreased cost of bad quality should compensate them. The cost of the quality is covered in the chapters 2.2 and 2.3 in this thesis.

Number six of the common benefits is increased sales. It has clearly low rank in the both surveys. The ISO9001 does not give direct guidance to the sales, because the sales apply the same thing as profitability.. Sometimes the ISO9001 certification is needed for certain markets or customers. This can be seen in surveys "Expansion to international market" and "Easier penetration to new markets" that was average scored benefits in both surveys. But interesting point is that these new markets are not seen as higher sales. Maybe new market opportunities can be seen, but increasing sales from the new markets are not so clear.
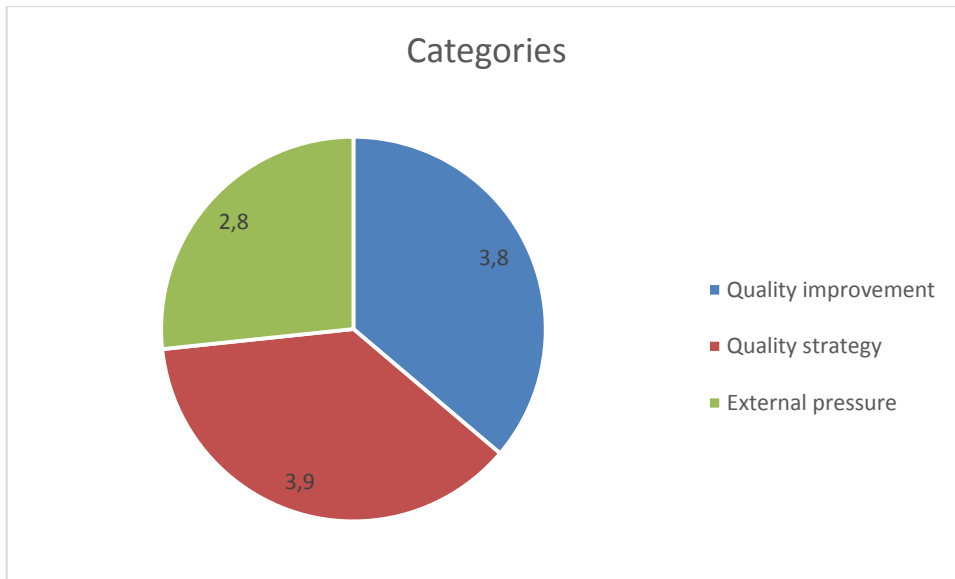
3.4 Motives of ISO9001 certification

The true motives behind the ISO9001 certification are not necessary willingness to improve quality of organization. An official motive for establishing a quality management system and its certification is always improvement of the quality, but sometimes there could be other reasons behind. True motives for the QMS and certification could be customer requirements or marketing needs, not the quality itself. If the motive is only to achieve the quality certification, then certification process is the end of quality improvement. The ISO9001 requires continuous improvement for higher quality and quality journey should continue after the certification.

Katerina D. Gotzamani and George D. Tsiotras have made a survey in 2002 among ISO9001 certified companies in Greece. One part of the survey was the motives behind the ISO9000 certification. The results of the survey are listed in TABLE 5. Score of each motive indicates the degree to which it has affected the companies' decision for certification from 0 to 5. (0 = not at all, 1 = very low, 2 = low, 3 = moderate, 4 = high, 5 = very high).

TABLE 5. Certification motives (Katerina D. Gotzamani et al., 2002)

Rank	Motives	Area	Score
1	Part of overall quality policy.	Quality strategy	4,21
2	Quality improvement of final products	Quality improvement	4,05
3	Quality improvement of internal operations	Quality improvement	3,93
4	Future customer demand	External pressure	3,63
5	Competitive advantage	External pressure	3,51
6	Improvement of internal communication	Quality improvement	3,45
7	Introduction to TQM	Quality strategy	3,35
8	Entry to foreign markets	External pressure	3,32
9	Customer demand	External pressure	2,46
10	Certification of competitors.	External pressure	1,26

These motives were divided to the three categories, external pressure, quality improvement and quality strategy. These categories and their average scores are presented in FIGURE 7

FIGURE 7. Motives of certification

This survey shows that motives for the ISO9001 certification are real quality improvements and quality strategy of company. External pressure is not so significant. But in the areas like customer demands and competition external pressures are clearly visible.

3.5 Summary

Many ISO9001 surveys show importance of the certification and the quality management systems. It cannot be denied that the ISO9001 certification improves quality of the company products or services. But the ISO9001 also improves other areas in the company like customer satisfaction. The improved internal operations of company, like documentation and communication, are one clear benefit of the QMS. Defining the mode of the operation and internal processes is one important part of the ISO9001 standard and improvement at these areas is obvious. All these achieved improvements enable fundamentals for good quality that should be the final target of the QMS.

There is a considerable amount of published quality surveys worldwide. This thesis refers only to few interesting ones that can be linked to other content

of this thesis. All research papers have overall positive results for the ISO9001 and the certification. Really negative results were not commonly available. Even critical reader has to believe that the ISO9001 QMS has positive effect to the business and it improves company performance at several areas. Other indirect benefits like improved profitably or productivity cannot be clearly linked to the benefits of the quality management system.

4 INTRODUCTION TO ISO9001

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. ISO is a network of national standards bodies. There are 114 countries as member bodies. SFS is ISO member body of the Finland and they influence ISO standards development. All developed and developing countries are members of ISO and almost rest of the world are at least correspondent members.
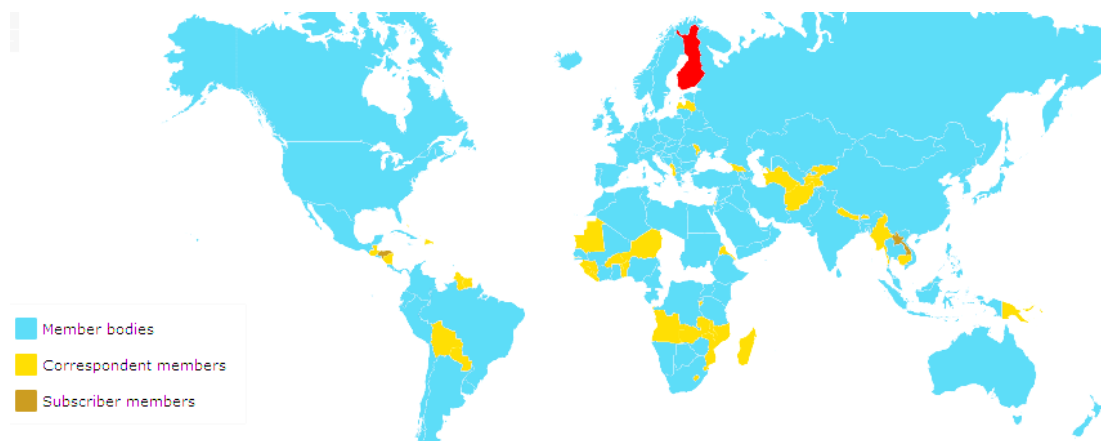
FIGURE 8 ISO members on map (www.iso.org)

ISO develops and publishes several standards to several kinds of industries and organizations. The ISO 9000 is a family of the quality management standards. There are many standards in the ISO 9000 family, including:

- ISO 9001:2008 - sets out the requirements of a quality management system

- ISO 9000:2005 - covers the basic concepts and language

- ISO 9004:2009 - focuses on how to make a quality management system more efficient and effective

- ISO 19011:2011 - sets out guidance on internal and external audits of quality management systems.

ISO9001 defines criteria for a quality management system. It is only standard in the ISO9000 family that can be certified. ISO9001 can be used at any size and field of organization. (www.iso.org, 2013.)

The ISO 9001 quality management system is based on eight principles (ISO, 2010).

- Principle 1 – Customer focus

- Principle 2 – Leadership

- Principle 3 – Involvement of people

- Principle 4 – Process approach

- Principle 5 – System approach to management

- Principle 6 – Continual improvement

- Principle 7 – Factual approach to decision making

- Principle 8 – Mutually beneficial supplier relationships

4.1 History of ISO9001.

There are five versions of the ISO9001 standard. The current fourth version is from year 2008 and fifth version is coming in September 2015. ISO9001:2008 is still valid three years after the new version is published. A recommended procedure is to update to the latest version of standard in the re-certification audit. For maintenance audits is recommended to use current version of standard. Some companies are still using QMS based on the version 2000, because major changes are not done since 2000.

ISO9001 versions

ISO9001:1987. The first version that is based on British Standard BS5750. It is in addition influenced by US defense standards, so called MIL-SPECS. The 1987 version basically defines only model of quality assurance.

ISO9001:1994. This version takes care of the preventive actions instead only checking final product. It continued to require evidence of compliance with documented procedures.

ISO9001:2000. The version includes and replaces all subversions, ISO9001, ISO9002 and ISO9003 from year 1994. The year 2000 version brings process management in high priority. Also top management commitment and continual process improvement are important additions to the year 2000 version. Continual improvement has to be done by defined meters and metrics. (www.wikipedia.org, 2015.)

ISO9001:2008. The version is current and it only introduced clarifications to the year 2000 version. In addition consistency to the ISO14001 is taken in account. Implementing of the ISO9001:2008 is described more details later in this document.

ISO9001:2015. This version will be released in September 2015. It doesn't change scope of standard, but will have new high level structure. New structure enables integration of the every management system. Like integration seamlessly to the ISO14001 environmental management system.

4.2 Other common certificates

Other common certified management standards in the industry are the ISO14001 and the OHSAS18001. Different kind of companies' web pages and lobbies have quite often these certificates next to the ISO9001 certificate.

The ISO14001 defines the environmental management system EMS. The EMS sets criteria for organizations environmental related documentation and processes. In addition it defines the targets and meters for environmental

metrics. They are for example waste and carbon dioxide emission reductions. The EMS can be integrated to the QMS, because structures are similar. Future versions of both ISO14001 and ISO9001 support integration of the QMS and EMS. (ISO, 2004).

OHSAS18001 is requirements for the Occupational Health and Safety management system. It is defined by the British standard organization, not by ISO even OHSAS18001 is used globally. OHSAS 18001 is a framework for an occupational health and safety management system. It can help organizations to put in place the policies, procedures and controls needed for organization to achieve the best possible working conditions, aligned to the best internationally recognized practices. (www.bsigroup.com, 2015).

4.3 Certification

The certification is a method to show other parties that organization has implemented the quality management system. The certification is done globally according ISO9001 requirements and that's why the certification follows the same principles all over the world. ISO does not involve to certification of any organizations. Certifications are done by the accredited certification companies like SGS or Bureau Veritas.

The certification of the quality management system is very popular all over the world. Over one million organizations in 178 countries have achieved ISO9001 certifications (Bureau Veritas, 2013).

Quality management system can be established without any guidance from ISO documentation. Also ISO9001 quality management system can be used without external certification. But there are several reasons why quality management system certification is done.

- Proof of the operation model. Company can show to others that they have controlled and documented mode of the operation.

- Helps internal communications and gives arguments to difficult changes. Implementing changes to work methods could be difficult and certification audit will help that.

- The certification can be used in global contracts. ISO9001 certification could be requirement in global trade. Companies maybe don't know each other's and the certification can be used as widely known benchmark.

- Marketing reasons. Certified quality management system can be used at marketing as proof of quality products.

In Europe certificate is typically stated on company web pages and A4 sized poster on office wall. But in many places in Asia companies are not so modest and the ISO9001 certification is stated in company facade. There could be large signs where are stated company name and ISO9001 certified label, like in FIGURE 9.

FIGURE 9. Boat dealer in Pattaya Thailand

The ISO9001 certification is valid three years from the first certification audit. Maintain audit where the status of the quality management system is checked has to be done yearly. Selection of the certification company has to be made carefully because it means typically several years co-operation with maintenance are re-audits.

5 ESTABLISHING QMS IN DNWP OY

The case work assignment was to achieve the ISO9001 certification for Dedicated Network Partners Oy. Tasks at this work were establishing quality management system, making quality manual and managing ISO9001 certification process.

The motives for establishing quality management system were very pragmatic. Newly established company needed documented processes and common instructions how to operate. The ISO9001 was logical answer for these requirements. Also marketing benefits and customer requirements for the ISO9001 were noticed.

5.1 Company presentation

The case company of this thesis was Dedicated Network Partners Oy (DNWP). DNWP develops, manufactures and sells telecom equipment for dedicated utility networks. Utility networks are telecom networks built for mission critical services and where reliability is the key feature. DNWP is a spin-off company of Nokia Siemens Networks and DNWP inherits strong quality momentum from its mother company. Establishing the quality management system and the ISO9001 certification is one step on path moving to totally independent company.

Dedicated Network Partners is working with mission critical utility networks. Reliable communications are vital when running the mission critical business operations in industries such as power, oil, gas, mining and transportation. Prerequisites for time and mission critical data transmission are high network availability, service quality and security, which are not always present in public networks.

TABLE 6. Applications and customer segments for utility networks

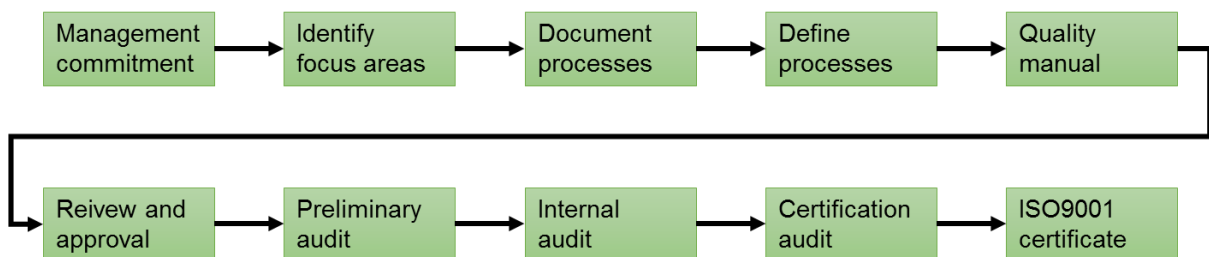| Industry	Application examples
Railways	Traffic control system Information display systems Announcements system GSM-R CCTV
Oil and gas pipelines	Substation control and monitoring CCTV
Power companies	Substation control and monitoring Tele protection CCTV
Highways, Airports	Traffic control systems Information display systems CCTV
Military/police/ Governments	Governmental TETRA radio networks CCTV

(www.dnwpartners.com, 2014)

5.2 General

The quality manual is the main document for the quality management system. It should define quality management system as processes. The processes are needed for controlled operation and continuous improvement. Some things can be described as work instructions where lighter documentation can describe ways of working. All products and services related processes, and realization of them has to be described.

The ISO9001 standard and related instructions were the main guidelines for setting up the quality management system. The standard is generic for all kind of organizations and does not typically give exact guidance. Organizations have to specify their own unique focus areas and define detailed processes.

In the case work establishing the quality management system was divided into nine phases. Main reason for this kind of work order is standard way of doing according the ISO9001. Quality management system establishing phases are covered in FIGURE 10 and the chapters 5.3 - 5.11.

```
Management    →  Identify    →  Document    →  Define     →  Quality
commitment       focus areas    processes      processes     manual
                                                                |
                                                                ↓
Reivew and    →  Preliminary →  Internal    →  Certification → ISO9001
approval         audit          audit          audit           certificate
```

FIGURE 10. QMS establishing phases

5.3 Management commitment

The importance of the management commitment is pointed at several chapters of the ISO9001. It is very important that top management is committed when quality management system is established. Otherwise it is not possible to define needed modes of operation and allocate needed resources.

The assignment for this case work to establish the quality management system was given by top management and owners of the company. This kind of authorization gave good starting point for the QMS.

5.4 Identify focus areas of DNWP

The most critical point establishing quality management system was identifying focus areas of DNWP. These focus areas were then described as processes and monitored according quality manual. Focus areas have to be meaningful for the DNWP business and has to have an impact on delivered

product, services and finally to overall customer satisfaction. Three focus areas were selected and processes were documented for them. The focus areas are described in the chapters 5.4.1, 5.4.2 and 5.4.3. The areas are described in the same order as ISO9001, not in order of their importance.

Also other areas of the operation are described in the quality manual because they are required by the ISO9001 standard. But their importance for DNWP is not so significant.

5.4.1 Control of documents

The control of the documents is important for operation of the quality management system. Without controlled procedures it is not possible to find documents and their valid versions. At DNWP document control was divided to three categories.

1. Manufacturing data in the PDM system.

2. Oher controlled documents with unique document numbers like process models and instructions.

3. All other work documents that are updated regularly.

5.4.2 Product realization process

The product realization process is product development flow including requirement management, customer communications and R&D work. The ISO9001 standard gives frame how the process has to be defined in FIGURE 11.

An essential part of the process is finding customer needs and the requirements. Before requirements are known, the product development cannot be started. Product development process is based on the verification against requirements and the validation against real customer neededs. In the DNWP case verification is laboratory testing and validation is field trial test in real network,
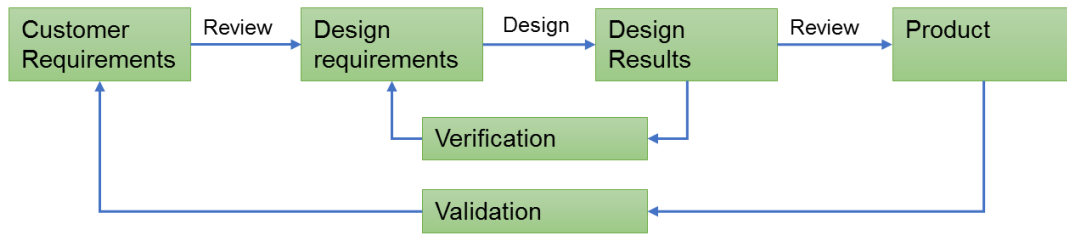
FIGURE 11. Product Realization process model (ISO, 2010)

5.4.3 Product delivery process

The product delivery process describes delivery model of the DNWP. Products are delivered directly from the manufacturing partner to customer according product orders. The DNWP quality manual does cover the order intake and the customer communication, but does not cover manufacturing. The manufacturing partner has its own quality processes under its own ISO9001 certification.

Selecting the key processes and focus areas of DNWP was quite clear work. Other important areas are described by work instructions instead of process model.

5.5 Document processes that already exists

DNWP has many processes and ways of working which were in the use but not documented. Because persons working for company are experienced and most of them have worked together several years they know what to do and when. This kind of silent knowledge was now documented to the quality manual as processes.

It is possible to work successfully without defined and documented processes, but then the requirements for personnel are very high. The main advantage of documented model is traceability and possibility to improve operation. Also induction of new persons is much easier if mode of operation is documented.

5.6 Define process model where it was needed

At some areas there was no common way of working. Persons had their own methods how to proceed. For this area a process model was developed and documented. The risk of misunderstanding and wrong decisions decreases significantly when using the defined processes

In addition at some areas process or common way of working exists, but it was not up-to-date. There could have been changes in an environment or personnel, but instructions were not updated. For these areas process model was updated and documented.

5.7 Quality manual

The quality manual is the main document of the quality management system. It defines quality management system by describing all relevant processes and information of DNWP. All information is not included directly to the quality manual itself and it is more like an umbrella collecting all documents and processes.

In the quality manual many processes and instructions are presented as links to another documents. Using links reduces need for maintaining quality handbook and correct link, also takes care of the version control.

Chaptering of the quality manual is similar as the ISO9001 standard. The same chapter numbers helps linking between quality manual and standard. Some chapters were not so relevant for the DNWP quality manual. But they are included to the quality manual having less content.

The quality manual defines, also quality metrics for the company. These metrics are followed periodically and called the key performance indicators (KPI). For example KPI could be number of warranty cases or deviations in project schedules. The KPI should be selected carefully so that they give real information about the quality performance of the company.

5.8 Review and approval of quality documents

The quality manual and all related documents have to be reviewed before they can be used. The document review team members were experts of current area together with members of the management team. ISO9001 standard highlights many times importance of the management commitment and the DNWP management team did review and approve quality manual.

Approving the quality manual is not only document approval. It defines quality policy and targets. The management team approval approves and authorizes all processes described in the quality hand book.

5.9 Preliminary audit

At the preliminary audit the certification company evaluates quality management system from documents. At this phase the operation of the company is not evaluated, only the level of the quality manual and the processes are studied. If the level of the quality manual is good enough and it follows the ISO9001 standard, certification process can continue. At that phase auditor identifies non-conformities that does not meet the ISO9001 requirements. Auditor gives time to fix founded non conformities before certification audit.

The preliminary audit was the first time when any external person checked the quality management system. In DNWP case there was not any major non conformities. Founded five minor non-conformities were fixed quite easily. One main reason for good preparation was experienced personnel of the company.

5.10   Internal audit

The internal audit was conducted between preliminary audit and certification audit. Non conformities found from preliminary audit were fixed before internal audit. According the ISO9001 standard the internal audit procedure and schedule has to be documented.

For DNWP internal audit cycle is bi annual as the ISO9001 requires. The first internal audit before the certification or maintenance audit of the Certification

Company. The second one six months after visit of the Certification Company.

The internal audit checked several individual tasks, as well as some specific cases like process from offering to customer delivery. Auditing was based on checking saved records that are defined in the quality handbook.

34 different areas of operation were checked during internal audit and non-conformities was found from 10 areas. Founded non-conformities were minor and nine of them were fixed in next few days. One of non-conformities was classified as not applicable, because DNWP as a young company did not have enough history to save all needed records.

5.11 Certification audit

The certification audit is the main event to achieve ISO9001 certification. The certification was done by auditor from the Certification Company. In certification audit the auditor visited company for one day and during this day there were several things under inspection. One major task was checking of non-conformities from the preliminary audit. Auditing day's agenda is in TABLE 7 and one day agenda is typical for small and medium size companies.

TABLE 7. Auditing day agenda

Päivämäärä ja arvioija / Date and auditor:	
Aika/Time:	**Aihe:**
9.00	Avauskokous /Opening Meeting
9.30	**Laatujärjestelmän pää arviointi** • Esiarvion poikkeamien korjaavat toimenpiteet • Scopen verifiointi • Laatupolitiikka • Tavoitteet mittarit, seuranta • Vastuut , valtuudet • Sisäiset auditoinnit • Johdon katselmus • Asiakastyytyväisyyden hallinta
11.30	Lounas ja välikokous / Lunch and intermediate meeting
13.00	**Arviointi jatkuu** Käydään läpi toteutettuja projekteja alusta loppuun ja niiden toteutukseen liittyvää ohjeistoa tarjous , myynti prosessi, tuotteen toteutus, suunnittelu, komponentti ja alihankinnat, testaus tuotteen toimitus
15.00	Valmistautuminen loppupalaveriin / Preparations for closing meeting
15.30-17	Loppupalaveri / closing meeting

5.12 Cost of QMS

The cost of the quality management system can be divided to two aspects, establishing the QMS and maintaining the QMS. The cost of establishing is much easier to calculate than the cost of the maintaining QMS. Establishing costs included direct costs of making the quality manual and certification. Maintenance costs are more difficult to count, because also the cost of the poor quality has to be calculated. Quality costs are covered in this thesis the chapters 2.2 and 2.3.

Direct establishing costs could be calculated from used working hours to the QMS project. In this case working hours were not calculated because work was done over long period and working was not full days. But with accurate monitoring of the working hours this can be done. Estimation for this DNWP case is 4 person months excluding writing of this thesis.

5.13 Summary

Establishing the quality management system is always quite heavy work, but work amount could vary a lot depending on starting point of the company. If the most of the processes are documented and well-known methods are used, then workload is much lighter compared to situation where everything is started from scratch. Also culture of the company and mind-set of the personnel affect a lot when the QMS is established. If personnel is quality oriented, establishing the QMS is much easier when compared to a company where quality is only some words in company values.

In this QMS was not defined any problem solving method. It is not part of ISO9001 scope but many times a problem solving methods are linked to the QMS. There are several well-known root cause analysis tools that can be tailored to own use. One very usable is the 5-why model, known as Toyota model. In the 5-why model question 'why' is asked until real root cause is found, because finding real root cause is a key to solve problem. Many times

the first visible problem is not the real root cause and then problem solving goes to side track already in start. In some circumstances root cause analysis process is very useful, and it is good prospect for further development of this QMS. (Jeffrey K, Liker et.al. 2006.)

Another process model that is typically certified is the ISO14001. The ISO14001 defines the environmental policy and the environmental management system of company. It has become more and more popular in these days and main driver is customer requirements and more highlighted green values. Achieving the ISO14001 could be further development of this QMS. The ISO14001 defines processes and metering for environmental friendly operation. Required processes and meters can be integrated to the same ISO9001 certified QMS and quality manual. (ISO, 2004.)

The quality management system is still only a tool for good quality. The targets and processes have to be defined carefully. With poor process models and a non-relevant quality targets company can reach the ISO9001 certification but quality system does not improve quality. The ISO9001 certification does not care about relevance of processes and quality metrics and targets. A non-relevant hand book could be the ISO9001 compliant, but it does not help company to improve its operation nor quality of delivered products.

6 SURVEY: QUALITY EXPECTATION FOR UTILITY NETWORKS

The customer expectations about the quality are essential to know, to achieve high customer satisfaction. The customer expectations can be used when quality targets for the quality management system are defined. Many times there are assumptions what customers expect, but these are not based to any facts. Customer survey is a simple method to find the customers' expectations.

The case survey was part of the training course feedback form in several training sessions. Training courses were product training and were targeted to commissioning and planning personnel. The most of those people were working for companies selling or operating utility telecom equipment or they worked as consultants.

The quality survey was part of the course feedback survey, between June 2013 and May 2014. Details of groups are in TABLE 8. Diversity of the answers was wide because courses were conducted in different countries. Courses located in Finland had participants from several countries in Europe, Middle-East and Asia.

TABLE 8. Survey groups

Date	Location	Number of participants	Note
June 2013	Finland	11	Global course,
October 2013	Finland	6	Global course
November 2013	Sweden	7	
April 2014	Norway	6	
May 2014	Finland	8	Global course

The questions were divided to two categories. The main questions were selected to find which quality characteristics are the most important for customers. The secondary questions were related to importance of the quality management systems and the ISO9001 certification.

This survey was a total mixture of the quantitative and qualitative method elements. The quantitative view was that results were numeric values and answers did not require any rendering. The qualitative view was that participants were clearly selected group of people. They did not present average people because all of them were telecommunication professionals working for utility segment. (www.stat.fi, 2015.)

6.1 Quality expectations

The target of the quality expectation questions was to find the most important customer expectations related to the quality. Questions were selected according to the knowledge about the customers and mission critical utility networks. It was known that all these areas are important, but finding the most relevant areas is difficult without valid data. At this questionnaire there was a list of the 12 characteristics and participants had to select three most relevant for his/her business.

The Questions

- Low need for maintenance

- High level of network availability

- High MTBF, long lifetime of HW units

- Long lifecycle of products (availability and support)

- Fast and reliable product support in problem situations

- Rich feature set

- Fast and reliable delivery

- Good documentation for self-support (operating manual, application notes, help dialogs in equipment

- Ease of commissioning

- Quality certification

- Road map accuracy (Content and schedule of future releases)

- Other; please specify:

Results

Total 38 persons did answer to questionnaire. All results from different sessions are shown in TABLE 9. Graphical summary of the results are shown in FIGURE 12.

TABLE 9. All results

Characteristics	Jun 2013	Oct 2013	Nov 2013	April 2014	May 2014	Total
High level of network availability	6	2	5	5	6	24
Fast and reliable product support	6	4	2	2	5	19
Long lifecycle of products (availability and support)	5	2	3	2	2	14
Good documentation for self-support	2	2	4	3	2	13
High MTBF, long lifetime of HW units		4	3	4	2	13
Low need for maintenance	3		3	1	2	9
Road map accuracy (Content and schedule)	5					5
Ease of commissioning	1	2	1		3	7
Fast and reliable delivery	1	1		1	1	4
Rich feature set	3					3
Other; please specify:	1					1
Quality certification					1	1
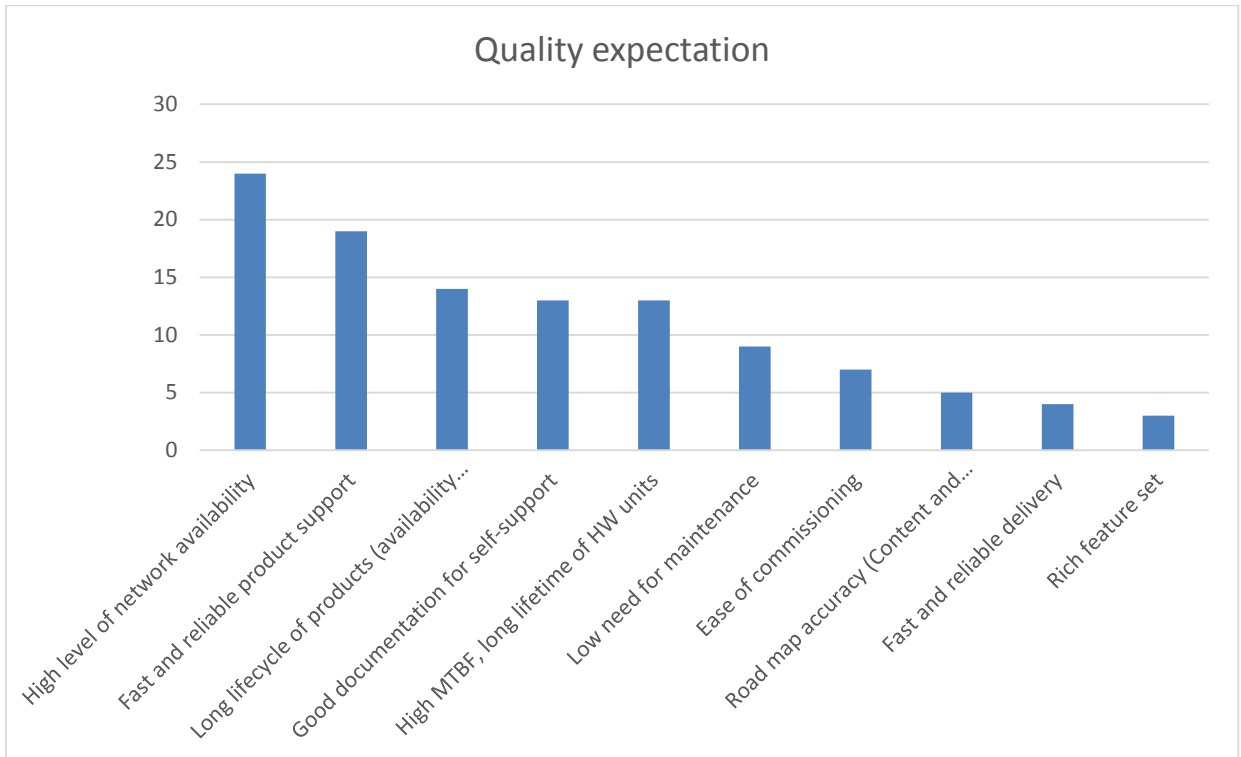
FIGURE 12. All results

In FIGURE 12 there are all results from the quality expectations survey. Total number of answers was 113 and there were 38 persons who answered. There should be 38 x 3 = 114 answers, but someone did select only two points. Results were almost linear with low curve and there were not major topics.

6.1.1   Categorization

Because the results were too flat for conclusions, questions were categorized in to five main categories. Then questions in the same category were summarized. All categories had three questions and sorting questions to categories is listed in TABLE 10.

TABLE 10. Question categories

Category	Question	Explanation
Network availability	High level of network availability	Network usability and minimum down time for any reasons.
Support	Fast and reliable product support in problem situations	Remote or local technical support in problem situations or network commissioning phase.
Support	Long lifecycle of products (availability and support)	
Support	Good documentation for self-support (operating manual, application notes, help dialogs in equipment	
Network availability	High MTBF, long lifetime of HW units	Mean time between failure rate showing units reliability.
Network availability	Low need for maintenance	Network maintenance includes re-configuration and work related to possible HW failures.
Features	Road map accuracy (Content and schedule of future releases)	Road map presents current and future feature set of product.
Features	Ease of commissioning	
Features	Rich feature set	
Others	Fast and reliable delivery	
Others	Other; please specify:	
Others	Quality certification	

TABLE 11. Categorized answers

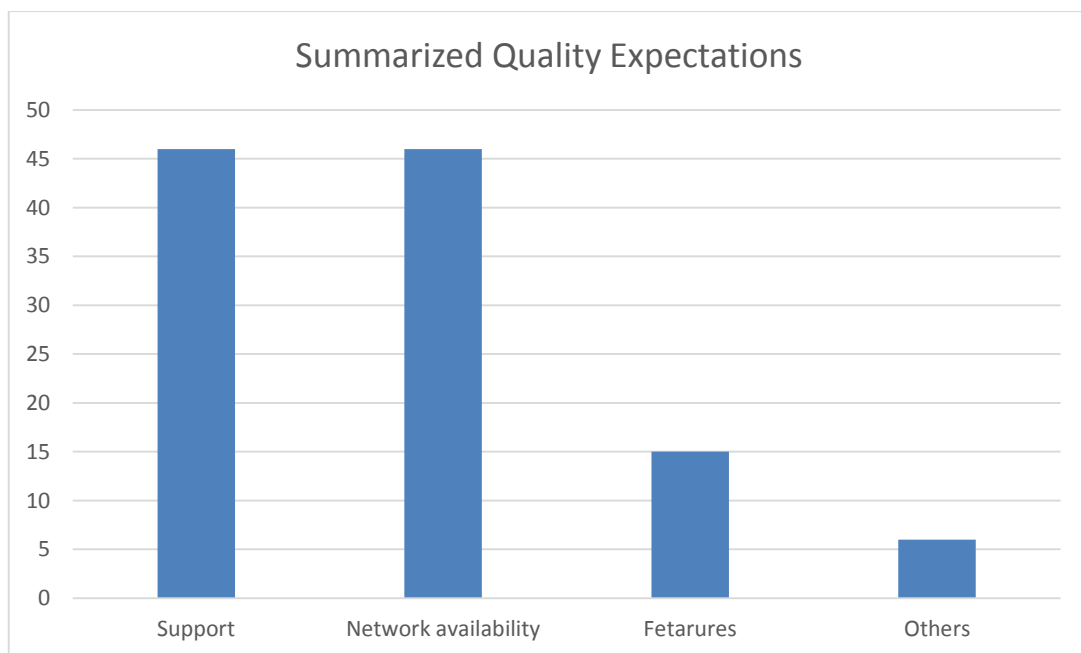| Category	n	%
Support	46	41 %
Network availability	46	41 %
Features	15	13 %
Others	6	5 %
Total	113	100 %

FIGURE 13. Summarized quality expectations

The categorized results are in TABLE 11 and FIGURE 13. Now there are the clearly visible major areas of expected quality characteristic. Support and

network availability are equal with shares 41 Then there is a clear difference to the third, features 13 % and fourth category others 5 %.

The combined share of the support and network availability was 82% which covered 50% of characteristics. This is not very close to the Pareto 80:20 ratio, but it shows clearly which quality characteristics are the most relevant for customers. (Pareto, 2013)

The product features are not as important as reliability and support related issues. This shows typical attitude of the mission critical networks, the reliability is the key.

It can be seen that support is the important issue for the customers. Its importance is as high as network availability. There are two reasons for that. One is that many people who answered this questionnaire were working with network maintenance and good support in problem or commissioning situations will help their daily work.

Another reason is that the complex networks will always need some maintenance even there are not a direct problems in network availability. The reason for network maintenance could be network expansions, or changes in some other part of the network that affect directly or in-directly to rest of the network. Any time when maintenance or network commissioning is done, fast and reliable support is expected.

The results would be different with different background of the participants. Now background of the participants was homogenous. This survey presents a good outlook of the expectations of the telecom engineers.

6.2 Importance of certification

The target of the importance of the certification questions was to identify how important the quality certification is for the customers. There were three statements related to the certification.

The Questions

Answer three questions below. Select best answer from these five options; I strongly agree, I agree, Moderate, I disagree or I strongly disagree.

- ISO 9001 certification is very important (or any other 3rd party quality certification)

- High quality is more important than purchase price

- Best reference of high quality is own previous experience of company/team

Total 24 persons answered importance of the quality questionnaire. These questions were asked only in training classes year 2013, in TABLE 8.

TABLE 12. importance of certifiaction results

	strongly agree	agree	Moderate	disagree	strongly disagree
ISO 9001 certification is very important (or any other 3rd party quality certification)	4	17	8		
High quality is more important than purchase price	1	18	7		
Best reference of high quality is own previous experience of company/team	4	18	8		

FIGURE 14. Importance of certification

Importance of the certification results are in TABLE 12 and FIGURE 14. These answers show clearly that quality is important for the customers. Because all three questions present different view they are analysed separately.

The ISO9001 certification is very important: The most of answerers, 59% agreed this statement. 14% agreed strongly and 28% were moderate. No one did disagree this statement. Result shows that certification is very important, but not high priority issue. The certification or business related issues are not main interest of typical answerer having engineering background.

High quality is more important than price: The most of answerers, 69% agreed this statement. 4% agreed strongly and 27% were moderate. No one did disagree this statement. High quality is clearly more important than price. Over one fourth of answers was however, moderate showing, that pricing is also an important and customer are not willing to treat the telecom equipment and networks as a luxury item. On another hand typical profile of participants

was technical not business oriented and this will give more value to the quality over the price.

Best reference of high quality is customer's own previous experience: The most of participants, 60% agreed this statement. 13% agreed strongly and 27% were moderate. No one did disagree this statement. This result show that previous experience about the company is an important and making things right will help in future. In addition negative aspects will be remembered and if things does not go as they should it will affect on the future.

6.3 Summary

After the first answers some changes to questions were under investigation, but the same questions were used for the all groups. With different questions groups are not any more comparable.

The first part of the case survey, quality expectations was interesting. It really showed importance of the customer support and the system reliability.

The results from the second part of survey, importance of certification was not so interesting. It seems that the customers like the certification and high quality, but these are not in a key role. Also importance of own experience was agreed, but not strongly. Nobody did select any of these to disagree category and it is somehow obvious, nobody wants non-quality.

The number of questionnaires was relatively low, but participants were presenting the real customers of the case company. Feedback from the actual users is more relevant than a randomly selected group.

7 CONCLUSIONS

This thesis includes three main parts, a literature study, a case work establishing quality management system and another case work quality survey. The quality is a common theme in all of them even view point is different. Literature research and case work establishing the QMS shows that defined processes and internal operation are the main thing in QMS. Direct benefits of the QMS can be seen easier from these areas. When the internal operation of company are in good shape it gives a good base for the high quality products.

It can be found that the product quality is not only a thing related to the high quality. The case survey shows that customer support and communications are very important. Other research surveys does not highlight customer interface so clearly, but these surveys were made with all kind of companies, not focused to the telecom sector.

The results from the case survey were used to define metrics for the quality management system. Because support and reliability of the products are important for the customers, this affected to the selection of the key performance indicators of the QMS.

The quality management system is only a tool for quality work. Efficiency of the QMS is related to defined processes and the KPI's. QMS could be the ISO9001 certified but it doesn't improve performance of the company if it is not well defined. ISO9001 standard and ISO guidance are only higher level frame for the QMS and detailed implementation is on the responsibility of each company. Because the ISO9001 standard can be used in all kind of companies and organizations it does not give detailed guidance to implementation.

Direct benefits of the ISO9001 certification was not found in the sales of the companies, In-direct benefits can be identified more easily like fulfilling customer requirements. But in longer term using ISO9001 certified QMS

should affect to sales, if QMS is well prepared. That is because good quality management systems improve all functions of the company.

7.1 Discussion

This thesis was written two years from summer of 2013 to spring of 2015. Because the writing period was so long, many chapters needed refining in final review. The author's experience about quality did increase all time over this writing period and working as acting quality manager.

Quality as subject is not as fast evolving as many other areas in today's industry and longer writing period gave more perspective to work. In quality there are always new trends, but the next major issue is year 2015 version of ISO9001 standard.

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APPENDIX

BUREAU VERITAS
Certification

Dedicated Network Partners Oy

Head office: Linnoitustie 6, FI-00260 Espoo, Finland
Site: Elektroniikkatie 3 B, FI-90590 Oulu, Finland

Bureau Veritas Certification certify that the Management System of the
above organisation has been audited and found to be in accordance with the
requirements of the management system standards detailed below
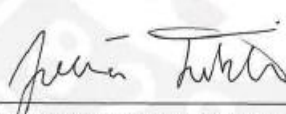
STANDARD

ISO 9001:2008

SCOPE OF CERTIFICATION

Design, manufacturing, sales, service and support of telecommunications equipment

Certification cycle start date: 16 January 2014

Subject to the continued satisfactory operation of the organisation's Management System,
this certificate expires on: 15 January 2017

Original Certification date: 16 January 2014

Certificate Number: FI-HSK8080294.A   Version 1, Revision date: 16 January 2014

Juha Leukkeri, Technical Manager, Bureau Veritas Certification Finland

UKAS
MANAGEMENT
SYSTEMS

008

Certification body address: Brandon House, 180 Borough High Street, London SE1 1LB, United Kingdom
Certification office: Hermannin Rantatie 10, FI-00580 Helsinki, Finland

Further clarifications regarding the scope of this certificate and the applicability of the Management System requirements may be obtained by
consulting the organisation.
To check this certificate validity please call, tel. + 358 10 830 8630.