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Organizing Quality Management work at large manufactures

Master of Science Thesis

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ABSTRACT

Companies organize quality management work in different ways according to their needs. This study was done at one of Bosch-Rexroth's manufacturing plants in the United States. The research was done in parallel with an internship at Bosch-Rexroth. The research was conducted on quality groups who were responsible for daily quality work within the manufacturing plant. Indicators were identified how large manufactures go about organizing their quality management work and a close look was taken into their responsibility and roles.

A case study was selected for the study because it fits well with collection of data. Data was collected through document studies, interviews, observations, SWOT analysis and literature review. The educational objective is to gain modern and practical insight into how larger manufacturing plants organize their Quality management work, and hopefully to gain some knowledge about a best practice model for similar manufacturing plants.

The theoretical framework is focused on defining quality, Quality Management, and organizing quality work. Definition of quality is explained and that it can be within themes such as: products, defects, processes, customers and systems. Quality management is explained in relation to the Sand Cone Model and a look will be taken into areas that show how quality management work can be divided. These areas are Quality Assurance, Quality Control and Quality Inspection. The cornerstone model is connected with Quality Inspection since that area deals mostly with customers. Past studies on how quality work can be organized, are presented with a connection to the plant and outside suppliers.

Bosch-Rexroth specializes in the "Drive and control Technology", and has four major business units consisting of; Mobile Applications, Machinery Applications and Engineering, Factory Automation and Renewable Energies. The plant in Pennsylvania employs around 600 people, making custom designs according to customers' requirements. Bosch-Rexroth produces products like hydraulic control valves, hydraulic cylinders, customized manifolds and power units with various options for particular solutions.

The study yield analysis structured in section of strengths, weaknesses, opportunities and threats. Giving points on the current structure of quality management work, in respect to previous structure. Both can have negative and positive points, but the idea is to understand the reason why quality management work is structured in such a way and to identify factors of best practice.

The major factor influencing the quality of the current setup are organizational matters like: resources, internal- and external communications, understanding of each other's roles in a complex structure and balancing product quality, cost and delivery. The roles and responsibilities of quality groups vary according to their functional area of responsibility. The main findings are that quality issues should be dealt with at their root causes early in the production process, and showing a modern approach how you can structure firm's quality groups to do so.

ACKNOWLEDGEMENTS

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I've been fortunate of having support of my friends throughout this journey. Their balance towards my personal life and work made the days exciting and pleasant.

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Abbreviations and descriptions

BPS	Bosch Production System
CQM	Centralized Quality Management
DQM	Decentralized Quality Management
HQM	Hybrid Quality Management
PUQ	Purchasing Quality
PUE	Project Purchasing
PUR	Commodity Purchasing
PPM	Parts Per Million
Quality	“The quality of a product is its ability to satisfy, or preferably exceed, the needs and expectations of the customers” (Bergman & Klefsjö)
QMM	Quality Management Methods
SOP	Start of Production

1 Introduction

This chapter gives an introduction into the research area of the Master Thesis. The background provides a brief introduction on different structuring of quality management departments. Following with the purpose of this research, along with the research questions, and the delimitations for the scope of the research come last.

1.1 Background

Most manufacturing companies are working with some sort of quality management work for their operations. Quality management groups are engaged in various activities regarding processes and use wide array of techniques to give that support (Dean and Bowen, 1994). Companies come in all sizes and shapes and a one-fits-all or best practice model are hard to apply (Naidu, Badu, & Rajendra, 2006).

The researcher will look for indicators and factors to consider for successfully organizing quality management groups and to provide an insight into an example of a structure that can help companies make a better decision regarding how they can structure their quality management work. Hellström et al. (2010) emphasis that quality management is practiced in different ways, dependent on what effects it is wanted to have on the business. Roles can vary throughout the organization according to the business result needed to achieve. The industry is always looking for ways to improve their structure and pay the way for quality improvement initiatives (Balding, 2005). At bigger manufacturing plants this structure can be different and groups need to be distributed throughout the plant. Samuel and Roger (1998) talk about how important it is to look at quality divisions at an individual plant levels, that resources can't always be centrally located and the distribution of quality groups varies within particular plants.

The thesis will present a case study of a large manufacturing plant who is in the business of "Mobile applications", more specifically in the "Drive and control Technology". They design and manufacture, high performance, high productivity, hydraulic power units, systems and components using world class technology. Parts can be very complex due to costumer design requirements and require a high degree of quality and durability.

Quality groups have the responsibility for daily quality work within the manufacturing plant with quality control procedures built in the processes (Samuel and Roger, 1998). Quality departments roles are to add values by maintaining the element of quality, their jobs will not all be seen in quality departments but also throughout the organization (Silverman et al., 1996). A problem that the Bosch-Rexroth's plant was faced with was that some departments in the organization needed more and constant support with quality management work and the previous organization of quality management was not enough. A change was made three years ago, Bosch-Rexroth re-organized their quality management groups, making an addition

quality group who was integrated into a department who was in need of further support and technical quality knowledge.

1.2 Purpose

The purpose of this study is to examine how quality management work is organized at a large manufacturing plant, and to understand how quality management groups can be structured. This will be done by looking at the roles quality groups have and to figure out the responsible roles and tasks they perform.

1.3 Problem analysis and Research questions

The following research questions have been proposed for achieving the above goals:

- 1. What roles and responsibilities can quality management groups have at a large manufacturing plant?*
- 2. How can quality management groups be organized?*

The above research questions closely related, and will be answered together in this report.

2 Methodology

This chapter describes how the master thesis research was carried out, how it was designed, what methods were used, and how participants were selected as well as the results that will be used later.

2.1 Research strategy

When selecting a research area for the study the researchers should focus on the field where their interests lies within, and that will give the researchers a rich learning experience within the field (Bryman & Bell, 2011). The research is structured as a case study, focusing on how quality management groups are structured, what their responsibilities and roles are in a larger manufacturing company.

As Bryman and Bell (2011) note that a qualitative strategy emphasizes words rather than collection of data and documents. To be able to describe the influencing factors, a qualitative research strategy was used to explore the nature of that relationship. This strategy is appropriate to gain an understanding of the processes and roles of each department. A good way to understand this relationship is to interact with people working in the departments and it might be good to talk to the ones that have been here long enough to see these changes take place. Participants from related department were interviewed, observations made from interactions through tasks or projects, and literature review was done in parallel. It will help the research to understand why processes were structured this way, and how they came to the conclusion to have it as it is today (Bryman, Bell 2007).

This study will be focused on the quality management groups at Bosch-Rexroth Bethlehem plant. The author of this thesis did a six months long internship at the Purchasing Quality department. The internship was specially aimed at Master students with background in quality and operations and only sent out to students at Chalmers University. The duties during the internship time included operative tasks such as continuous improvement projects, statistical analysis, strategic improvement plans, and other quality assurance tasks. Information for the case study such as document studies and interview were done in parallel to the internship.

Bosch-Rexroth is a leading specialist in drive and control technologies. They are a part of the global Robert Bosch private corporation, a German multinational engineering firm. For simplification purposes here after I will refer to Bosch-Rexroth as Bosch. Bosch has several manufacturing plants in the North America region and is the Bethlehem plant one of them. They are in the business of producing complex products and systems of a high degree of quality. Improving their total quality is a key factor for them, whether it's supplier quality or internal quality. In order to monitor and retain their quality departments like Purchasing Quality and Quality Management Methods have been set up. The research will cover how quality management groups are setup at manufacturing companies, what roles and responsibilities they have in the quality process, and how do their divide their roles.

It was beneficial for the case study to be able to do it parallel to the internship. It gave the opportunity to get in a better touch with associates from different groups and departments throughout the plant. The purpose of the thesis will not be to look into a specific project, but to understand the structure with the departments with insights on the current work done in them.

2.2 Research design

The research will be focused around the Purchasing Quality group and the Quality Management Methods in order to gain information and understanding how they are organized as a quality management groups. Interviews will be done with relevant people in departments of Purchasing witch is divided into the group: Project Purchasing, Commodity Purchasing, Purchasing Quality, and also in their internal quality management department called Quality Management Methods.

Research designs provide a framework to collect and analyze data. For this research a case study design was structured. According to Bryman & Bell (2011, p.59), case studies are widely used in research and they can be used at a single locations such as at a production sites. The study can be applied at workplaces or in an organization were you have a bound situation or a system in place, aiming at producing general findings. Case studies favor methods like qualitative research, were you can observe participant's and can do unstructured interviews. The method is told to be particular helpful in generation of detailed and intensive examination of cases (Bryman & Bell, 2011). Yin (1984) claimed that case studies are a good way of dealing with multiple qualitative inputs.

An approach of mixing interviews, observations, document- and literature review provides a broad spectrum of data. Relying much on one data source and can lead to one sided view, but having more sources of data can provide a stronger base for the conclusion. Verschoor (2008) claimed that, one might fall into a pitfall of not showing the real situation, but rather an ideal world, referring to a scenario were spectrum of data limited. Mixture of documents and human involvement create the variables needed to be able to draw a conclusion and come to finding in the research. The research was both done at Bosch in the USA and afterwards continued at Chalmers University of Technology in Sweden. The structure showing how the research was carried out can be seen in Figure 2.1 below.

Bosch							Chalmers		
Case Study									
				Literature review					
							Analysis		
									Conclusion
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar

Figure 2.1: Overview of the design of the research.

2.3 Research methods

Working on ongoing projects and meeting new people in different department, give a hint of areas to go deeper into and what was to research. Four main data sources were used during the project, interviews, internal documents, discussions and literature review. The qualitative data was gathered in in parallel to the internship and literature review continued also after the internship.

2.3.1 Data collection

Considering the goals of the research, the most appropriate data collection method is to use interviews, document studies and literature reviews, and observations. The organization had also a variety of documents available that gave a good insight into department's roles, structure, how the company operates, and who they serve. Observations were done daily during project work, meetings and on regular working hours. The interviews were scheduled with employees and give a better link between observations and the documents.

The research questions were analyzed and suitable methods picked with a respective goal in mind. Table 2.1 below gives an overview of the approaches use for the data collection regarding the goals of each research question.

Research questions	Data collection methods	Goals
What roles and responsibilities can quality management groups have at a large manufacturing plant?	-Document studies -Interviews -Literature review -Observations -SWOT	To understand the departments tasks are and how processes are in the plant regarding to quality work.
How can quality management groups be organized?	-Document studies -Literature review -Observations - SWOT	To understand how quality groups are structured and the effects that integration of quality groups can have on departments.

Table 2.1: Research questions are listed with their respective methods and goals.

2.3.1.1 Literature review

The literature review is a data collection process aiming at finding already existing researches that are relevant to your own research. Literature review can either be a starting point of your research, were it provides a foundation for a problem to be researched further. You can confirm what has been previously investigated, and gain a better understanding of a problem. It can also be used as an benchmark, if results of an research are already know, finding other

similar results through literature can be helpful in comparison to your results (Bryman & Bell, 2011).

The outcome of the literature review for this research was to find what had been written about organizing quality, and see how possibly other companies went about their quality management work. This was so used in comparison to the results of the research at Bosch. Reviewing that literature enabled the researcher to identify what has been studied and if the results would yield any benefits or drawbacks for the research.

2.3.1.2 Interviews

Qualitative research interviews were performed, they have a tendency to be less structured. More specifically 'Semi-structured interviewing' was used. The interviews were performed either in person or via telephone. According to Bryman & Bell (2011) a semi-structured interview is when the research has a list of questions fairly related to the topic that he want to cover, often referred to as the interview guide. The interview guide was handed out before the interview to give the interviewee time to prepare for the interview. It is not in the researches interest to catch someone off guard but rather to have them prepared some rich spinoffs from the conversations around the questions can happen.

All interviews where tape-recorded for quality purposes. Our memory has some natural limitation and it can be dangerous trying to recall conversations when it comes to detailed interviews about multiple questions with multiple people (Bryman & Bell, 2011). Telephone interviews can be useful if resources are limited at the current location. It can increase accessibility to people, but has It's disadvantages when compared to personal interviews. Complex questions can be harder to ask over the telephone, and it can be harder to control the interview (Opdenakker, 2006). Some of Bosch associates are located at other plants in North America and it did happen that an associate at my current location had unexpectedly to travel for work. Instead of rescheduling the interview, it was conducted over the telephone. Eight extensive interviews were conducted with people throughout the company, with each interview being around 45 minutes long. The associates chosen for the interview were identified with the help of the researcher's immediate supervisor with the goal in mind to interview people with diverse experiences throughout the hierarchy levels of the company.

There were two key departments who supported the research, the quality department (Quality Management Methods) and purchasing department. The purchasing department has 3 sub departments that list as follows; Commodity, Project and Quality. The positions interviewed can be seen in Figure 2.2.

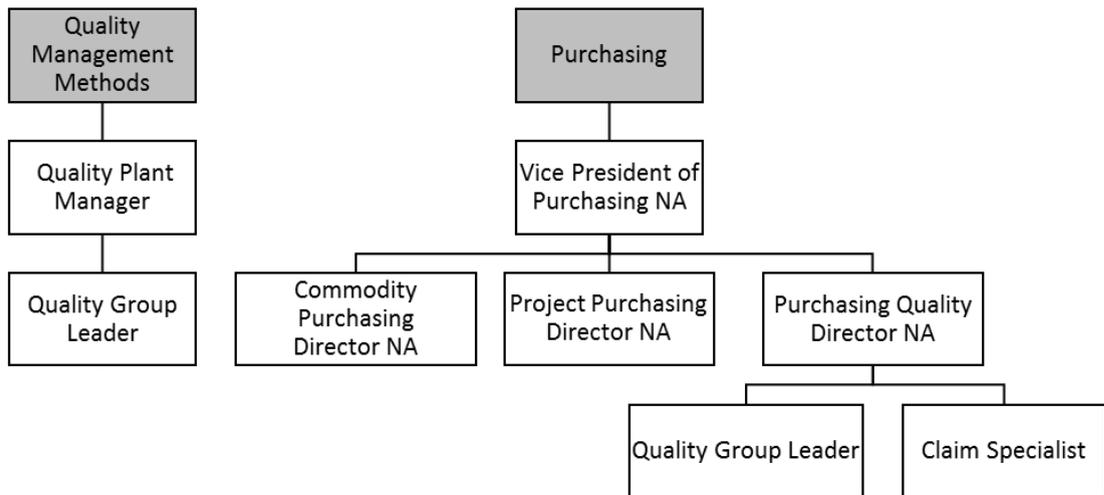


Figure 2.2: Organizational structure chart of the interviewees. To the left is the structure of the quality management methods department and on the right is the structure of the purchasing organization.

The interviewees were chosen with the goal in mind to get a broad view of opinions. Vice precedent gave the view of top management, directors the middle management view, group leaders the plant level view, and the specialist the hand on view, see Figure 2.3.

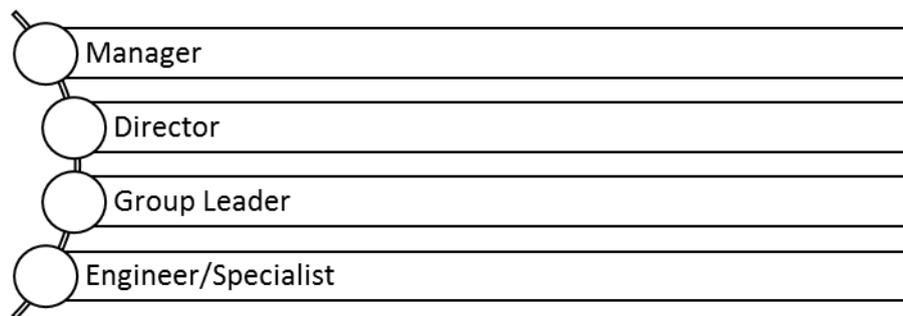


Figure 2.3: Overview of the different hierarchy roles interviewed for the study.

Relative discussions often formed during ongoing projects or task and were they used to gather more data.

Using a general interview guide makes the interviews more structured. The interviewee can grasp over the topic that will be discussed and make appropriate preparations ahead of the interview. There is no need for spontaneous answers. The purpose of the interview is to find as much as possible about the research questions. Therefore it can only help the research to send the guide out with the invitation to the interview. The interview still has some room for flexibility regarding topics discussed, spinoffs from questions can happen and are welcomed.

The guide however helps to steer the topic a little bit, and makes sure all of the questions are answered and none are forgotten (Bryman & Bell, 2011).

Consistency was kept in the questions between interviews, some of them varied a bit according to the roles and location of each interviewee. E.g. were the interview guides for employees in the same department pretty similar. By doing so it can be easier to come to a conclusion if there are any specific trends in the answers. For the SWOT part, questions needed to be the same for the analytical part of them.

The researchers' time at Bosch was limited to his internship so samples were chosen with awareness early on. It was obvious that professionals needed to be handpicked from different departments. In doing the handpicking feedback was given from the researchers' supervisor, in combination with the obtained experience through projects and connections to other departments. Professionals were searched with the research questions in mind. It was sought after to get a broad spectrum of views on the interview questions to help the researcher to understand the quality management work performed. Once the interviewees had been selected, they were contacted by email, informed about the researcher's background, why they had been chosen and research purpose. After that a meeting was proposed in outlook that suited both persons. The interview guide was submitted with the meeting request, so the interviewees could get familiar with the questions and think about them before discussing them.

Prior the interviews all interviewees were notified about the intention of the interview being tape-recorded. Bryman and Bell (2011) say it's done for quality purposes, because relying on someone's memory can be hazardous. The records helped the student to recall any conversation topic that went on between the researcher and the interviewee. So when it comes to writing down the content of the topic it could be done with more accuracy and precision. The records were only accessible for the researcher and were deleted just before the research was published.

The interview questions were open questions. Open questions are asked to give the interviewee to reflect his own opinion and to develop open discussion about the topic (Bryman & Bell, 2011). The purpose of the questions was for the researcher to get an overview and insight into the current situations at Bosch.

2.3.1.3 Observations

Observations were conducted during the period of the whole internship time at the Bethlehem plant. Field notes from project work, observations, or conversations were made ongoing throughout the 6 months period. It is important to write down the viewpoint of participants, their interactions and reflections from groups. It can be hard to judge what is useful and not, but doing this can give you a better depth into the situations so you understand what's more relevant in the end (Bryman & Bell, 2011)

2.3.1.4 Document Study

A document study was done at the company during the case study. Notes were written down continuously throughout the internship time. Inside portals at the company had relevant documents and department newsletters were useful for the data collection. Notes were made on my thoughts and ideas from meetings and daily interactions with people that help in contribution to the studies.

2.3.2. Data Analysis

The SWOT analysis had been selected for data analyzes. SWOT analysis, categories data into strengths, weaknesses, opportunities and threats, and is a good way to find contrast and similarities. A set of questions was structured in a similar way for all the interviewees and the interviewees were the asked to give their opinion on it. The answers were then analyzed in a SWOT way, and conclusions could be drawn from the finding of the analysis.

SWOT analysis can help both with categorizing internal and external information. It can helps generation a list of the organizations strengths and weaknesses, as well as threats and opportunities. Making qualitative data into strategic logic, helping reviling possible patterns in the data (Pickton & Wright, 1998). Typical setup for a structured SWOT analyses can be seen in Figure 2.4.

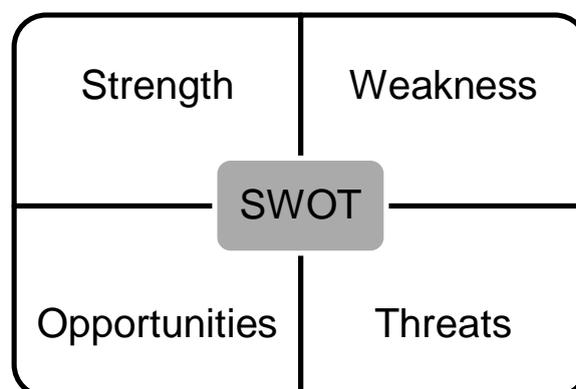


Figure 2.4: SWOT analysis typical layout.

Pickton & Wright (1998) describe SWOT as a critical part of a strategic management planning process. It's framework provided a structured analytical tool, which has been praised for

practicality and simplicity. It should not be viewed as a statistical tool, but can help us generate outputs for management and business development processes.

2.4. Research Trustworthiness

When judging the quality of a research, reliability & validity are often used as a foundation for that discussion. They are important criteria's but are often referred to as trustworthiness. Trustworthiness consist of four criteria's (Bryman & Bell, 2011):

- Credibility - Are the finding believable for other?
- Transferability - Can the findings be applied to other contexts?
- Dependability – Can the finding apply later on in time?
- Confirmability – Have personal values interfered with the research?

There is also a risk when researchers are observing as participants as they could 'go native'. Bryman & Bell (2011) define it as if the researcher loses its sense of observing the situation and gets wrapped up into the viewpoint of the people who they work with. The downside of this is if the researches stops having their independent views and starts copy what he/she is being told. On the other side we have the advantages of getting really close to the action. Building up trust with the coworkers can get you the unpolished reality (Bryman & Bell, 2011).

For this study the trustworthiness of the research was enhanced by use of interview guides and tape recorder during interviews. Being consistent with questions between the interviewees helps the credibility of the data and by tape recording them it was made sure all conversations are transcribed with more accuracy.

2.5 Research Ethics

When doing a research ethics need to be taken into consideration. Could we harm in anyways the people who the research is conducted on? Are we limited in activates we can engage in relation to the interviewees? Bryman & Bell (2011) list four ethical issues that need to be considered:

- Is there harm done to the participants?
- Is there a lack in information consenting?
- Is their privacy being invaded?
- Are there deceptions involved?

All these listed above were taken into consideration throughout the research time, to prevent any ethical issues later on the road.

There can also be a risk of cultural differences that might affect the researcher. Were the researcher is from Iceland, studying in Sweden and working at a multinational plant like Bosch has in Bethlehem were majority of people are Germans and Americans. Person with a different

cultural background might view things differently when interviewing other cultures. Having a diverse background might help a research to identify the cultural differences. Having no previous knowledge at the company might increase a risk of results being affected by the current state and behavior of the employees answers. On the other hand it can also be beneficial to have a fresh pair of eyes who are not prejudicial and might excluded option from the beginning based on previous experience.

3 Theoretical Framework

This chapter will give an overview into the area of the theory used for the thesis. The theoretical framework will support the research questions and give the reader insight into the areas and what has been previously researched.

It's a common question to ask what quality is? It is recognizable by customers when they see it, and companies promise to have abundant of it in their service and goods. It can be confusing and sometimes frustrating to figure out how to deliver quality, since a clear definition of it is often missing. Given the important of products quality, one would think it should be a problem solved long time ago. That's not quite the case and companies are still solving problems associated with poor quality (Bergman & Klefsjö, 2011).

In the manufacturing business quality is a part of science and not related to art. Its quantitative data allow us to deal with it using tools and techniques that have been developed and defended through the past decades. The quality tools have been proven to solve quality problems to a great extent. Manufacturing plants come in many sizes and shapes, and applying the right quality approach in a certain manufacturing industry could take some experience and knowledge (Rose, 2005).

3.1 Definition of Quality

In order for an effective implementation of quality management practices it is need to clearly define what the word "Quality" stands for. A common view of quality concepts is described by Bergman & Klefsjö (2011) as "The quality of a product is its ability to satisfy, and preferably exceed, the needs and expectations of the customers". In any industry a certain degree of quality must be integrated into processes for products of high standards (Hayes & Pisano, 2000). Even though the definitions of what quality is differs between industries, there are still some factors that remain the same in most manufacturing industries (Matzler et al., 1996).

There are also some common themes that individuals talk about when asked about quality, Rose (2005) talks about five themes:

- Products – The most obvious link in peoples mind this the quality is associated with products. Quality is defined as we see it as a feature or attributes in products. Whether it's an automobile, electronic device or a single component. The outlook of the product can make us confident in its quality. This is defined as "You know it when you see it" quality.
- Defects – The idea that a product might be defected is related to how we view the product itself. Our perception of quality my wary on the features we favor in the product. For examples if an automobile has an integrated locking system, it work on the first try, seats are comfortable on long trips, and lives up the it's specs about fuel consumption. Defects are different and notice them usually straight away or pretty

soon. We expect quality product to be defect free and when we purchase these no external outlook defects should be visible.

- Processes – No things get a bit more complicated. We care much about the process if we work in a manufacturing setting production products. The users of our products usefully don't think about how their products are produced or care much about it. Only think they care about is the final product and how it performs. The process that produces a product usually determines how the final outcome of quality will be like.
- Customers - When it comes to selling you products, the quality of it might be determined how the market views your products. Someone can have the best headphones on the market today. That statement can be true, but if no one is buying headphone at that time is the statement that relevant? People who make popular products might have a different view of quality, determined by the wants of the customer. The customers need and expectations can be what define the quality of how the product is made.
- Systems – System is a combination of things working together. For an outside perspective quality is determined how these things work to gather as a complete system. All the categories above; products, defects, processes, and customers could all be a part of a system that quality is determined how well they work together.

3.2 Quality Management

Gupta et al. (2003) says Quality Management can be very effective for an organization, but in order to succeed with it we need to understand some ground principles and how it can be structured since it needs often to be tailored to fit specific organizations. One way to see it is to take a look at areas organizations compete on, like with being flexible, having fast deliveries, and do it cost efficiently. The Sand Cone Model (Ferdows & De Meyer, 1990) explains how organizations choose to compete in more than one aspect. The model emphasizes on long lasting improvement without sacrifices. In order to do so efforts need to be done in a specific order, having quality as foundation. Only after that is established the rest of the organizations capabilities will follow and develop to the better. The Sand Cone Model is seen in Figure 3.1 below.

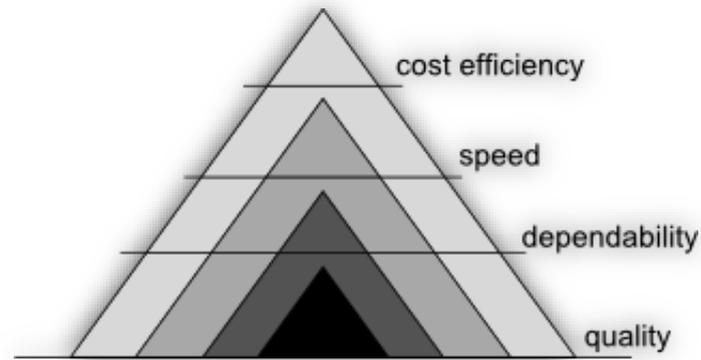


Figure 3.1: The Sand Cone Model with quality as the foundation for the pyramid, if the quality would be removed the rest of the pyramid would collapse.

Lester A. (2014) talks about quality being an attitude of the mind, and to achieve it effectively the whole organizations should be involved and committed to the process. To archive the right performance standards the mindset needs to be integrated into the board of directors down to the operators on the shop floor.

Quality Management is often divided up into three areas: Quality Assurance, Quality Control and Quality Inspection. Together they cover quality functions like (Lester, 2014):

- Procedures
- Methods
- Techniques
- Programs
- Plans
- Control
- Reviews
- Audits

3.2.1 Quality Assurance

Quality Assurance is the process that helps us to ensure that there are quality procedures in place, along with processes (Lester A. 2014). Part of the quality assurance is a focus on certain quality management requirements and to have confidence to fulfill them (Bergman and Klefsjö, 2010). This can be used to satisfy customers as they can ask for quality assurance documents, these documents can give a proof of the quality procedures and adequate control have been set up (Lester A. 2014). Assurance activates necessary to develop this disciplined processes are according to Rose (2005):

- Choose the right standard or specification for the organization.
- Define your operations, have a plan and well defined data collection activity to measure against that plan.
- Define the resources needed and provide them.
- Every entity should be assigned to responsibility to someone.
- Combine these activities into your quality assurance plan.

3.2.2 Quality control

The role of Quality Control within quality management is to fulfil quality requirements along the way (Bergman and Klefsjö, 2010). Quality control departments usually monitor specific project results. Determining if companies are meeting the required quality standards and trying to find ways to eliminate any factors that can cause uncertainty to the performance (Rose, 2005). The quality control department covers areas like the design, specifications for material, production, assembly and distribution stages. They can get feedback from market researches about performance criteria and customer requirements (Lester A. 2014).

3.2.3 Quality inspection

Another principle is to have a team structured based organization. Customers and suppliers can also be the reason Quality Management methods are used for collaboration within the organization (Molina et al. 2006). Quality inspection is the link to the customers and often do the final inspection of the product. The cornerstones model described in Bergman and Klefsjö (2010) where customer focus is the center part of the model overlapping other parts, see Figure 3.2. It's a quality management method consisting of six pillars and described by Berman and Klefsjö (2010) like this:

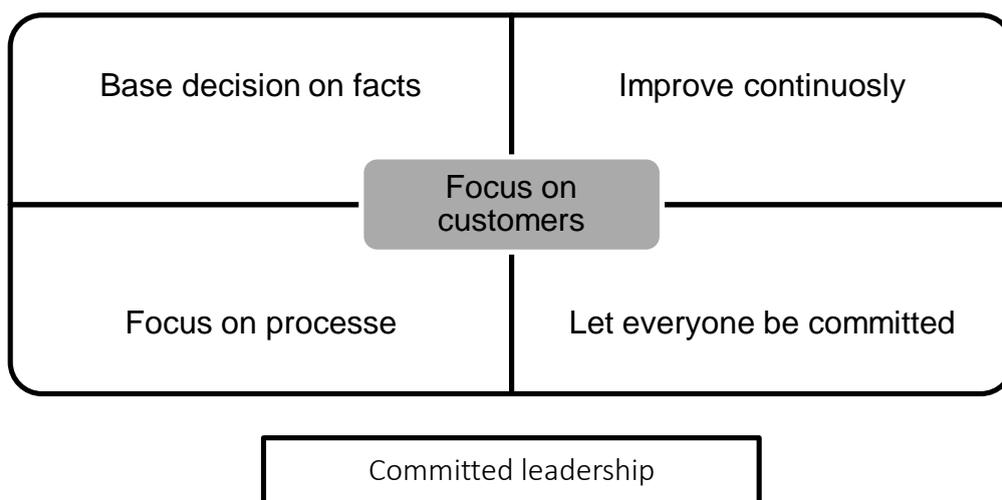


Figure 3.2: The Cornerstone Model and its values.

- Focus on customers: Find out what they want and need. Match expectation or exceed them, both internal and external needs.
- Focus on processes: Satisfy customer with output while using as little resources as possible. Have a well-defined process by using process charts.
- Base decisions on facts: Don't let random factors be a decision factor. From analysis conclusions are drawn, which are used for improvements. Use Quality Control tools and Management tools.
- Improve continuously: Anyone who stops improving stops being good. Use the improvement PDCA cycle. Use facts to bring out continuous improvements.
- Let everybody be committed: Let employees be committed by partake in decision making and improvement work. Let them know they are needed. Inform them about the situation. A person who does not have information cannot take responsibility. A person who has information cannot escape taking responsibility. Trues the employees. Key factors here are: Communication, suggestion system and education.
- Committed leadership: Strong and committed leadership creates a culture for successful and sustainable quality improvements. Must partake in all levels of the organizations and take actively part in the improvement process.

3.3 Organizing Quality Work

A question firms are faced with is how to organize quality work. Elg et al. (2011) says the role of quality managers is broad and it includes strategic chooses in the firm, as well quality management tasks for production. *"The key question for firms is not whether they should adopt and work with quality issues but how quality management should be implemented and continuously organized"* (Elg et al., 2011, p.2). How firms organize their quality work has gone through changes during the past years. Earlier firms used to check quality of finished products, but now they are focusing more on quality control in the production process (Shewhart, 1931, 1939). Quality assurance is now working with quality issues earlier in the production process, and are even a part of the product development process (Lengnick-Hall, 1996). Quality work is now integrated into the operations of companies, and is seen as an important strategic management matter that will develop even further (Sousa and Voss, 2002). For a further development of quality initiatives to happen, it is important to create a supporting structure leading to sustainability of the quality work (Balding, 2005).

Hellström et al. (2010) claim that Quality department's roles are to work with audits, processes and to improve processes for their firms. That they are focused on workflow and to eliminate non-contributing cost. Quality department's influence the company based on their responsible areas, and that their roles can be different depending on the responsible roles they are assigned to (Hellström et al., 2010). The quality management roles regarding supplier relationships have made a big impact on how supplier quality problems are dealt with. Quality groups now dealing with audits, certifying a product or a supplier, and are forcing corrective actions on suppliers (Watkins, 2005). Watkins (2005) claims that ordinary quality approaches that are on a division or plant level have NOT been producing the desired results regarding

supplier development. Supplier quality management has forever changed the way companies manage their suppliers in the procurement of complex products, and in the assembly industries outside suppliers produce 50-80% of the content in products (Batson, 2008). Many large organizations with an emphasis on global sourcing, have been contributing resources with responsibility for supplier performance and serve as a quality function at the plant (Watkins, 2005). Having a problem solving group that can resolve supplier technical issues and find root causes of problems is a key factor in achieving reductions of cost of poor quality on the operations level in the organizations (Phillips et al., 1983).

3.4 SWOT Analysis

SWOT is an analytical tool and is used for evaluations of 'Strengths', 'Weaknesses', 'Opportunities' and 'Threats'. It's a strategic planning tool and can be used in project or business analysis. It involves specifying an objective in business and identify internal and external factors that have positive and negative effects on that objective (Hali, 2007). The analysis can help us to highlight areas within the organization that are vulnerable, and use that as a leverages to strategically strengthen processes (Feldman et al., 2011).

Strengths and weaknesses are identified through internal analysis. Strengths might e.g. be cost advantage, loyal customers, attractive characteristics, and high satisfaction with service or product. Weaknesses could be limited product variety, lack of management understanding, high overhead cost, and a weak brand image (Feldman et al., 2011). When it comes to opportunities and threats Feldman et al. (2011) talk about the external environment is an increasing factor for corporation success. Some external factors are e.g. technology, economics, competition, politics, social and ethics. Opportunities can include new markets, expansion of production and new technology. Threats can come for competition, politics, shift in customer wants and needs.

4 Case company background

The following chapter gives a little insight into the case company's background and the industry they are working in.

Bosch Rexroth Business campus in Bethlehem is the center of operations for Rexroth industrial hydraulic in the United States. It's operations employ approximately 700 people in the area. They are a leading specialists for drive and control technology around the world, with a broad range of advanced drive, motion and control solutions. They design and manufacture, high performance, high productivity, hydraulic power units, systems and components using world class technology. Their cutting-edge technology is unique, and their industrial knowledge allows them to make customized designs according to customers' requirements, with a customer base reaching over 500.000. More than 36,700 associates worldwide are passionately committed to developing tailored, safe and resource-friendly solutions to help the modern world move just about everything. Their innovations enhance the reliability, flexibility, energy efficiency and performance of machine manufacturers and end users. The formation of Bosch-Rexroth started in 2001 with the merge of the automation technology unit at Robert Bosch GmbH and Mannesmann Rexroth AG. This is now a brand of the BOSCH Group generation sales revenues of approximately 6.5 billion euros in 2012.

Rexroth is specialized in the "Drive and control Technology" and as a branch of the Bosch group they fall under the "Industrial Technology" section. Rexroth has four major business units; Mobile Applications, Machinery Applications and Engineering, Factory Automation and Renewable Energies. Figure 4.1 gives an overview of these sections.



Figure 4.1: The four major market segment that Bosch-Rexroth is deployed through.

The Bethlehem plant is mainly working under the "Mobile applications" section. Producing e.g. full array of hydraulic control valves, hydraulic cylinders, customized manifolds, and power units with various options for particular solution. The different products are shown in Figure 4.2:

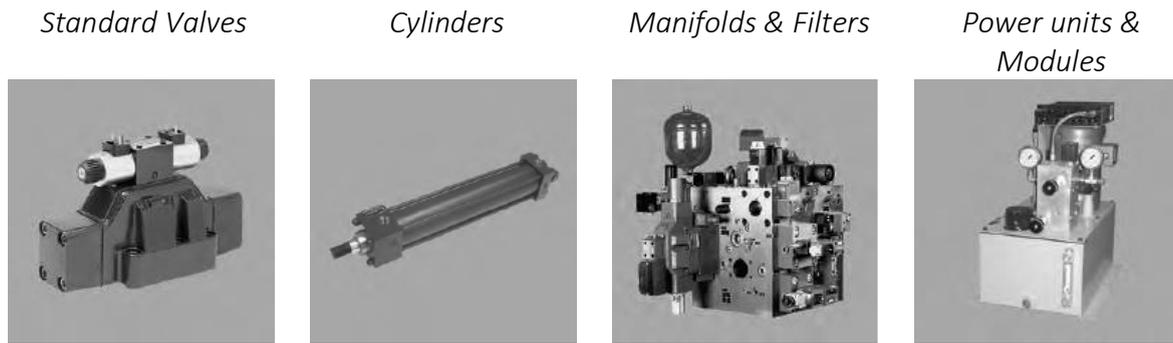


Figure 4.2: Example of products produced at the Bethlehem plant.

Bosch uses the same strategy for all of its plants and is it built up on the House of Orientation (Figure 4.5). The House of Orientation is a guide for all associates to help them understand and shape changes within the company, with the long term goal of securing competitiveness. The House of Orientation has three levels, starting with “Vision” at the top, “Mission” in the middle, and the foundation on the lowest levels are: “Core competencies”, “Bosch Business System” and “Values.

- Vision – Where they want to go and what they want to be.
The vision is their shared image of the future. It states where Bosch wants to go and what drives their actions.
- Mission – How they work together.
The BeQIK mission gives Bosch bearings as they move towards their future goal. It reveals the focal points of the of company’s actions. The objective is to keep on improving internal processes. In this, CIP is the brand for the continuous improvement process at Bosch.
 - BeQIK stands for:
 - (Q) Quality: Their most valued asset.
 - (I) Innovation: Be innovative today to ensure tomorrows business.
 - (K) Customer Orientation: Inspire customers and associates.
- Core Competencies – What they are good at.
It’s a mix an interrelated core competencies that they have been building up, that

give Bosch a competitive advantage (Figure 4.3).

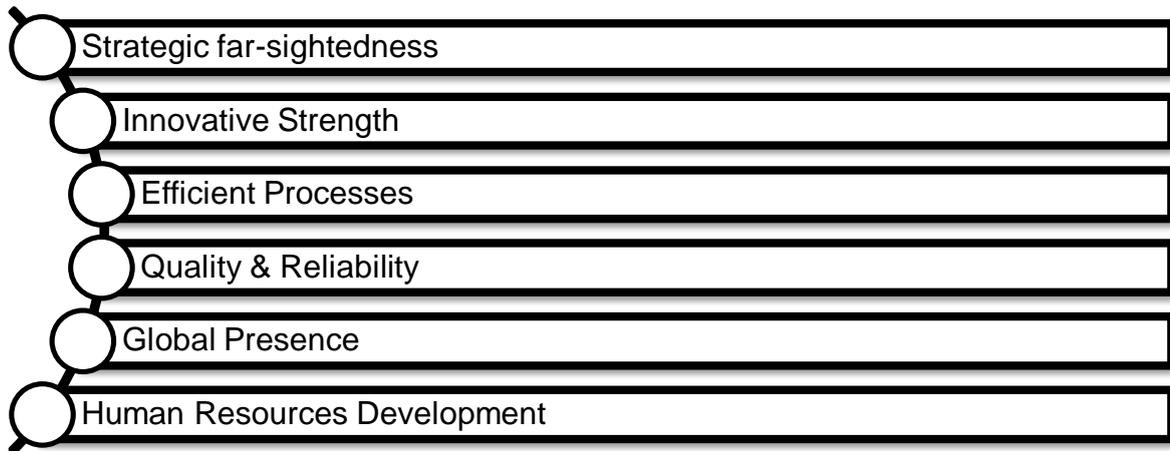


Figure 4.3: These are the core competencies that Bosch has been building on and according to them gaining competitive advantage with.

- Bosch Business System – How they learn and stay out in front. Bosch uses a systematic methodology to implement its vision. It helps them to continuously improve, manage changes, re-invent themselves and to master structural changes. The structure in Figure 4.4 shows that methodology.

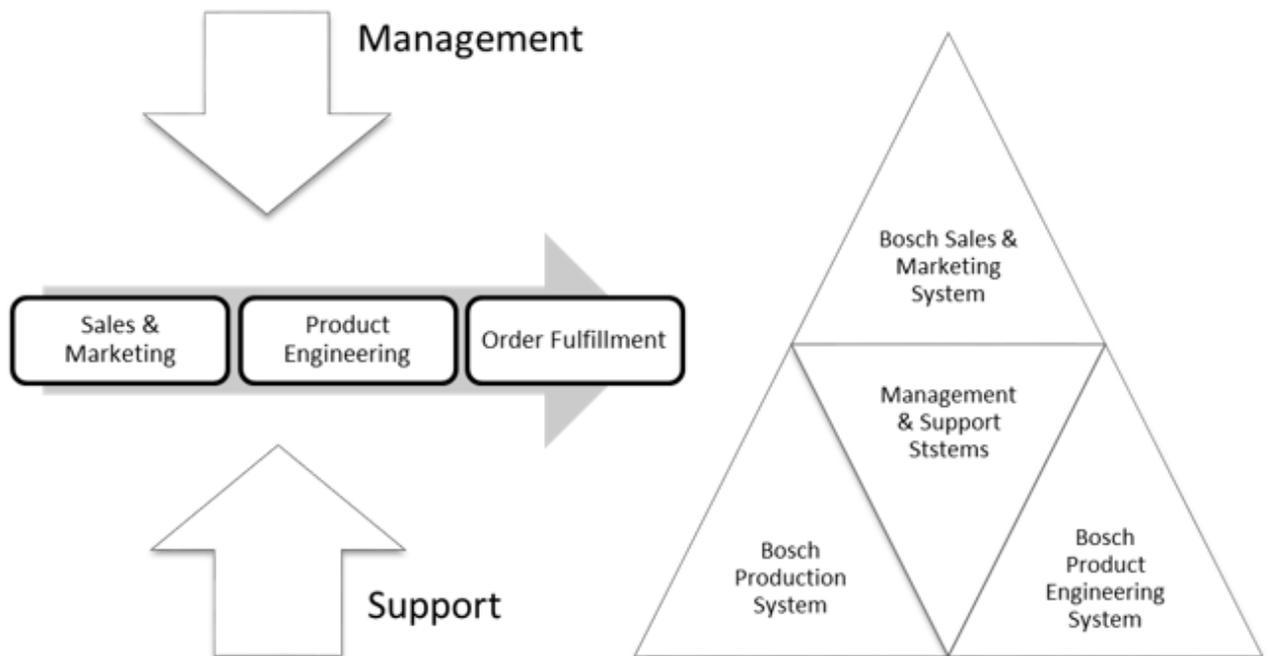


Figure 4.4: Bosch Business System showing how their systematic methodologies.

- Values – What they build on and what motivates them.
These values (Figure 4.5) are the foundation that Bosch has built its past success on and which the future success will be built on.

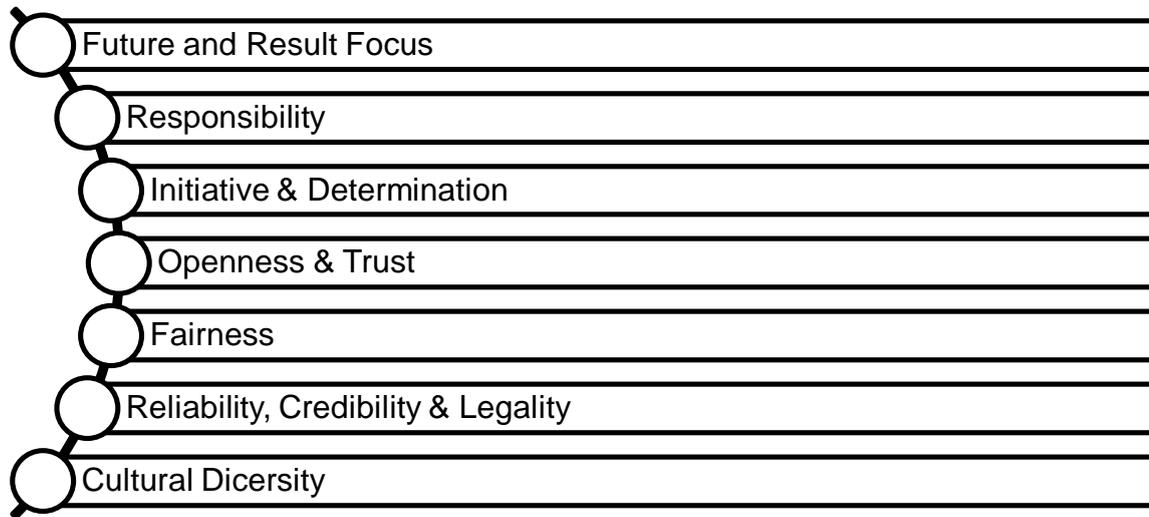


Figure 4.5: Values Bosch uses as a foundation for success.

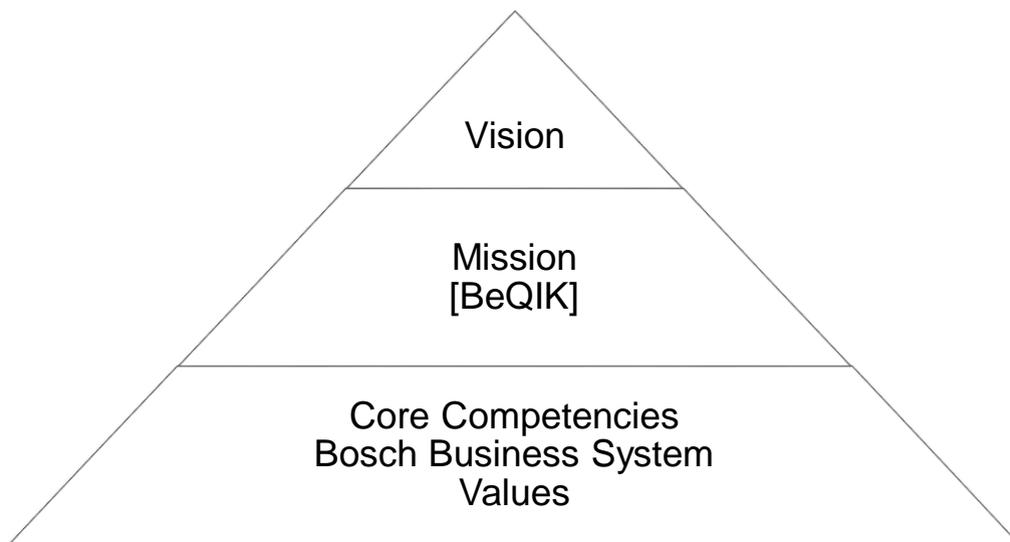


Figure 4.6: House of Orientation

Bosch Quality Management Principles

The quality policy in place at Bosch is determined by the board of management. Its goal is to support, reliable, fault-free, products and services to customers and consumers. Product quality is determined by the quality and the design (design quality), the quality of the manufacture (production quality), and the quality of the advice and support given to customers. This is what the Bosch Quality Principles document (Bosch Group Management System Manual for Quality, Environment and Security. Issue 4.0. Jan 1, 2014. Robert Bosch GmbH.). This document is signed by the General-, Commercial Plant-, and Quality managers of the plant. The document is posted in all meeting rooms and at some work stations around the plant.

Bosch Quality Principles	
<p>1. Our goal is to fully satisfy our customer's expectations through the quality of our products and services.</p> <p>2. Quality and quality improvement is every associate's responsibility and ultimate goal from the board of directors to apprentices.</p> <p>3. Our directives, processes, systems and goals are based on requirements from international standards, customer expectations, our knowledge and experience. Knowledge of and compliance with these directives and processes is the foundation of our quality.</p>	<p>4. Quality means doing things right in the beginning, thus preventing failures in the end. Continuous improvement of the quality of processes lowers costs and increases productivity.</p> <p>5. Avoiding failures is more important than eliminating defects. We systematically apply methods and tools for preventive quality assurance, learn from mistakes and eliminate their root causes without delay.</p> <p>6. Our suppliers contribute substantially to the quality of our products and service. Therefore our suppliers must live up to the same high standards we have adopted.</p>

5 Empirical data

This chapter is focused on the empirical data found in the case study. The findings are a result of observations, interviews and company documents that were gathered during the internship time of the researcher. The interviews and observations are mostly limited to two departments, the Purchasing and Quality Management Methods.

5.1 Quality management work

Exceeding quality standards is the cornerstone of the Bosch corporate culture. They focus on providing an integrated quality management work to meet the increasing quality requirements arising from the growing complexity of their products and globally networked operations. They place particular emphasis on early error avoidance in the product creation process and the timely identification of non-conformances in the manufacturing process. For this purpose, they integrated key content and processes from their product engineering system and production system into the roles and responsibilities of their quality management groups.

“We strive for our customers’ satisfaction. Therefore, we manufacture products and offer services with a quality that exceeds our customer’s expectations.” (Bosch’s approach to quality) – Director of Purchasing Quality

The general view of the middle- and top management is that quality management is a structure of processes and procedures that help the organization to ensure quality within its service or product. Bosch views quality management not as just an over documented processes, but something everyone should be able to apply and understand. It should reflect the policy at the organization, goals and their commitment to quality. It creates a structured way of working for all employees. Helping them having a quality minded focus so the organization can easier reach its quality goals. This helps Bosch in their daily operations to teach and reach their ultimate goal of customer satisfaction.

Quality has many definitions and appears to associates in a different way depending on their roles in the organization. It was described by associates during the interviews and observations as; performance requirement, doing a job correctly, meeting customers’ demands, being able to provide service at given parameter, to continually improve, meeting set goals, and having stable processes.

5.2 Quality groups responsibilities through the production process

When quality is considered throughout the production process it starts with the customer requirements, the supplier selection is then done from these customer requirements. The Purchasing department follows through with the supplier quality. After suppliers parts have been taken into the plant and are approved, Quality Management Methods then takes over and controls the internal quality all the way to a satisfied customers, see Figure 5.1.

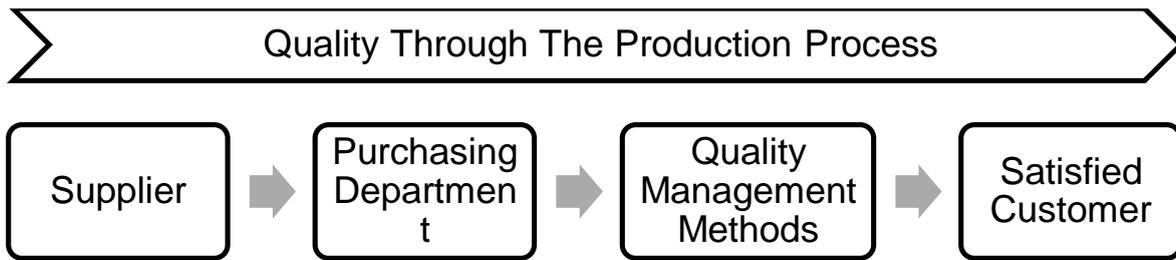


Figure 5.1: Quality through the production process. Showing stages of responsibility for the quality groups in the process from start to the end.

5.2.1 Supplier to Purchasing Department

The purchasing department is made of three groups that each have their roles within the supplier quality management process. They own the Supplier Quality Management process and are each responsible for tasks within it. Following target strategy of reaching zero default parts per million.

Project Purchasing (PUE) is responsible for supplier quality tasks before suppliers' Start of Production (SOP). They perform tasks like simultaneous engineering, application projects, cost savings projects, and relocation and localization. Purchasing Quality (PUQ) handle tasks before and after SOP. Before SOP tasks are preventive quality assurance for new parts and after SOP tasks is support for serial parts, safeguarding for localization projects, and systematic suppliers development. Commodity Purchasing (PUR) is responsible for roles after SOP, like mentoring the supplier across the region, market research, supplier evaluation, negotiations, contracts, business planning, and purchasing strategy. Their responsibilities and roles can be seen on Figure 5.2.

Project Purchasing (PUE)	Purchasing Quality (PUQ)	Commodity Purchasing (PUR)
<ul style="list-style-type: none"> • Before SOP* • Simultaneous Engineering • Application projects • Cost savings projects • Relocation and localization 	<ul style="list-style-type: none"> • Before SOP* • Preventive quality assurance for new parts • After SOP* • Support for serial parts • Safeguarding for localization projects • Systematic suppliers development (zero parts per million) 	<ul style="list-style-type: none"> • After SOP* • Mentor for supplier across the region • Market research • Supplier evaluation • Negotiations • Contracts • Business planning • Purchasing strategy

Figure 5.2: Purchasing groups and their responsibilities and roles within the purchasing department.

*SOP = start of production at supplier end.

The main content of the SQM process is to select a supplier with the right capabilities. Working with suppliers on quality developments and engineering tasks. Once that is reached the new supplier products go through initial sample inspection, and once they pass inspection the decision is made to release parts with that supplier and the manufacturing processes begins. The supplier quality management work is determined by looking at key performance indicators, how quality is monitored, target tracking, and as well as other measures making sure there is almost no deviations from Bosch’s requirements.

Below is a more detailed overview of the SQM process at Bosch. Customer requirements are the input to this process and the output is a satisfied customer. Much preparation is done at suppliers end before they are approved and can start producing products for Bosch. After production has started a follow up process takes over. The follow up roles are for inspection- and continuous improvement purposes, see figure 5.3.

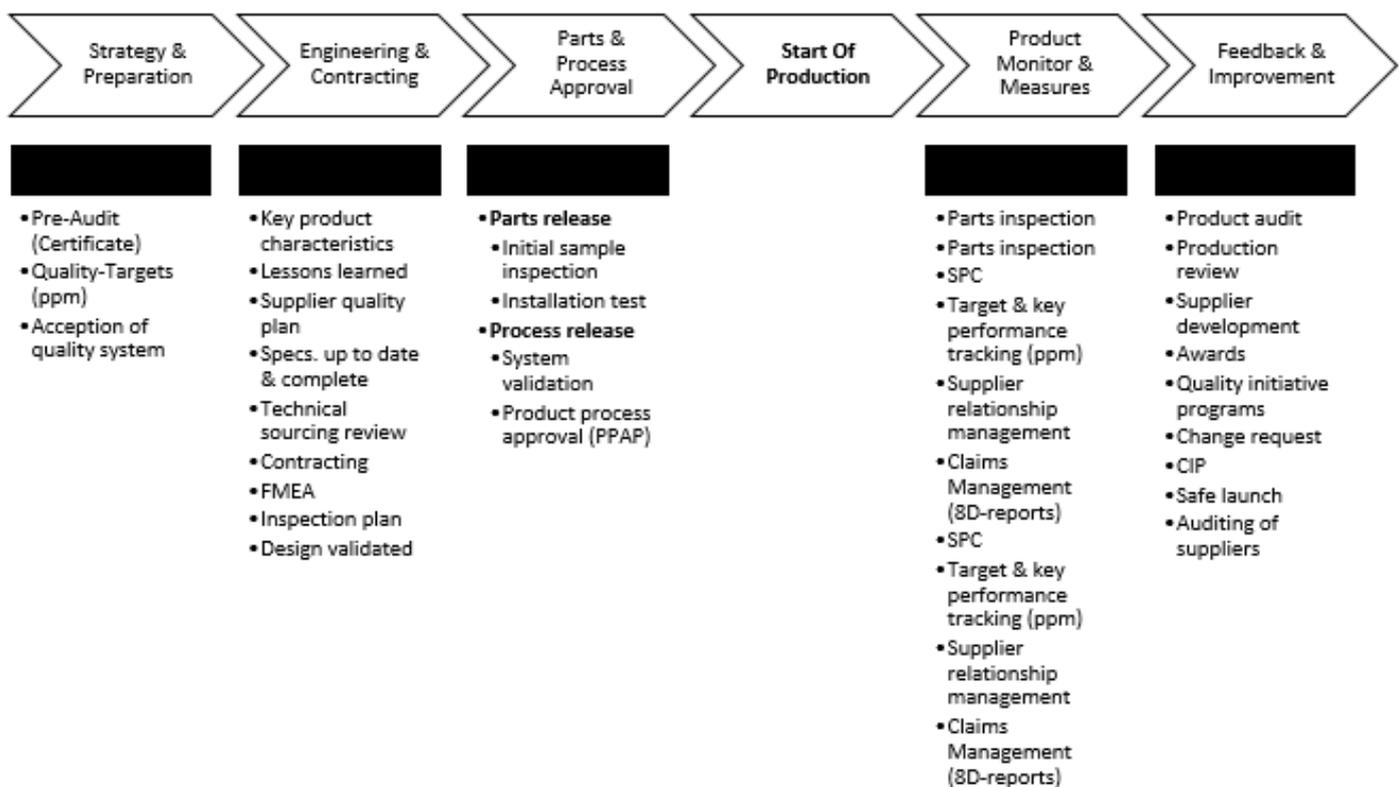


Figure 5.3: The Supplier Quality Management Process at Bosch. Showing different stages before and after production at the supplier. Parts from suppliers need to go through this process at the Purchasing department.

The purpose with all these step is that in the end Bosch wants to realese suppliers with good capabilities, by validating the product process and launching suppliers safely by measuring key chararestics.

“There are not a lot of suppliers with issues, most of them have zero defect, but still around 10% of your suppliers will have some sort of problems that you need to dedicate your resources to.” – Director of Purchasing Quality

The top vendors or also called focus suppliers, are given corrective action plans. It's a detailed plan made by Bosch listing what they are doing wrong, where they can improve and how they should improve. Focus suppliers are spotted by looking at pieces rejected, and from that data you know who are creating the biggest problems. They are then monitored and visits are done by Purchasing Quality at their sites. Key point at supplier visits:

- Resolution of passed issues.
- Going over defects that have recently happened.
- Make sure suppliers have reviewed them and made preventive actions so it does not reaccure.
- Look if they are capable of coninuing produciong the parts.

“Outsourcing the quality to suppliers or leaving them alone with their qualit issue can't really be done in reality.” – Director of Project Purchasing

The supplier will always have to have someone to get feedback from their stakeholder. Many reasons are for that, e.g. product can be complex and also one time orders, if changes are being made to the parts, or they start producing new parts. They are allways in need of feedback from their stakeholder and that is where Purchasing Quality is seen as a strong reasource to serving that purpose.

5.2.2 Quality Management Methods to Satisfied Customer

Quality Management Methods are responsible for internal plant quality. They are the division who controls what Bosch produces internally. As said before, though Bosch production is shifting more away from production to assembly, it does not mean that they have stopped all internal production of parts. They still make some parts and focus then more on the critical parts.

The processes they have in place are there to achieve their target of making a good product now. Meaning to build their products right for the first time and make their customers happy. If this is done correctly then they save the company money and resources by spending less non-value added time on warranty claims and running into problems down the road. Their responsibility is also to work with continuous improvements throughout the plant (service, production and warehouses), changing systems to improve internal processes. It's essential to have good processes in place to ensure good internal quality. When working in a manufacturing plan with around 600 associates it is not enough to tell a person what to do. You have associates working multiple shifts, people rotating working stations, and new people coming in. Therefore all knowledge needs to be standardized in processes so it is available for everyone.

The roles for the department are to support the production unit and provide them with problem solving support. Problems may occur in production and the most severe are the ones who threaten a stop of a production line. Then Quality Management Methods works as a response team, analyzing issues quickly with their problem solving techniques and tools. They are in control of measurement labs in every facility on campus, that is equipped with finite measurement equipment with the ability to 3D measure objects and do accurate measurements down to a tenth of a micron. They perform tasks like; routine checks, quality production checks, planning checks, quality floor issues, and confirm capabilities of a product. Having finite measurement equipment comes with much checking and calibrations of equipment. Tasks like outside contracts, database maintaining, customer audits, field analysis as well as answering quality related question from customers are done by them as well.

If an issue is encountered that is related to a product from a supplier, then it goes through the process of rejection. An associated might notice something wrong with component when he/she picked it up for use on the production line, he/she then notifies Quality Management Methods about the issue. They perform an investigation on the component and determine if there is an issue. If they conclude that this is an issue they perform a root cause analysis, and if it points out to be directly related to the supplier then it's brought to Purchasing Quality attention. See figure 5.4.



Figure 5.4: Process for internal rejection of supplier's product.

That rejected product is then escalated back to the supplier with the help of Purchasing Quality. There are three common option taken after consulting with supplier about the issue:

- Return the product
- Repair the product
- Scrap the product and get credit

5.3 Previous: Organization of quality management

Bosch used to have a quality management group at its production site in Bethlehem that took care of all quality management work. The quality department was Quality Management Methods who managed initiatives across the campus. They were responsible for supplier quality, internal quality, and customer quality. See Figure 5.5.

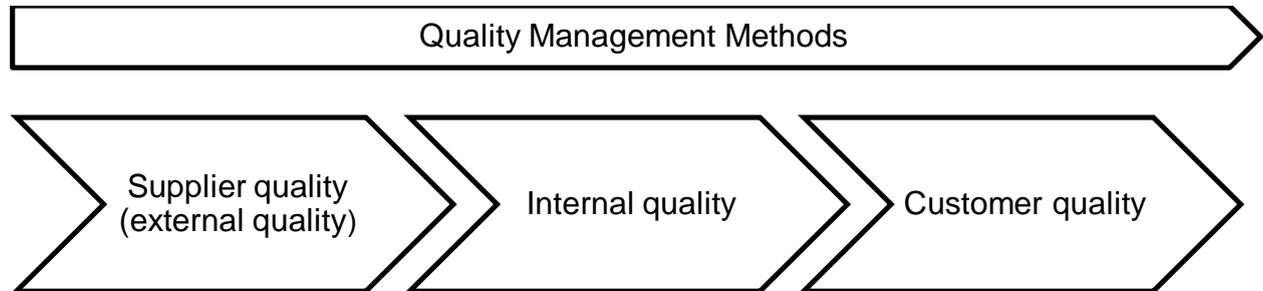


Figure 5.5: One quality group responsible for the quality during throughout the production process.

Quality Management Methods is a quality department with responsible for campus quality. The Bethlehem plant has two campuses with three main buildings with active production and their resources are therefore distributed amongst each location. Though their resources where distributed around the campus they were not considered a separated quality department since they were managed closely by their group leader and did cross training on various position at the campus location. The department quality manager was then in charge of oversight of processes, tracking quality key performance indicators (KPIs) to evaluate their success within the organization, and having the overall sight. Quality Management Methods supported the purchasing department with quality related issues regarding supplier quality, they ten handle all internal quality issues related to product or service, and support customers with quality related issue or questions.

5.4 Current: Organization of quality management

The current setup was introduced three years ago, the changes made were that Quality Management Methods was now to only focus on internal quality and customer quality. Purchasing quality was a new quality group integrated with the purchasing department. Purchasing consisted before only of Project Purchasing and Commodity Purchasing. Business processes are managed by each department depending on their area of responsibility but as they sometimes rely to each other close cooperation between departments regarding quality work. See current layout in Figure 5.6.

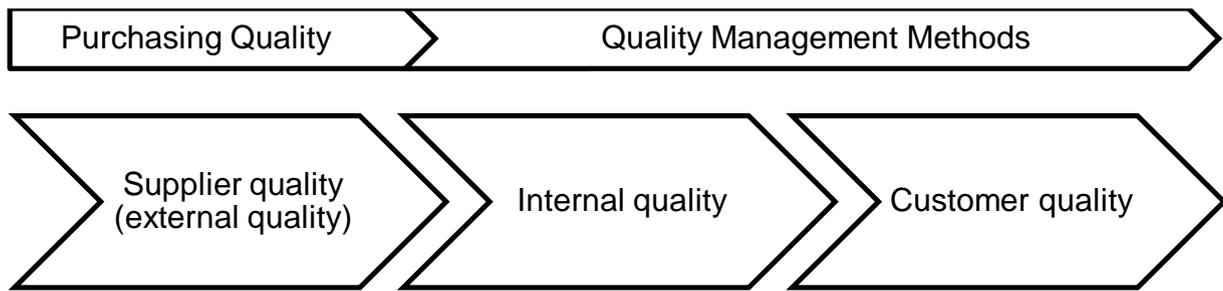


Figure 5.6: New approach with two separate departments doing quality management work throughout the production process.

The idea behind the split is that Bosch wanted to have one face to the supplier. A dedicated team who could work closely with the supplier. Their strategy is moving from production of parts to buying parts from suppliers. Meaning there is a shift from internal quality to external quality, because that is where Bosch's business is going. Having production of parts outsourced but keeping core competence parts made inside in the future. Their core competences will be shifted away from machining and more to the assembly and testing of products. The quality of the final assembled product really depends on the quality of all the individual parts made for it, because that is essentially where the variation in the product is coming from.

Above that it is to remove barriers between departments. They had a separate quality group and purchasing group that will always have some organizational barriers. But by integration the two and having all the roles within the same group, you remove these barriers. It was also done because within the North America region all the Bosch plants are using the same suppliers that are located in the region. Why having individual resources within these plants working on proactive measures with suppliers. By doing that you are duplicating your resources.

"By creating a Purchasing Quality group within each purchasing department at each plant, you now have a team who is preventing supplier focused and can stay on top of them" –
Purchasing Quality Group Leader

Now you have a Purchasing Quality groups that work like a centralized quality department for the North America region. With these groups communicating with each other throughout the region you can assign the group that is closest the supplier to focus on multiplane plant issues at the same time. Though you have taken resources from the Quality Management Methods department and made an extra quality group, they are still coordinated by a Purchasing Quality director who manages these quality groups. Despite their multiple plant locations they work together as one department under the same roof.

5.5 Quality groups roles and responsibilities

Quality Management in manufacturing corporations is about continuously improve all aspects for the production: before, during and after production. Figure 5.7 displays how these three

aspects make up the overall quality management responsibility at Bosch. Quality inspection is often talked about and done as a part of the quality control process.

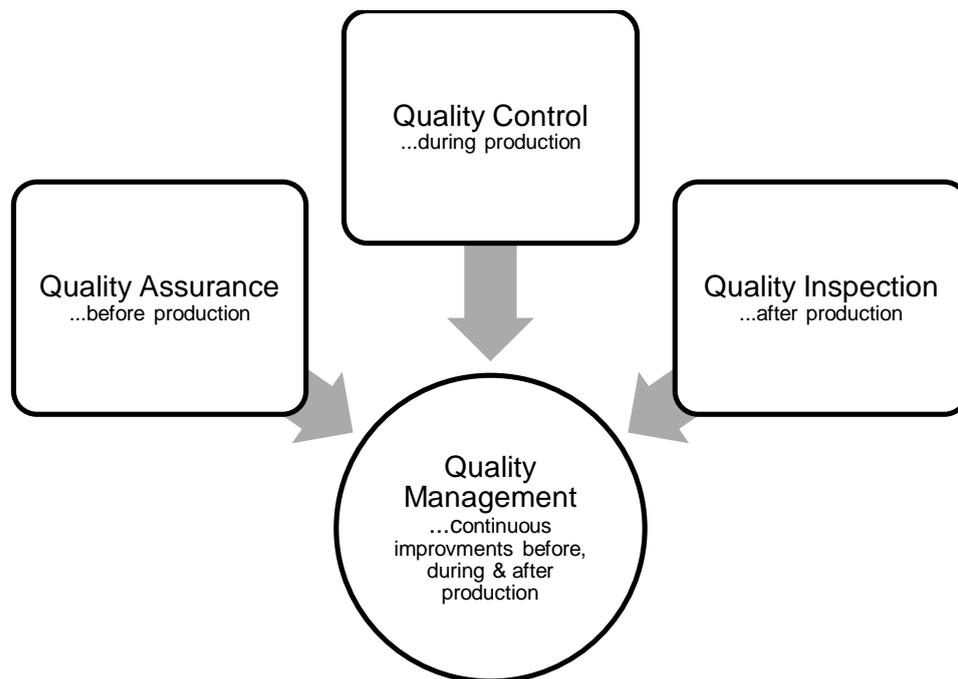


Figure 5.7: The three aspects are responsible for the overall quality management at Bosch. Each in a different place in the process.

When it comes to making a zero-defect product Bosch has processes and procedures in place that are split into two categories quality assurance and quality control. Quality inspection is done with quality control at Bosch, but was just include in the above figure for visual overview. This is done by a department named Quality Management Methods who handles quality assurance and quality control together. In the recent years though there has been a split to these roles and purchasing quality as taken over the quality assurance part of it.

5.5.1 Quality Management Methods department

Quality Management Methods (QMM) is the bigger quality department of the two at Bosch. Their objective is to support production with task like outside contracting, running labs, maintaining measurement equipment, doing production checks, planning check, deal with floor issues, and etc. They also support the production unit with problem solving, answer quality related questions from customers, audit customers, do facilities visits, field data analysis, PDCA for key customers and support portals to key customer about Bosch's claims. They are responsible for making final decision on rejections. The processes they have in place is to guard the making of a goods product, with the gold to build the right product for the first time and making the customers happy.

5.5.2 Purchasing Department

Purchasing quality (PUQ) is a Quality Management group within the Purchasing department. Their target is the zero-defect strategy, but that involves consideration & adherence of customer requirements, having qualified & reliable suppliers, identification of defective products, and minimization response avoidance of risks through a consistent and continuous quality work within the Supplier Quality Management (SQM) process. The SQM process (external quality process) consists of supplier selection, quality development & Engineering with supplier, initial sample inspection, parts and process release, key performance determination and target tracking as well as measures in case of deviations from Bosch requirements, and feedback regarding all process phases and continuous improvements.

5.6 Challenges maintaining quality management responsibilities

The majority of the responsibility for quality should rest on the supplier and the roles of the Purchasing Quality group is to support and train the suppliers so they will take more responsibility for themselves. The ultimate goal would be have all the incoming parts with zero defects and therefore need to do no incoming inspection of supplier's parts. But history has showed Bosch that it is not realistic.

"No supplier is perfect, you're always going to encounter some quality issues, and you need a group to work with these problems." – Director of Commodity Purchasing

Having a group like Purchasing Quality in the purchasing department is a proactive move and is pushing into the direction of giving suppliers the feedback to become sustainable. It is Bosch's goal to build them to that level and there are some who are close to that, but not hundred percent (100%). Part of that reason that this is hard to reach when you are manufacturing complex parts and systems, then it is harder to get everything perfect. Another reason is that Bosch does not have enough resources to bring the suppliers to that level. Third, the standard for quality is also getting tighter as well, and even more on the automotive side. Parts per Million (PPM) standards are being pushed lower, so there is a constant pressure and adjustments of standards.

The Bethlehem plant has a more difficult production compared to other Bosch's plants in North America. It manufactures a lot of low quantities orders and one time orders. Some supplier's don't want to get into low quantity production, so when it comes to picking suppliers for producing low quantities volume order they sometimes have to go with "less attractive" suppliers.

"It is more difficult to maintain a high standard of quality with low quantity orders, instead of being focused on mass production of parts." – Purchasing Quality Claim Specialist

Sometimes high quantity orders come in and then they don't expect to inspect so much. For the one time order Bosch need to make sure these are good before we use it further down the

line. Lead time plays a big role cause you can deal with less inspections of you allow for greater lead time. The margin for error is small when lead time needs to be short and therefore inspection standards are kept higher. For cheaper components suppliers can have a reserve of products, but if you have a complex product in low quantity that costs couple of thousands of dollars the chances are negligible that suppliers keep a reserve in a case of an issue.

5.7 SWOT Analysis: Organizing quality management groups



The SWOT analysis are based on information from the interviews of the case study. The interviewees answered the same question in four way regarding its strengths, weaknesses, opportunities and threats. Interviewees were asked what they thought about the organizational change made three years ago when a quality group (Purchasing Quality) was intergraded into the Purchasing Department. With the change the quality management work was now managed by two groups, instead of previously one. The interview data has been summed up into points and can be seen in the four figures below.

Points from the strengths analysis can be seen in Figure 5.8 below.

Strengths
<ul style="list-style-type: none"> • Clear priorities between: quality, cost & delivery. • The quality loop is smaller within the function and therefore issues resolve more quickly. • Quicker performance feedback to supplier. • You don't need to pull quality resources from another departmen who might have different goals/priorities. • Quality is now integrated through the whole sourcing process. • Purchasing has taken full responsibility for quality of parts they source. • Purchasing depement is more committed to quality and consistant throughout their sourcing process. • One interface to the supplier. • Purchasing groups now all pull together with same goals and strategies in mind. • It gives addition leverage on suppliers to have a complete department working on them. • Supplier problems are resolved much quicker. • Better upfront quality planning. • It supports the business direction to outsource production more. • Removes barriers between purchasing and quality. • Smarter use of resources within the region. • You have a close connection to the product. If maturity levels are high things can be done very well.

Figure 5.8: Strengths from the SWOT analysis on what the interviewees though about the organizations change made three years ago when a quality group (Purchasing Quality) was integrated into the Purchasing department.

Points from the weaknesses analysis can be seen in Figure 5.9 below.

Weaknesses
<ul style="list-style-type: none"> •You might get disconnected to the rest of the plant. •A friction between departments can occur if communications are not rich. •New quality work developments can be more difficult to implement with two groups. •Sharing of equipment can be a problem when groups have different priorities. •Engineers get their maturity from knowledge sharing and splitting group decrease shared expertise. •Quality Management Methods is more "repellent" to give additional support to Purchasing. Attitude is that Purchasing Quality should handle their quality issues. •Budgeting is a struggle since both groups share equipment. Both need some budget. Purchasing Quality is not really given any budget since Quality Management Methods own most measurement equipment. •There is more distance from the product and the final customer. •Purchasing Quality is doing more administration tasks like scheduling and replacement of parts. •Disconnection to the daily plant activities.

Figure 5.9: Weaknesses from the SWOT analysis on what the interviewees thought about the organizations change made three years ago when a quality group (Purchasing Quality) was integrated into the Purchasing department.

Points from the opportunities analysis can be seen in Figure 5.10 below.

Opportunities
<ul style="list-style-type: none"> •A complete Purchasing department can have further developing options. •A smaller communication loop has a higher probability to successful execute project, e.g. regarding time and cost. •Opportunities to consider quality, cost & delivery all respectively. • Increased agility and flexibility within the Purchasing function. •Opportunities to be more proactive within Purchasing. •Further supplier development can be done. •Expertise can be shared more with suppliers, since Purchasing Quality can go out there and work directly with the supplier. •Supplier quality performance can be better evaluated and better suppliers can be released. •Quality groups can't be leveraged by production since they don't all report to them anymore. •More bundling of parts can be done with the same supplier. •Having someone integrated in the team can lead to a higher level of discussion. •Full time individuals can become experts in that area learn that process completely.

Figure 5.10: Opportunities from the SWOT analysis on what the interviewees thought about the organizations change made three years ago when a quality group (Purchasing Quality) was integrated into the Purchasing department.

Points from the threats analysis can be seen in Figure 5.11 below.

Threats
<ul style="list-style-type: none"> • On the policy deployment side, topic focus can be comprimized by influence of other Purchasing groups. • There is a risk of small groups lacking broader knowledge. • You might not be able to serve the whole porfolio of part as well as in a bigger group. • Purchasing quality strategies could get out of line with plant strategy. • Less resource available. • Risk of not having the best people in the best postition due to less resources. • Associates can loose their expert knowldge since they are working with more diversity of products. • A more complex organization has been created that is hard to fully understand. • There is still a argument within the organization about best practice of structuring these groups. Because plants experience different problems. • It can be harder to monitor motivation and focus of smaller groups.

Figure 5.11: Threats from the SWOT analysis on what the interviewees though about the organizations change made three years ago when a quality group (Purchasing Quality) was integrated into the Purchasing department.

6 Analysis

This chapter will be a discussion on the two research questions, in relation to the empirical data & analysis in chapter 5. It will try to answer the research questions proposed in chapter 1.3.

Research questions from chapter 1.3:

- *Research question 1: What roles and responsibilities can quality management groups have at a large manufacturing plant?*
- *Research question 2: How can quality management groups be organized?*

6.1 Roles and responsibilities of quality management work

In theory supplier should own their quality and solve their own issues. But in reality if the supplier can't come to a resolution, it does not help to ignore him. They might go back and still struggle to make it right, with his cost of sorting and reworking going 100% up. One of the Bosch's mentality is to help supplier to develop, this can't of course not be done with all of their suppliers. But supporting your supplier network strengthens the relationship you have with them and makes them more custom to your demands.

They are also open for taking on new suppliers who are not there yet, but have the potentials to get there. The advantage of that is the same as brining in a fresh student who you can train on how to do things, do things the way you want. You are essentially laying down the right processes for them to follow. Everyone has heard the saying to get something young and train it to do what you want. That isn't a bad thing, but can be seen as a win-win situation for everyone. It's just like teaching a child to walk, you have to develop them and help them to get there. By the time they get there you have an individual who can stand on their own feet's. The advantage of that is the same as brining in a fresh student who you can train on how to do things, do things the way you want.

Bosch requirements are tough and by helping the supplier to develop you are helping the supplier to reach the maturity level needed. The supplier learns how to do the product right from the beginning that leads to reduces in cost and scrap. He has gotten help with resolving his issue and learns to have the right processes in place that will therefore lead to a successful business relationship in the future. Giving the supplier this support pays immediately off for Bosch. Supplier is following his quality standard, are using lean manufacturing, and they receive products that the likely to have less issues. This saves non-value added time if issues appear in-house at Bosch and leads to better quality of both processes and parts.

6.2 Different perspectives how to organize quality management groups

The setup of quality department is always a management decision. You can adjust the setup of

the departments according to their sizes. The economy of scale needs to be considered and are underlying reasons for that. Some reasons are perceived more strongly and appeal more to some than others depending on group's perspective.

It was clear through this case study that having two quality department at the same production site would result in different view and opinions about themselves and the outlook of each other. Below I have divided the perspective of the quality management groups into two sections.

6.1.1 Quality Management Methods perspective

The spilt of the quality department into two quality departments with separate roles is still questioned a bit from QMM side. It is believe that flexibility has been lost at the Bethlehem plant since of the spilt. Purchasing Quality is a group of three people and if resources in that group start to be unavailable a problem can emerge quickly. E.g. if one person is traveling, another is on a holiday and the third is on a sick leave. Then there is no one to deal with urgent tasks. This scenario is of course avoided at all costs by planning for it to not occur, but it's a possibility since the department is so small. Quality Management Methods believes that by having the resources under the same manager you can shuffle them better around and be more flexible.

Flexibility can be reached e.g. by doing a better job of cross training associates throughout the department and then backfilling becomes less of a problem. An associate can be assigned to one area but to get there you are first moved around within other areas. Also when one focus factory is slow resources can he shifted easier around helping each other where workload is more, therefore smoothing down any peaks that might occur. One department manager can have a better overview of this situation, instead of now having two who are coordinating smaller units.

There is also a concern that the Purchasing Quality group is handling most related quality issues, were Project Purchasing and Commodity Purchasing should be the owner if these issues. Purchasing Quality should only be supporting them and not carrying the load of their quality work. If a small department like Purchasing Quality is taking care of such amount of problems and need outside help, Quality Management Methods can't always give them much support because their resources are limited and scheduled for other tasks. This can lead to a dilemma if a lot of issues start queuing up things fall into a gap, with Purchasing Quality only focusing on their biggest issues due to limited amount of resources.

Another concern with Quality Management Methods is that problems can't be properly handle due to lack of resources and suppliers problems are taking longer time to resolve than customer topics. Their view is that since Purchasing Quality was is a smaller unit the pressure they can put on their supplier is less than it could be, compared to if there would be a bigger quality department.

6.1.2 Purchasing Quality perspective

There is a concern within the Purchasing Quality that Quality Management Methods does not understand their roles within the organization. From Quality Management Methods' point of view Purchasing Quality is just a department who is giving the purchasing group extra support. Which is correct but what kind of support is to be given differs from both department view.

The organization struggles to understand the role of the Purchasing Quality group. Due to the increased complexity of parts being outsourced to suppliers there has been an increasing knowledge gap within the Purchasing group. The move from quality groups just being a supporting function to an integrated part of the Purchasing department, has decreased that gap by integrating a group with the needed technical expertise. Purchasing felt that it was needed to organize the quality work in a new way and get the needed quality support by having quality groups working more closely with them.

This setup is seen as needed for a couple of reasons. Since one of the strategies for the Purchasing department is to look into cost saving projects and make profit to secure Bosch's growth. They might not always go to the best supplier, but try to choose a supplier with more competitive prices who still can meet the technical requirement for doing that part. The Purchasing department has therefore been forced to work with the supplier and help them improve over time. Another aspect is the "one face" to the supplier that has not existed before but is now being provided. Having a completed department who can handle supplier issues can have a positive image for the company. Throwing issues around between departments can be frustrating for the supplier. Now there is a dedicated team working with the supplier on the arising issues.

Thirdly, the Purchasing department feels that the current setup has helped them to gain more leverage on the supplier, the opposite to what Quality Management Method's view was previously. The person who signs the contract with the supplier is now also responsible and more quality orientated. Previously they made decisions that were mostly based on cost. But by having cost and quality under the same umbrella you are making sure both are considered. This has given them more leverage on the supplier, cause before you had only Quality Management Methods complaining about technical issues to the supplier. Now we have that combined with the Project Purchasing who control the contract to the supplier and that gives us more leverage behind the corrective actions they want to take on the suppliers. They are now all pulling in the same direction with all groups and by pulling together a greater force can be achieved than having separate departments pulling individually.

Before the split there was none really work with escalation plans, everything before was more on a notification basis. Parts were sent back, replacements were gotten, and pressure was put on supplier by notifications. But there was none who could work the issues out with the supplier and help them in fixing the problems. If the supplier would not improve and continue to send bad parts, chances are that they would just get a status of being eliminated and

purchasing would have to start looking for another supplier. Now with Purchasing Quality working on proactive tasks they have resources to devote to these issues and really solve the problems, instead of just administrating it like was done before with Quality Management Methods.

6.3 SWOT Analysis: Organizing quality management groups

The SWOT analysis are based on the empirical data from chapter 5.7 “SWOT Analysis: Organizing quality management groups”. That chapter is based on information from the interviews of the case study. The answers have then been summed up into extensive analysis and will I elaborate in the empirical data in the four chapters below.

6.3.1 Strengths

By integrating quality into purchasing you create a closer team with a better overview of history of the defects and can do a better upfront quality planning. It will help with the new direction of the business, were they are planning to be outsourcing production more. So this integration has helped to set the quality focus were it needs to be.

Purchasing is anonymous in terms of getting things released. When you get quality support from another group, you’re pulling resources from another function and they may not have the same goals as you do. So what is being done is having a Purchasing department who can on its own choose a project, work the supplier, do all inspection, survey and analysis. Before you had to wait if the resources were not available to be pulled. They might have different goals than you, and might not be as excited to support you. It removed the barriers between the purchasing activities and the quality activates so you don’t have a situation where purchasing are off on their own buying any sort of junk and the people in the quality group have to clean up the quality issue later on. Now Purchasing are given more power as a combined group to sources parts right from beginning. This gives them the opportunity to be quicker in every aspect, whether it’s sourcing parts or solving issues.

There is now a complete function who can source a component by itself, and bring it into production. They have a close connection to the product, things are done locally and things have been working work very well so far. Purchasing has now created what is called a “one interface” to the supplier, where suppliers only interact with one department. For supplier this is less confusing than having to communicate with other departments as well. One contract and one department their working with. This also brings addition power for quality measures. Cause the suppliers know it’s all under the same roof. With suppliers knowing that they can’t play any funny games. Bosch has a much faster respondents to problems, because the loop is shorter. There is no interdepartmental communications about problems, and issues are handled directly by the same department. If suppliers repeatedly keep doing the mistakes they will easily lose future contracts, or even current contract.

There is more commitment regarding responsibilities and priorities, by having a group with common goals makes everyone more committed. Therefore quality, cost and delivery all

become an equal priority. Groups are more focused, committed and consistent. They are all now pulling in the same direction, and when all groups are pulling together they can achieve much more than forces who are working against each other. Purchasing quality resources are also coordinated by the same regional manager so supplier issues can be shared better and tackled by the closest plant.

6.3.2 Weaknesses

Since the shift, Quality Management Methods has the attitude it not my job to support you guys anymore, if Purchasing Quality is asking for help. It's is view more now that PUQ should handle their quality issues, but sometimes addition support is needed. If there is a customer approval or a customer quality issue that need to go through a corrective action. Sometime it is more difficult to get that support since they are a separate group with different schedules. There are now less communications with QMM for obvious reasons, but it can costing some delays. Not that it is their fault, since they might have their own issues under pressure.

One weakness is the struggle of budgeting. If Purchasing Quality needs some addition quality equipment that is hard to share, they don't have any budget for buying tools. They are not going to buy tools from the other group budget since they are considered a separate department. PUQ is not given any budget, but have been getting cost covered by the Purchasing Department which they are a part of now. There is not really a clear cut line there, because some equipment that they might buy could sometimes be shared or who should pay for extra equipment if that is needed. This has not been resolved yet and remains unclear. For that reason they often share some labs or inspection areas. Generation another problem of prioritizing of usage of the equipment. Quality Management Methods is the owner for most of the excitement with some machines that are really expensive so having an addition machine like that is out of the window at this moment. If there is an internal issue and the engineers need to have a prototype measured at the same time as the other quality groups needs part samples measured, then we have us selves a conflict and in the end of the day the one who owns the equipment is the one who sets the priorities.

They are now a bit disconnected to the daily plant activities. There is a little bit of distance from the product and the final customer. Cause from the moment Purchasing Quality people started reporting to Purchasing, their interactions with the shop floor and the final customers declined. Purchasing quality is now more into scheduling of returns, replacement of return and other addition paperwork. This can oppose a problem if communications are not rich. Groups might be waiting on a solution and not hearing of any progress in it, creating a friction between departments. Where one barrier has been taken down another is created. Now there are two quality groups within the organization, with different goals and objectives. It is a tradeoff and has added a layer of both complexity and democracy.

New development in quality is now more difficult to implement. Purchasing Quality have to be trained with Quality Management Methods. Syncing thesis two groups on a knowledge and

process based levels is now harder. There is no way that a person knows details about every component, and when you split up groups they will lose the depth of knowledge. There is less and less teamwork and interactions going on. You lose a degree of knowledge by working in smaller groups, since knowledge sharing of expertise is not happening as frequently. Engineers are not always fully mature and need to learn from each other. They share their expertise, and depend a little on the knowledge sharing of each other.

6.3.3 Opportunities

Integration bring the opportunity to be really focused on quality for the beginning of the sourcing process. If more resources were devoted to the quality group there would be more opportunities for Purchasing to become more proactive. Having the extra resources would enable them to do more, like hosting another supplier quality day, do training on 8D, root cause analysis, and take suppliers with potentials but who are not mature enough but the development assistance needed.

They have further developing options since all groups within the Purchasing department can learn from each other, and therefore you are creating this knowledge sharing culture within the purchasing organization. You have more expert knowledge integrated in the team and that can lead to a higher level of discussion. Fulltime individuals can become experts in that area and learn that process completely. Having these fulltime experts, they can go out there and work with suppliers. They are now able to take their expertise and share it more with the suppliers. These experts can help with the process of releasing better suppliers, since they can help with evaluation of their quality performances and minimize any chance of releasing a poor supplier.

Based on being under the same roof, having the common responsibility, it should be a higher probability to successful and on time execution on cost saving project. E.g. if the quality person if just focusing in the quality, he just wants to keep the process stable. If it works, don't touch it and change anything. But with then we will not get any major cost reduction. Now they can come together finding solutions that will maintain the level of quality be also find option for cost reduction. Agility and flexibility, the velocity has been increased within the purchasing function. Because you have a group that should be able to do everything you need, from selection a partner to getting it into the factory. You're going to increase your velocity and reduce your lead time of bringing products from nowhere into production. That's is a real opportunity Bosch can build on from now.

They are doing more of bundling. Having all these different plants (Bosch plants) buying before the same components from different suppliers, is a waste of our resources. It's not maximizing the potential leverage that can be created with the supplier. What was done, is creating a global project where they could bundle order together with suppliers. This drives cost reduction and strengthens bonds with suppliers by giving less suppliers more contracts. This helps with claim management, cause if we are working with supplier who you have less than 1% of their business, you don't have much leverage to push them through any changes or

improvements. But if you are going in with 10-15% of somebodies business, you have their attention on implementation of changes.

6.3.4 Threats

By combining these groups topics in the policy deployment, can be compromised. E.g. having Purchasing Quality focusing on cost, they will lose some of the quality focus. Cause they themselves need to make a compromise.

Limited resources are a threat for the group. Not having the best people in the best position. When you have a bigger quality department you can have certain people who are experts in certain area or products focused on that part. Now you have less resources focused on a broader field, so it is given they are not experts in all these fields. Smaller groups are more likely to not have all the knowledge needed and it can be harder to monitor the motivation of them as well, if they really are focused or not. You're not going to serve the overall part portfolio as well as a bigger group could do. Your sourcing strategy could also not be in line with the plants strategy regarding sourcing of parts.

A more complex organization has been created that is hard to fully understand, and the customers can struggle to understand the structure of the organization. When you present yourself to other companies it can be frustrating for the customer to hear about different groups handling different the same concern. Not like you want to hide anything, but it is better to be presented as a one unit. There can even be an internal struggle with that. There are still some arguments within the organization about the best practice of structuring these groups. Because different plants experience different problems, and many argue the best practice is to structure everything the same way, having a clear long term strategy.

7 Conclusion & Discussion

Research question 1: What roles and responsibilities can quality management groups have at a large manufacturing plant?

Research question 2: How can quality management groups be organized?

7.1 Roles and responsibilities that quality management groups have at a large manufacturing plant

Quality management groups have different roles and responsibilities according to the companies their setup in. It was essential for this study to know how Bosch operated at its manufacturing plant. It is evident that the quality management groups roles and responsibilities change from one department to another.

It is generally believed that manufacturing plants should have a large influence on supplier's product quality, previous studies indicate that suppliers should own their quality issues that occur in their production facilities. What this study showed was an approach to relations between a manufacturing plant and how it manages its suppliers. The purchasing strategy is still to buy the cheapest products fulfilling given specifications, the attachment to supplier quality issues is to an importance to Bosch and they take on the role of developing their suppliers. Bosch has emphasized this by having a Supplier Quality Management process in place and one of its responsibilities is to bring suppliers to the maturity level suiting Bosch's requirements.

Plant quality handled by Quality Management Methods, tries to makes sure that the product is done right from the first time and that their customers are satisfied. Their responsibility is to give quality support and monitor processes so things get done correctly and that saves the company money and resources by spending less non-value added time on re-work or warranty claims. Their roles are to support production with problem solving support, both preventive and proactive. Making sure foundations for quality are monitored and controlled so the product is built right from the first time and ultimately translating into customer's satisfaction.

The findings from this study show that quality groups roles and responsibilities vary even within the same manufacturing plant. This study on a large manufacturing plant indicates that size of the plant effects quality management group's roles and responsibilities. Quality Management Methods and the Purchasing quality group are structured differently, according to plant operations. Quality Management Methods is located at three different locations throughout the campus of the plant, giving support with diverse roles and responsibilities. Purchasing quality group works with the suppliers and assures incoming parts are up to specification. If we look at the bigger picture quality groups at Bosch perform audits, create the routines and process for the firm, and try to reduce non-value added activates to achieve Bosch's standard of quality.

This matches with what Hellström et al. (2010) claimed about the roles of quality departments. That quality departments roles are to perform audits and to create routines and processes for the firms. Also to have strong focus on cost reduction and eliminate cost from non-value

activities. My studies also concur with Watkins (2005), that supplier issues are becoming the responsibility of customer's quality groups and that previous roles of quality groups need to be stretched into supplier development as well. The supplier quality management process Bosch emphasizes on, is there in place to complement their outsourcing strategy. Batson (2008) claims similar findings in assembly industries where outsourcing of complex parts is forcing companies to change how they manage their supplier. I agree with Phillips (1983) that quality or problem solving groups are needed for their technical expertise and to solve operations tasks like cost of poor quality. What limits this study is the factor that Bosch's plant has the strategic approach to move more towards being an assembly plant of complex products with a smaller production operations.

7.2 Organization of quality management groups

If done right the integration of quality management groups can be a success for the company and bring out the best in organizing quality work. If not it can result in some challenges for both departments. Having group leaders who have a good overview and an understanding of the Purchasing quality group and Quality Management Methods is essential for a successful integration. Knowing what areas and operations cross for both departments, where cross training is needed for associates, and sharing of equipment. Quality managers have the responsibility for making strategic choices for the groups and make sure the groups roles are in line with firm strategic direction.

It is evident that this arrangement has given the Purchasing department the opportunity to be a stand-alone department and have priorities between quality, cost and delivery in check, like their strategy is moving towards. Having quality integrated through the sourcing process has made the Purchasing department more committed to quality and enabled them to source suppliers and parts more consistently. According to the analysis a smaller quality loop within a function can resolve issues more quickly and enables them to have a close connection to the product. Quality issues regarding suppliers seem to be declining and at the same time maturity levels of suppliers are getting higher. Resource allocation was the main weakness of organizing quality groups. The Purchasing Quality group has a clear disconnection to the rest of daily plant activities and the final product. There is a risk of maturity levels being lower in smaller groups, since knowledge sharing and shared expertise are limited.

Existing views implied that there was no one way to organize quality management groups since companies operate in different industries and vary in size. This study has shown a current example of how a large manufacturing company does organize its quality management groups. The limitations of the work are that this specific Bosch plant has a strategy of outsourcing most of its production and sticking to production of critical parts and assembly of products. My finding concurs with Elg et al. (2011) which showed that the roles of quality managers are broad, spanning strategic choices in the firm down to tasks in the production. We both concluded that firms need to understand and work with quality issues, and that quality management groups should be continuously organized. Strategic goals for firms can change and quality work needs to be implemented according to the right direction of these

goals. I agree with Shewhart (1931, 1939) who claimed that firms have been organizing their quality work differently during the past years. Now firms are placing more emphasis on having quality groups controlling the work earlier in the production process. This is consistent with what Lengnick-Hall claimed. He claimed that quality assurance groups are now working with quality issues earlier in the production process, and are starting to become a part of the product development process (Lengnick-Hall, 1996).

7.3 Discussion

After conducting the research it can be seen that more weight of the work has fallen on the Purchasing Department and is that due to the researcher position at the time within the Purchasing Quality group. It can be argued that a person working in the same department as they are doing a research on can lead to bias views and that they can lift ones views higher than others. It has to be noted that the researcher was aware of that situation from the beginning and tried to the best of his abilities to be neutral towards both departments. It can still not be fully avoided that little more weight is placed on the department, since my internship task did involve more interactions with purchasing employees and daily work gave me a better insight into the Purchasing Department roles. My tasks did though cross over to the Quality Management Methods department but it is hard to keep a perfect balance in that sense.

As for recommendations for further studies, it can be beneficial to do a similar study on another Bosch plant and then benchmark it against this study. Plants often vary depending on focus area of production and this study was done at a large manufacturing plant with an outsourcing strategy and which is often making low-volume customized orders. It can then be interesting to look at another plant and see how their operations match with the findings from this study.

It can be seen that this current integration of quality work into the plant operations can be successful. It is recommended for Bosch to work further with that setup and to continuously improve that structure. The Purchasing Quality group has introduced new opportunities to the organization. I had a strong sense that most employees outside of quality viewed the two quality groups as the same. It might be beneficial just to make a presentation of the roles and responsibilities that the Purchasing Quality groups has and to send it out in a newsletter for associates. Since Purchasing Quality is a small department it is necessary to have mature leaders who understand the roles of both departments and do cross training with employees where it is suitable, in this case the incoming inspection area comes to mind. The departments need to get separate budgets, at the moment Quality Management Methods get their budget and Purchasing Quality falls in between the Purchasing Department and Quality Management Methods with no budget assigned to them. It can be a hustle for them to run daily operations and for implementation of bigger projects that benefit both groups, but have no clarity where they should ask for the money to cover that cost.

The learning points for this case study are that you should look into a field that interests you and though it might be hard in the beginning to identify that field it can be good to just start with a vague idea of direction and see where that takes you. I tried to my best knowledge to write the background and theoretical framework before I collected the empirical data. In the end I saw a misalignment between the empirical data and what I had previously written. I then reverse-engineered my thesis according to the findings and kept a clear “red thread” between the research questions, background, theoretical framework and the empirical data. If I would have to do this all over again I would not change much regarding the data collection, but I would assume less about the theoretical data and connected it afterwards to my findings.

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Appendix A

Interview guide, - sample from one the interviews. All interview guides had the same questions, except for the middle sections which varied a bit depending on the interviewee.

Opening questions:

- Tell me about yourself and how you ended up here today? (academic/experience)
- How would you describe the overall mission and goals as the director of PUQ-NA?
- What are the core activities you are responsible for?

Interview questions:

- What is your biggest challenge as a director of PUQ-NA?
- What are some of the reasons for having a purchasing quality group? Why was it created/QMM not enough?
- Is it common for every plant to have a PUQ groups?
- Can supplier quality management be completely outsourced to the supplier? Why/Why not?
- What measures are taken on behalf of PUQ to continuously improve supplier quality?

SWOT analysis:

- Strengths: of integrating a quality department (PUQ) with purchasing department (PUR)?
- Weaknesses: of integrating a quality department (PUQ) with purchasing department (PUR)?
- Opportunities: of integrating a quality department (PUQ) with purchasing department (PUR)?
- Threats: of integrating a quality department (PUQ) with purchasing department (PUR)?