Quality Assurance of Purchased Parts in the Automotive Industry

A Multiple Case Study at Scania CV AB and Volkswagen Nutzfahrzeuge AG

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DESCRIPTION OF THE DIVISION OF WORK

The thesis *Quality Assurance of Purchased Parts in the Automotive Industry* is the work of two students, Lovisa Ulfsdotter and Agnes Zakrisson. Work has been evenly divided between them. At the beginning of the process, a plan of the project was developed by Lovisa with support from Agnes. Responsibility was delegated for the first chapters and then continually delegated at the start of each new chapter. Writing of the report has been continuous and responsibility for each chapter was as follows:

- Chapter 1 Introduction – Agnes
- Chapter 2 Methodology – Lovisa
- Chapter 3 Literature Review – Lovisa
- Chapter 4 Case 1 Scania CV AB – Agnes
- Chapter 5 Case 2 Volkswagen Nutzfahrzeuge AG – Lovisa
- Chapter 6 Analysis - Agnes
- Chapter 7 Results and Recommendations - Lovisa
- Chapter 8 Conclusion and Discussion – Agnes
- References – Agnes
- Appendices – Lovisa
- Other – Agnes

Lovisa and Agnes prepared for interviews and visits with some help from supervisors from Scania and Luleå University of Technology. Empirical data was gathered by both authors present at all initial interviews, the two focus group interviews, and the two visits. Transcriptions of material were evenly divided between both. The supervisor from Luleå University of Technology was Fredrik Backlund and the supervisors from Scania were Mats Forsberg, Magnus Lagström, and Andreas Fabó. Language revision has been made by representatives from Scania and an external language reviewer.
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This master’s thesis comprises 30 credits and is the final step in the Master of Science program in Industrial Engineering and Management at Luleå University of Technology. Work for the thesis was conducted during the spring of 2014 at Scania CV AB in Södertälje, Sweden and during a visit to Volkswagen Nutzfahrzeuge AG in Hannover, Germany.

The authors would like to thank Scania CV AB for their hospitality and for making this thesis possible. A special thanks to the respondents in interviews and focus groups who gave their input and contributed to the results, as well as the supplier who let us visit them for observation. The authors would also like to thank the supervisors Mats Forsberg, Magnus Lagström, and Andreas Fabó for their feedback and support throughout the work on this thesis. Additionally, a thank you goes to Volkswagen Nutzfahrzeuge AG in Hannover who welcomed us and strongly contributed to the result. A special thanks to Peter Ulbrich who helped us organize the visit and interviews, and to Per Åke Persson from Scania CV AB who followed the authors to Hannover and supported us during the visit.

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Södertälje, May 2014

Lovisa Ulfsdotter

Agnes Zakrisson
ABSTRACT

The importance of product quality and customer satisfaction has increased due to the growth of a global market. The latter provides an opportunity for companies to offer their products worldwide and for customers to choose from a range of brands. Companies with quality as a core value can use this as a competitive advantage, which means that not only the produced products need to be of high quality but also operations within the organization. Within the purchasing department, many parts that are used for production of the product are first handled. In order to keep product quality high the purchased parts need to meet the customer requirements for quality.

The aim of this thesis is to increase understanding of quality assurance of purchased parts for companies that operate in the automotive industry and to find potential improvement areas. The primary study is at Scania CV AB, Sweden, which is a company that operates within the automotive industry, and produces trucks, busses, and industrial and marine engines. A second case study is conducted at Volkswagen Nutzfahrzeuge AG, Germany, which produces transporter vehicles. Both Scania CV AB and Volkswagen Nutzfahrzeuge AG are brands of Volkswagen Group AG, which includes ten additional brands. Initial interviews at Scania CV AB show that there are six major problem areas related to the quality assurance process for purchased parts. These areas are employee competence, supplier competence, internal management and organization, time aspects, supplier’s quality mindset, and finally communication. From analysis, communication gets the highest priority and therefore the study focuses on issues that concern internal and external communication in order to find suggestions for improvements.

The thesis shows that the studied cases value quality highly and that they have separate quality departments in each organization. This indicates that they have a quality culture, which is essential in order to understand the importance of quality. Quality management system and quality assurance processes enable a standardized work method and is a support for the setting of requirements to the supplier. The results give no indication on which system or process is most appropriate. Recommendations are related to communication and how to improve it continuously. In the first phase of the suggested improvement cycle, Plan, important factors regarding communication should be considered. These factors are frequency, direction, modality, and content together with limitations such as quality, resources, and time. In this way, communication can be planned and implemented in the Do phase of the cycle. The results further show that a model that categorizes the supplier and the part can be a helpful tool to prioritize communication when there is lack of time and resources. The final phase is a combination of Follow-up and Evaluation. This step is important for continuous improvement, and the results from evaluation should be implemented in the next Plan phase.

Final recommendations concern the importance of supplier collaboration where communication is an important key for success. The study shows that it is essential to strive for a relational structure with a long-term relationship and joint activities. The climate should be supportive and quality should be a core value for both companies. Finally, companies in the automotive industry should use their power to assure quality of purchased parts, but at the same time remember that the supplier has requirements and expectation as well that the company must respect in order to develop a good relationship and collaboration.
SAMMANFATTNING

Produkttvållighet och kundnöjdhet har blivit allt viktigare parametrar på grund av en växande global marknad. Den globala marknaden öppnar upp möjligheter för företag att erbjuda produkter världen över och för kunder att välja bland en mängd olika varumärken som uppfyller kundernas krav. Hos företag som har kvalitet som ett kärnvärde ses ofta detta som en konkurrensfördel, vilket innebär att inte bara produktarna måste hålla hög kvalitet utan även andra funktioner inom organisationen som i sin tur påverkar produktarna. Många artiklar hanteras först av inköpsfunktionen innan de används för produktion av slutprodukten. För att kunna leverera förväntad kvalitet till slutkund måste även de inköpta artiklarna möta kundernas kvalitetskrav.


**TERMINOLOGY**

**APQP**
Advanced Product Quality Planning, a method for quality and production planning in product development.

**Commodity purchaser**
Purchaser responsible for parts running in production at Scania CV AB and Volkswagen Nutzfahrzeuge AG.

**Complex parts**
Parts with several critical functions and high risk of damage if failure.

**ePPAP**
Electronic system for handling documents within the Production Part Approval Process at Scania CV AB.

**Field problems**
Problems that occur after the product is delivered to the customer.

**FMEA**
Failure Mode and Effect Analysis.

**IATF**
International Automotive Task Force.

**ISO 9001**
Quality Management System developed by International Organization for Standardization.

**ISO/TS 16949**
Quality Management System for the automotive industry developed by IATF.

**PPA**
Production Process and Product Approval, a quality assurance process.

**PPAP**
Production Part Approval Process, a quality assurance process.

**Preventive quality**
Assurance of quality before production of parts.

**Project purchaser**
Purchaser responsible for introduction of new products at Scania CV AB and Volkswagen Nutzfahrzeuge AG.

**QPN**
Qualification Program New Parts at Volkswagen Nutzfahrzeuge AG.

**QTR**
Quality Technical Requirement at Volkswagen Nutzfahrzeuge AG.

**Quality**
Conformance to requirements.

**Second tier supplier**
The next supplier upstream in the supply chain after the supplier.

**Special characteristics**
Critical functions of the part.

**Specification**
Specifies the part, and sent to the supplier.

**SQA**
Supplier Quality Assurance, engineering responsibility at Scania CV AB Purchasing to assure the supplier’s processes and parts.

**Supplier**
Company that delivers parts and services to the customer.

**T1-5**
Transporter generation 1-5 models produced by Volkswagen.

**Three-rings**
A group of SQA, commodity purchaser, and project purchaser at Scania CV AB Purchasing.

**VDA**
Verband der Automobilindustrie, Automotive Industry Association.
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1 Introdution

The purpose of this chapter is to introduce the reader to the thesis. A brief description of the background leads to a problem discussion, aim, and the research questions that are answered in the study. Additionally, research scope, delimitation, and disposition of the report are presented.

1.1 Background

A definition of quality given by Crosby (1979, p. 17) is formulated as “conformance to requirements”. In the global competitive environment that continues to develop at a rapid pace (Sánches-Rodíguez & Martínez-Lorente, 2004; Quintens, Pauwels, & MatthysSENS, 2006), the importance of quality and customer satisfaction has increased (Curkovic, Vickery, & Droge, 2000; Dominic, Goh, Wong, & Chen, 2010; Peterssson, Johansson, Broman, Blücher, & Alsterman, 2009). The global market allows companies to offer the same or similar products to their customers (Dominic et al., 2010); where quality can be a means for a company to differentiate from competitors (Rapert & Wren, 1998). Curkovic et al. (2000) state that superior quality is necessary for a company to compete in the global market, not just a way to differentiate, but also as an opportunity to create competitive advantage (Dominic et al., 2010; Kroll, Wright, & Heiens, 1999; Rapert & Wren, 1998). According to Dominic et al. (2010) and Kroll et al. (1999), high quality leads to customer satisfaction and loyalty, which is essential in today’s global competition. Customer satisfaction and loyalty lead to increased market share due to increased demand (Curkovic et al. 2000; Kroll et al. 1999). Ziggers and Trienekens (1999) state that efforts in quality can lead to increased profitability, both because of improved production and because of products with high-quality standards. Focus on quality can also reduce costs, optimize production, and create more value (Kroll et al., 1999; Ziggers & Trienekens, 1999). Another benefit when focusing on quality is that companies can attain competitive advantage, even in an environment with changes in economic and competitive factors (Kroll et al., 1999). Bergman and Klefsjö (2007) argue that even a company that can be considered to have competitive advantages need to strive for continuous improvements to maintain its competitive position. This is also supported by Quintens et al. (2006) who claim that many companies strive to achieve improvements in production and marketing strategies to sustain its competitive position in the global environment.

Purchasing is a strategic function with high potential to achieve long-term profitability and a means to reach manufacturing and business objectives (Das & Narasimhan, 2000; Quintens et al., 2006). According to Sánches-Rodíguez and Martínez-Lorente (2004), purchasing can be crucial for the sustainable competitive ability of a company. Das and Narasimhan (2000) describe that one of the means to achieve business objectives through purchasing is supplier capability auditing. By building a capable supplier base, companies can reach objectives in areas such as manufacturing performance, time to product introduction, and customization (Das & Narasimhan, 2000). According to Bradley and Pritts (2001), the demands on suppliers increase when companies strive for higher quality. Therefore, during the late twentieth century, supply chain management and collaboration has become an essential part of the business strategy, and a means to achieve competitive advantage for companies due to the increased knowledge of suppliers and customers (Cao, Vonderembse, Zhang, & Ragu-Nathan, 2010; Coronado & Lyons, 2007). Relationships between customer satisfaction and quality-oriented purchasing have been found to be significant (Sánches-Rodíguez & Martínez-Lorente, 2004). To achieve customer satisfaction, the importance of quality on purchased parts is equivalent to the importance of the quality on delivered products (ibidem). Based on the assumptions of Bergman and Klefsjö (2007, p. 311), Gadde, Håkansson and Persson (2010, p. 4), and Sadeghieh, Dehghanbaghi, Dabbagh and Barak (2012, p. 4612), approximately 70-80 percent of the total cost in the automotive industry is connected to purchased parts. Due to this high percentage, the quality of purchased parts has an essential impact on the total quality of the final product (Bergman & Klefsjö, 2007, p. 311).

Ahi and Searcy (2013) argue that business sustainability has a close connection with environmental, economic and social issues, which leads to good preparation for internal and external changes. Therefore, sustainable development has received increasing recognition in the supply chain, which includes for example environmental issues, social responsibility, and economic factors (Ahi & Searcy, 2013; Xia & Tang, 2011). Sustainable development is defined by the World Commission on Environment and Development (1987) as, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Due to this, companies need to consider the implications of their decisions (ibid.).
Berke and Satir (2011) state that supply chain management has evolved toward a network of suppliers, partners, and customers and that sustainability management is following this transformation into a network concept. Xia and Tang (2011) argue that companies in the automotive industry must identify suppliers by using the criteria quality, cost, delivery, development, and management to ensure competitive advantage and sustainability in the supply chain.

Within the manufacturing industry, competition is intense, as well as the need to utilize resources in a more efficient way, while technology continues to develop (Chen & Cochran, 2005). One factor that impacts strong competition is Lean Production that has changed the conditions in which manufacturing companies compete (Dennis, 2007; Petersson et al., 2009). As a part of manufacturing industry, automotive companies face great challenges, partly due to lowered trade barriers between countries that include emerging markets such as China and India (Tay, 2003). Due to growing competition in the industry, automotive companies have realized the importance of quality and are constantly striving for improvements (Bradley & Pritts, 2001). Tay (2003) describes how quality in the automotive industry has moved from quantifiable factors, such as reliability and durability, to more experiential and subjective factors that build a brand. Thus, it is essential for companies that operate in the automotive industry to be aware of the importance of quality, and how purchased parts may affect this, to maintain its competitiveness in the developing global market environment.

1.2 Problem Discussion

Even a company that is considered to have well developed methods concerning quality assurance of purchased parts needs to strive for continuous improvement of these methods to maintain its competitive position. Since purchased parts have a major impact on total cost and quality, quality assurance is an important means to achieve business objectives and has an impact on long-term profitability. Thus, companies in the automotive industry face a significant challenge concerning quality assurance in the purchasing function in order to reduce the nonconformance of delivered parts, which can otherwise cause quality issues in both internal operations and for the customer. However, it is clear from a literature review by the authors of this thesis, that quality assurance of purchased parts has not been explored in a great extent and is therefore relevant to study further.

Volkswagen Group AG is a world-leading corporation operating in the automotive industry. It includes companies such as Scania CV AB, Volkswagen Nutzfahrzeuge AG, Porsche, and Bentley (Volkswagen AG a, 2013). Today Volkswagen Group AG among many other companies in the industry faces the challenge of high ambitions concerning reduction of deviations, which together with the tough competitive environment forces them to improve current methods for quality assurance of purchased parts. This makes Volkswagen Group AG a relevant case to study.

After an initial study at Scania CV AB, communication was found to have great importance and potential to be improved, see Section 4.3. Therefore, communication was made the focus for this thesis. Communication can be seen as a key factor for business success (Mohr & Spekman, 1994) that can build trust and long-term relationships (Sharma & Patterson, 1999). According to Sharma and Patterson (1999), communication has a strong relationship to quality and is essential in order to understand different parties’ demands and requirements, which is supported by Gadde and Håkansson (2007), Prahinski and Benton (2004), and Carr and Kaynak (2007). Sharma and Patterson (1999) and Mohr and Spekman (1994) further state that communication is important in supplier collaboration. Stanly and Wisner (2001) argue that internal communication is important in order to have well-functioning external communication. Therefore, this problem area is interesting to study further.

1.3 Aim

The aim of this thesis is to contribute to increased understanding about quality assurance processes conducted at companies operating in the automotive industry. Further, suggestions regarding improvements for quality assurance of purchased parts are developed, with the long-term goal to reduce the number of deviations on delivered parts.

1.3.1 Research Questions

Based on the aim of the thesis, three research questions are formulated, with focus on the automotive industry:

**RQ1: How can quality assurance of purchased parts be characterized?**
The first research question aims to increase the understanding of quality assurance of purchased parts in the automotive industry based on a literature review and empirical studies.

**RQ2: How can problem areas within quality assurance of purchased parts be characterized?**

Research question two concerns identification of problem areas within quality assurance of purchased parts at a company in the automotive industry that have potential to be improved.

**RQ3: How can communication within quality assurance of purchased parts be improved?**

As a result of the initial study at Scania CV AB, research question three aims to find suggestions for improvement in communication within quality assurance of purchased parts, based on a literature review and empirical results. The structure of the research questions is illustrated in Figure 1.

![Figure 1 Illustration of the research questions.](image)

### 1.4 Research Scope and Delimitations

This thesis focuses on preventive methods and processes regarding quality assurance of purchased parts; that is, assurance of quality before production of parts at the supplier. Since the case companies for this study primarily works with preventive methods to assure quality of purchased parts this is a natural way to delimitate the study. The less defective parts that are brought into production, the less effort needs to be spent on reactive actions. Therefore, general purchasing processes or reactive actions that concern quality deviation of purchased parts will not be taken into consideration. In this study, deviation is defined as differences between parts and agreed specification. Therefore, situations in which deviations are caused by poor specification are not considered. Supplier selection is excluded from this thesis and thus quality assurance of the supplier since this is more comprehensive than quality assurance of purchased parts, which is the focus of the thesis.
1.5 Report Structure

The structure of the report is as follows:

**Chapter 2 – Methodology**

This chapter describes the thesis methodology concerning the research process, purpose, approach, strategy, sample selection, data collection, data analysis, and trustworthiness.

**Chapter 3 – Literature Review**

In chapter three, the theoretical frame of reference that is used to answer the research questions is presented. It is based on a literature review.

**Chapter 4 – Case 1 Scania CV AB**

The chapter presents the results from the empirical study concerning quality assurance at Scania CV AB. This chapter includes identification of relevant problem areas.

**Chapter 5 – Case 2 Volkswagen Nutzfahrzeuge AG**

The chapter presents the results from the empirical study concerning quality assurance at Volkswagen Nutzfahrzeuge AG with a focus on communication.

**Chapter 6 – Analysis**

This chapter describes the analysis of the empirical results and theoretical frame of reference.

**Chapter 7 – Results and Recommendations**

Here the result based on the analysis is presented together with recommendations to companies in the automotive industry concerning quality assurance of purchased parts.

**Chapter 8 – Conclusions and Discussion**

In this chapter, conclusions are drawn from the study. Furthermore, there is a discussion regarding the results and methods used, including reliability and validity of the thesis, and generalization of its findings.


## 2 Methodology

This chapter aims to describe different methodologies that can be used to conduct research. Choices that have been made in this study are presented and discussed in order to introduce the reader to the study. This chapter includes a description of the thesis process, research purpose, approach, and strategy, how qualitative and quantitative methods are handled, sample selection, data collection, data analysis, and the trustworthiness of the thesis.

### 2.1 Thesis Process

Figure 2 describes the process that the authors work through when conducting the study. Understanding the background, the research problem, and construction of the research questions help the authors to work through the initial literature study. The initial literature study gives the input needed to develop and decide the research methodology, which is further described in this chapter. The methodology helps the authors to optimize the output, recommendations, and the conclusion from the thesis. The study then continues with several abductive loops, with collection of empirical data and literature that together with continuous analysis advances the research. The final analysis is conducted with a methodology of pattern matching and cross-case synthesis in order to strengthen the results and recommendations given to companies in the automotive industry. Finally, the conclusion and discussion summarize the thesis and give suggestions for further studies.

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**Figure 2** Process chart illustrating the thesis process.
2.2 RESEARCH PURPOSE

According to Yin (2003), research has an exploratory, descriptive or explanatory purpose, and according to Saunders, Lewis and Thornhill (2012) there can also be a combination of these. Stake (1995) defines research as intrinsic, instrumental, or collective, which shows that there are different terms to describe a variety of research methods. For the research purposes of this thesis, the vocabulary and meaning described by Saunders et al. (2012) and Yin (2003) are used and further explained. The exploratory purpose is used to clarify the understanding of a problem (Saunders et al., 2012). Björklund and Paulsson (2003) explain that the exploratory purpose is used when there is a lack of knowledge in the field, and the aim is to fill the gap. According to Saunders et al. (2012), there are two ways to conduct exploratory research: literature study or by interviews. Furthermore, they explain the advantages of exploratory purpose are that it is flexible and adaptable to changes. Changes are made because it enables the researcher to adjust the direction when new data become visible and give new insights (Saunders et al., 2012). The focus of the study will become narrower as it progresses (ibid).

A descriptive purpose is selected when the objective is to gain and describe a truthful view of events, people or situations (Saunders et al., 2012; Yin, 2003). Moreover, Björklund and Paulsson (2003) explain that the descriptive purpose is used when there is basic knowledge in the field and the research aims to describe and not explain the existing relations. The descriptive purpose is therefore often a part of explanatory research, and a forerunner or an extension of exploratory research (Saunders et al., 2012). An explanatory purpose is used when the objective is to find relationships between variables in order to be able to explain them (ibid.). According to Björklund and Paulsson (2003), the explanatory purpose is used to gain deeper knowledge and understanding, to be able to explain and describe the identified problem. This can be done with help from various kinds of tools, such as statistical tests, where it is possible to study the correlation between variables (Saunders et al., 2012).

This research applies an exploratory and a descriptive purpose with the intention to expand knowledge and understanding of the quality assurance process of purchased parts in the automotive industry. The descriptive purpose enables the authors to describe and understand a current situation, which is necessary to be able to develop the process with an exploratory purpose. The descriptive part of the research is seen as a forerunner to the exploratory research. The research questions aim to increase understanding of a problem, which also indicates exploratory research. The aim of the study is therefore best met with exploratory research where the purpose is to improve the area studied. In this way, it is possible to gain deeper understanding and identify improvements for the quality assurance process in the automotive industry.

2.3 RESEARCH APPROACH

Björklund and Paulsson (2003) and Saunders et al. (2012) describe that there are three different research approaches, called deduction, induction and abduction. The deductive approach is based on collected theory, and the research strategy is formulated to test the theory (Björklund and Paulsson, 2003; Saunders et al., 2012). Furthermore, Björklund and Paulsson (2003) clarify that the basis of a deductive approach is to test theory against an empirical study, to make it possible to draw conclusions about the theory of interest. The gathered data is normally quantitative data, although it is possible to use qualitative data (Saunders et al., 2012).

An inductive approach is the opposite of deductive, since it starts with the collection of empirical data to investigate a problem or a situation (Björklund & Paulsson, 2003; Saunders et al., 2012). The purpose, as explained by Saunders et al. (2012), is to gather information through interviews in order to better understand and describe the nature of a problem. Through study of empirical data, the development of a theoretical framework can take place, which is used to distinguish relationships between variables (Saunders et al., 2012). The third alternative is abduction, which is a combination of induction and deduction (Björklund & Paulsson, 2003). That means, according to Saunders et al. (2012), that the researcher alternates collection of empirical data with explanations of patterns, in order to generate new theory, which are tested against additional data.

This research can be best explained to have an abductive approach. The research is designed to gain information about the companies and their processes, in order to gain better understanding of the problems within them. Continually, this leads to a formulation of initial research questions that are used to identify suitable literature.
This in turn, guides the authors to conduct unstructured interviews and deeper literature research, which together is the foundation for further analysis. The continuous loop of the abductive approach, with interviews, literature findings and analysis, helps the authors to gain information and knowledge to complete the study.

2.4 **RESEARCH STRATEGY**

A strategy is a plan to reach a specific goal; therefore research strategy is a plan for how the researcher will conduct research in order to answer the research questions (Saunders et al., 2012). According to Yin (2003), the most important decision regarding the research strategy is how the research questions are formulated, which is further explained in Table 1.

**Table 1 Situations for different research strategies. Source: Yin (2003, p. 5)**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of Research Question</th>
<th>Requires Control of Behavioral Events?</th>
<th>Focuses on Contemporary Events?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>How, why?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, what, where, how many, how much?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival Analysis</td>
<td>Who, what, where, how many, how much?</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>History</td>
<td>How, why?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case Study</td>
<td>How, why?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

According to Saunders et al. (2012) the experiment strategy has its roots in natural science, which implies a study of the probability of change in independent variables. This is further described by Merriam (2006) and Yin (2003) who claim that the researcher needs to be able to manipulate parameters directly, precisely, and systematically in the laboratory in order to evaluate one or two variables. The experiment can be designed with different settings, which is described by Saunders et al. (2012). The research questions are formulated with “how” and “why” and the important part, that distinguishes the experiment strategy, is that the researcher needs control of behavioral events (Yin, 2003). A survey strategy is appropriate for exploratory and descriptive purpose, and a deductive approach, because it allows the researcher to collect quantitative data (Saunders et al., 2012). Merriam (2006) explains that the survey strategy can include both surveys and interviews or only one of them, and it is a deductive approach by nature because variables are selected from theory. Saunders et al. (2012) continue to explain that when sample selection is used properly it is possible to generate findings that are representative for the whole population. Additionally, the authors explain the disadvantage to be the dependence of information from others, which can delay the research.

Archival analysis is explained by Saunders et al. (2012) and Yin (2003). The interest of archival research strategy is to make use of administrative records and documents, and the research questions focus upon the past and changes over time (Saunders et al., 2012). The research questions are formulated with “who”, “where”, “what”, “how much”, and “how many”, see Table 1 (Yin, 2003). The disadvantage of archival analysis is said to be the difficulty in meeting expectations and resolving research questions because of the absence of important data (ibid.). Historical strategy is preferable when there is no insight or control of a situation (Merriam, 2006; Yin, 2003). The advantage of the historical strategy is, as the name expose, the history itself when the researcher needs to consider secondary data and physical remnants (Merriam, 2006). The research questions start with “how” or “why”, see Table 1, which are the same as for case study (Yin, 2003). Case study is the strategy for current and contemporary research, where it is not possible to manipulate variables, as it is in experiment strategy (Merriam, 2006; Saunders et al., 2012; Yin, 2003). A case study includes both direct observations and interviews (Yin, 2003), and which is described by Merriam (2006) to also include other types of empirical data such as documents and artifacts. The objective of case study is to gain a rich understanding of context, and to deal with a wide variety of evidence (Saunders et al., 2012; Yin 2003). According to Saunders et al. (2012) the appropriate reason for using case study strategy is when dealing with explanatory or exploratory research.
Yin (2003) divides case study into different categories, where the first category differentiates between single versus multiple case studies. According to Saunders et al. (2012), a single case study is used when there is a critical or unique case that the researcher wants to study.

The single case study can also be used when a case is representative and provides an opportunity to observe and analyze a phenomenon that few have considered before (Saunders et al., 2012). Multiple case studies consider more than one case, which means the results can be replicated across cases. The second distinction that Yin (2003) makes is to differentiate between holistic case and embedded case. Saunders et al. (2012) explain holistic case to treat the organization as a whole, and the embedded case to treat an organization as a number of subgroups or departments within the organization. The important part is that this is chosen by the nature of the case not by the researcher (Saunders et al., 2012). Action research is discussed by the authors and is described to be an iterative process to develop solutions to real organizational problems. The aim is to promote organizational learning through practical outcomes. The action research works through an iterative process of diagnosing, planning, taking action, and evaluating. Additionally, three other research strategies are described by the authors, which are ethnography, grounded theory, and narrative inquiry, which will not be discussed further in this thesis. (ibid.)

This thesis is based on a case study with multiple cases. The cases are studied from a holistic view of the organizations with focus on quality assurance of parts in the purchasing function. The case study approach is an appropriate choice since the empirical studies mainly imply current situations. The methods used are mostly interviews and documents that are used within the organizations to assure quality of new purchased parts. These methods are further discussed in Section 2.7. Additionally, the thesis is based on action research since it is an iterative process that aims to develop solutions to real organizational problems. The strategy helps the authors to develop theory that can be used to precede the abductive loop of this research, and finally find solutions to the research questions.

### 2.5 Qualitative and Quantitative Methods

There are two different methods to handle data collection and analysis; qualitative and quantitative method (Björklund & Paulsson, 2003; Saunders et al., 2012). Merriam (2006) explains the qualitative method as a way to create theory while the quantitative method examines a theory. Further, information from qualitative methods are usually presented in words and quantitative methods presented in numbers (Merriam, 2006; Saunders et al., 2012). Björklund and Paulsson (2003) explain the qualitative method in a similar way to Merriam (2006) and Saunders et al. (2012). According to Björklund and Paulsson (2003), a qualitative method is used when the information cannot be measured or evaluated in numbers, as in studies with quantitative methods, and the researcher wants to gain a deeper understanding in an area or situation. Saunders et al. (2012) state that a study can combine both qualitative and quantitative methods.

Björklund and Paulsson (2003) describe how research strategy determines whether qualitative or quantitative method will be used. A qualitative method is more appropriate if interviews and observations are used while the quantitative method should be used with surveys and mathematical models (Björklund & Paulsson, 2003). However, Saunders et al. (2012) state that quantitative method can be used even with structured interviews and observations. Saunders et al. (2012) further argue that a quantitative method is associated with a deductive approach. Quantitative method can also be appropriate in inductive studies if the purpose is to use data to develop theory. Qualitative method is associated with an abductive research approach and can also start as a deductive approach. (ibid.)

In this thesis, a qualitative method is used. The purpose is to gain a deeper understanding about the quality assurance of purchased parts in the automotive industry; hence, the research purpose is descriptive and exploratory, which makes a qualitative method appropriate. In addition, the research approach is abductive which, according to Saunders et al. (2012), is associated with a qualitative method.

### 2.6 Sample Selection

Since the population of potential data sources or respondents can be too comprehensive, it is essential for the researcher to make a sample selection (Merriam, 2006; Saunders et al., 2012; Trost, 1994). According to Merriam (2006), Saunders et al. (2012), and Trost (1994) there are two types of sample selection techniques, probability sampling and non-probability sampling.

Probability sampling is conducted by determining the probability that each element of the population will be represented in the selection (Merriam, 2006; Saunders et al., 2012) and then the sample is selected on
this basis to make the selection representative of the population (Saunders et al., 2012). In a non-probability sample there is no method to determine the probability of how and if each element will be represented in the sample (Merriam, 2006). According to Merriam (2006) and Saunders et al. (2012), non-probability sampling is preferred if the results of a study are to be generalized to the whole population. Saunders et al. (2012) explain that non-probability is useful when probability is not appropriate or even possible. Since the purpose of qualitative studies does not often include a generalization, non-probability sampling is more common in such cases (Merriam, 2006).

In this thesis, a non-probability sample is selected. The reason is that a probability sample is not possible or appropriate due to the limitations of the study. Merriam (2006) also argues that a non-probability sample is appropriate when a qualitative method is used. Therefore, probability sampling is not described further in this chapter.

Saunders et al. (2012) describe four different types of non-probability sample methods: quota, purposive, volunteer and haphazard. Quota sampling is a non-random method that selects the sample out of specific groups of the population and is based on the premise that the sample represents the population (Saunders et al., 2012). Trost (1994) also describes quota sampling as a way to achieve a representative sample. Purposive sampling depends on the researcher's judgment to select the sample so that the research questions can be answered (Saunders et al., 2012). In volunteer sampling, the participants within the study volunteer to contribute to the research (ibid.). This can be done either by inviting potential participants to respond if they are interested or by asking participants to recommend others that can contribute (ibid.). A volunteer sample is similar to what Trost (1994) describes as a convenience sample, which means the researcher is depending on the potential participants to be a part of the research. Convenience sample is the term used in this thesis. Trost (1994) further describes strategic sample, which is a version of purposive sample that Saunders et al. (2012) present. Although, Trost (1994) argues that this cannot be a representative sample of the population.

Based on Saunders et al. (2012) and Trost (1994) and the different methods of sample selection described, this thesis uses both convenience sampling and purposive sampling. Even though the sample is selected based on the authors' judgment so that the research questions can be answered, the scope and the resources available make a convenience sample appropriate.

### 2.7 DATA COLLECTION

There are two different types of data, primary and secondary. Primary data are collected for the first time for the purpose of the study. Secondary data are already collected for another purpose and can be both summaries and raw data. (Björklund & Paulsson, 2003; Dahmström, 1991; Eriksson & Wiedersheim-Paul, 2011; Saunders et al., 2012)

#### 2.7.1 PRIMARY DATA

Primary data can be collected through different methods. Dahmström (1991) describes three main methods as interviews, surveys and observation. The same terminology is used by Saunders et al. (2012). Björklund and Paulsson (2003) also mention experiment as a method to collect primary data. Experiment and surveys are not used within this research and this method is therefore not discussed further in this section.

**Interviews**

Interviews are defined as a conversation between two or more people where one, the interviewer, is expected to ask questions of the interviewee (Saunders et al., 2012). Interviews can be conducted in many different ways; for example, the number of respondents and questions can vary (Björklund & Paulsson, 2003). Both Björklund and Paulsson (2003) and Saunders et al. (2012) describe three different kinds of interviews; structured, semi-structured, and unstructured. Saunders et al. (2012) also use the term in-depth interviews for the last method. In a structured interview, the questions are predetermined and asked in a standardized manner (Björklund & Paulsson, 2003; Saunders et al., 2012). Interviews that are semi-structured are based on a predetermined topic and sometimes even key questions but the interviewer can guide the conversation based on previous answers and reactions from the respondent. Finally, in unstructured, or in-depth, interviews there are no predetermined questions (ibid.); in these kinds of interviews, the interviewer wants to gain a deeper insight about a specific area (Saunders et al., 2012).
2 Methodology

According to Saunders et al. (2012), the terms standardized and non-standardized interviews can also be used. The terminology that will be applied in this thesis is structured, semi-structured and unstructured. Saunders et al. (2012) argue that structured interviews are appropriate for quantitative research while semi-structured and unstructured interviews are appropriate in qualitative studies. Depending on the research purpose, different interview methods should be selected (Björklund and Paulsson, 2003; Merriam, 2006; Saunders et al., 2012). In exploratory research, an unstructured interview is appropriate to use because of the deeper understanding the interviewer has potential to gain (Saunders et al., 2012). For descriptive research, structured interviews can be helpful to identify patterns. Explanatory research can benefit from using semi-structured interviews to understand relationships but also from structured interviews if statistics are needed (ibid.).

In this thesis, semi-structured interviews are conducted to gain benefits from both unstructured and structured interviews at the same time. In this way, a deeper understanding about the area of quality assurance of purchased parts is gained and patterns identified.

Focus group interviews

A focus group interview is where the interviewer poses questions to a group of participants (Saunders et al., 2012). The focus group makes it possible for interaction among group members, which stimulates thinking in a way that is not possible using regular interview techniques (Dukta, 1993; Wilbeck, 2000). The focus group normally consists of four to twelve people (Dukta, 1993; Saunders et al., 2012). The respondents should be selected carefully and with knowledge of what they can contribute to the discussion (Saunders et al., 2012). According to Dukta (1993) and Saunders et al. (2012), the topic of the focus group should be clearly and precisely defined, in order to ensure interactive discussion between participants and sufficient depth of outcome. Due to Wilbeck (2000), it is appropriate to use focus group as a method for interview when there are large differences between people, when action and motivation will be examined, when differences should be understood and, finally, when there is a need for a friendly and respectful method of investigation. Focus group interviews can be divided into structured and unstructured interviews, where the more the moderator controls the more structured is the interview (Wilbeck, 2000). The role of the moderator should be decided before the session; normally the moderator keeps track of content and time, and offers well-prepared questions for discussion (Dukta, 1993).

For this thesis, focus groups are used to gain understanding of differences and work methods among people with the same role. The focus groups also help the authors gather opinions and thoughts about existing work methods and how they can be developed. The interaction between participants is needed to augment the authors’ limited knowledge about existing systems and to understand differences. The focus groups are structured with predetermined questions and a moderator that guides the respondents through the session.

Observations

Dahmström (1991) describes observation as a way to observe and register another person’s characteristics and behavior in a specific situation. This can be done in a way that is either direct, or open, so that the respondents know they are observed or indirect when the respondent does not know they are observed (Björklund & Paulsson, 2003; Dahmström, 1991). Saunders et al. (2012) describe two different ways to conduct observation. The first is participant observation where the observer is a participant in the respondent’s actions and becomes a member of their environment (Saunders et al., 2012). The second type of observation is structured observation that is predetermined and focuses more on frequency of action (ibid.).

During this research, observation was used when visiting the supplier in order to understand its process for assurance of quality on produced parts. Observations were, to the extent that it was possible, also used to examine and interpret the internal processes. The observations were direct; meaning that the respondent knew that he or she was observed. The observations were also conducted as a participant observation where the observer is a participant in actions taken by the respondent.

2.7.2 Secondary data

According to Saunders et al. (2012), secondary data can be used for further analysis and thereby provide new knowledge, conclusions and interpretations. There are different sources of secondary data and Björklund and Paulsson (2003) describe two of them as literature studies and presentation and oral performances. Literature is defined as all kinds of written material, for example books and journals (Björklund & Paulsson, 2003). Data can also be collected at presentations and oral performances where the information is intended for other research but still is of interest in the study (ibid.).
Saunders et al. (2012) divide secondary data sources into: documentary such as magazines and reports, surveys that are conducted in other research and multiple sources, which can be books and government publications.

In this thesis, secondary data is used mainly to collect relevant information about theories and frameworks that can be applied in the research. A literature review is applied in order to ensure that relevant theories are applied in the research. Search engines such as PRIMO and Google Scholar are used to find relevant articles, and the search terms will be documented in Appendix A Literature Search. PRIMO uses many different databases to find articles, books, essays, and published material from Luleå University of Technology (Luleå universitetsbibliotek/LRC). Empirical data secondary sources used are in form of standards, process charts, and other internal documents at the companies investigated.

2.8 Data analysis

According to Yin (2003), there are five specific techniques for analyzing case studies: pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis. The author describes that every case study should consider using at least one of the first four techniques to be able to produce high-quality analyses, and to be able to display and present the evidence. The first method described by Yin (2003) is pattern matching, which can be used for single or multiple cases, and is one of the most desirable techniques. The technique involves the prediction of a pattern when comparing the outcomes of the case with a predicted one, a theoretical framework (Saunders et al., 2012; Yin, 2003). If the identified pattern coincides with the result it will help the case study to strengthen its internal validity, which is described by Yin (2003). According to both Saunders et al. (2012) and Yin (2003) it is possible to draw conclusions if the results are predicted.

The second method, explanation building, is a method discussed by Saunders et al. (2012) and Yin (2003). It can be viewed as a special type of pattern matching, but the explanation building is more difficult in its nature (Yin, 2003). This method of analyzing data can be used for both single and multiple cases (ibid.). Saunders et al. (2012) consider explanation building as a system to test a theoretical proposition and not to generate new theory. On the other hand, Yin (2003) considers the explanation building as a way to build an explanation about the case. The method is suitable for explanatory studies (Yin, 2003). The disadvantage of the explanation building method is that the iterative process can lead the researcher in the wrong direction and away from the objectives of the research.

The third method explained by Yin (2003) is time-series analysis, which is used for single or multiple cases that are conducted with experiments. The method aims to follow intricate patterns of the research and the more intricate and precise the patterns are the more the analysis will build a basis for conclusions about the case study (Yin, 2003). Yin (2003) then describes the fourth model for analysis of case studies, which are logic models suitable for single and multiple case studies. According to Yin (2003), it has become more common for evaluation. The model stipulates a complex chain of events over time with a cause and effect analysis where the objective is to match empirically observed data with predicted theory. The last, and the fifth model described by Yin (2003), is the cross-case synthesis that is used for multiple cases. The model is formulated to use word tables from the different cases to display and compare the data. The advantage with the model is that it is possible to evaluate the different cases both together and as individual cases. (ibid.)

For this study, pattern matching is used to evaluate the individual cases continually. Later, the results of pattern matching are used for a cross-case synthesis. The cross-case synthesis helps the authors to first analyze the individual cases and secondly, compare the differences between the cases. According to Yin (2003), the usage of multiple cases for analysis strengthens the findings compared to a single case study.

2.9 Trustworthiness

In order to determine the quality and trustworthiness of research, reliability, and validity is commonly used (Björklund & Paulsson, 2003; Eriksson & Wiedersheim-Paul, 2011; Saunders et al., 2012). Baxter and Jack (2008) present the terms credibility, transferability, dependability and conformability as aspects of trustworthiness. In this thesis, the terminology of Björklund and Paulsson (2003), Eriksson and Wiedersheim-Paul (2011), and Saunders et al. (2012), is used. Björklund and Paulsson (2003) and Eriksson and Wiedersheim-Paul (2011) also present objectivity as a factor that determines trustworthiness.
Objectivity is not further discussed or handled in this thesis since the authors see this as a part of reliability and validity. According to Merriam (2006), the ethics of a research project is another important factor to evaluate concerning research trustworthiness.

2.9.1 Research Reliability

For research to have high reliability the data collection methods and analysis will present the same results if they were conducted again (Björklund & Paulsson, 2003; Merriam, 2006; Saunders et al., 2012) and will not be dependent on the researcher (Eriksson & Wiedersheim-Paul, 2011). Eriksson and Wiedersheim-Paul (2011) describe this as the trustworthiness of the measurement method. To ensure high reliability in a study, the methodology needs to be thought through and evaluated so that it is clear for other researchers to repeat the study if so desired (Saunders et al., 2012). Merriam (2006) describes three methods to make sure that the result of the research is consistent.

The first method concerns the researcher’s position that needs to be clarified in terms of hypotheses and theories upon which the research is based (Merriam, 2006). Secondly, triangulation is a method to increase reliability (Björklund & Paulsson, 2003; Merriam, 2006). Triangulation means that different data collection methods are used to collect the same kind of information (Björklund & Paulsson, 2003; Merriam, 2006; Saunders et al., 2012). According to Saunders et al. (2012) and Yin (2003) triangulation is essential in a case study strategy. Finally, Merriam (2006) describes a similar method to Saunders et al. (2012), that the methodology should be clearly described so that an external reviewer can repeat and approve the study. Björklund and Paulsson (2003) argue that control questions in questionnaires and interviews can increase the reliability.

To achieve a high reliability in this thesis, triangulation is used as a technique. This is done in the empirical studies by using different data collection methods and by verifying that the results from interviews and questionnaires are consistent. Letting the respondents read the transcriptions and give their input is a way to verify the results. Triangulation is also used concerning the theoretical framework where different sources are evaluated. The methodology is described and evaluated to make sure that a different researcher can conduct similar research again with a similar result.

2.9.2 Research Validity

Validity refers to what extent the research has examined what is intended (Björklund & Paulsson, 2003; Eriksson & Wiedersheim-Paul, 2011; Saunders et al., 2012). Validity has two aspects, internal validity and external validity (Eriksson & Wiedersheim-Paul, 2011; Merriam, 2006; Saunders, et al., 2012). Internal validity is described by Eriksson and Wiedersheim-Paul (2011) as the consistency between concept and the measurable definitions they have. Saunders et al. (2012) describe internal validity as the demonstration of causal relationship between variables, which can be shown by statistical empirical studies. Merriam (2006) argues that interpretation by the researcher has an impact on internal validity.

External validity concerns the extent to which the results of the research can be generalized for other relevant situations (Merriam, 2006; Saunders et al., 2012). Eriksson and Wiedersheim-Paul (2011) define external validity as the consistency between the result when a measurable definition is used and reality. In order to achieve higher external validity, Saunders et al. (2012) argue that a representative sample should be used and to replicate the study in another context. Merriam (2006) states that external validity can only be achieved if there is a high level of internal validity, since results that are not valid cannot be generalized. According to Björklund and Paulsson (2003), validity can be increased with triangulation and by using clear questions in questionnaires and interviews.

In order to increase the internal validity of the thesis, the results from interviews and questionnaires are verified with the respondents. The transcription is sent to each respondent to give them the opportunity to comment and change inaccuracies. Clear questions also increased validity. The sample of respondents is selected by convenience and purposive sample selection, which ensure that the results focus on the specific research area. This also makes the sample representative to the population, which increases the external validity. External validity is also increased by triangulation in both empirical and theoretical studies.
2.9.3 Ethics

Ethics is a factor that affects the trustworthiness of a research project (Merriam, 2006). According to Denscombe (2010), researchers are expected to conduct their study in an ethical manner. Merriam (2006) explains that ethics has to be considered at two stages of a qualitative study, during the data collection and when the results are published. There are, according to the author, five different factors that need to be considered: the engagement of the researcher, confidentiality, anonymity, that different groups of stakeholders want control over the results and the reader's ability to separate the data and the researcher's interpretations. Denscombe (2010) presents four key principles regarding ethics in research: to protect the interest of the participants, to ensure that participants have volunteered and that they are aware of the situation, to avoid fraud and operate with scientific integrity and, finally, to act according to the law of the land. Furthermore, Denscombe (2010) recommends that researchers develop a code of research conduct that should be used during the research.

In order to handle the ethical aspects of this thesis, the authors develop and follow a code of research conduct. This means that confidentiality and anonymity are handled with great respect. The owner of the information approves use of documents or information that are confidential before it is handled in the study. Anonymity is protected through coded interviews where only the title of the respondent is presented in the published report. To account for different interests and their influence on the study, a stakeholder analysis is performed before the research begins so as to create awareness of the different interests, which was helpful when handling the stakeholders. The authors give a clear description of interpretations and conclusions, to help readers to review the study critically. Sample selection is made by the authors who inform the respondents about the research, and its purpose, and also make sure they are participating voluntarily. Fraud is strictly forbidden for the authors. Additionally, the law, of the land the research is conducted in, is respected as well as the code of conduct of the companies observed.
2 Methodology
3 LITERATURE REVIEW

This chapter presents a literature review that develops an understanding about quality assurance of purchased parts that is used in further analysis of the research. The chapter aims to explain relevant theories that can be used to answer the research questions and with analysis of the empirical findings. The theories are summarized in a theoretical frame of reference at the end of the chapter.

3.1 LITERATURE FRAMEWORK

A literature framework is used, together with empirical results, to answer research question one, presented in Section 1.3.1, and to find potential methods that can improve communication in the quality assurance process for purchased parts, as research question three seeks to answer. The framework is shown in Figure 3. In the Figure, quality is the foundation. How quality is defined and handled in this thesis is based on different researchers’ definitions and dimensions of quality. Furthermore, continuous improvements are also discussed as a basis for quality. Supply chain management and quality are the boundaries of the literature framework, where purchasing is the branch of supply chain management that is studied in this thesis. Purchasing and quality together span the area of the literature studied for this thesis. Where these areas meet there is a discussion of quality assurance, which is the focus of the study. The bridge between quality assurance and purchasing is defined to be competitive priorities and supplier collaboration. The connection between quality and quality assurance is defined to be quality management systems and strategy that concerns quality. Different methods of quality assurance are discussed in order to analyze them for different cases and to understand the similarities and differences between methods used in the automotive industry. Furthermore, quality assurance is viewed as a process that works to fulfill the requirements of the customer, where the interaction between internal and external customers together with suppliers is a significantly important part of the process. Communication between these parties is essential in quality assurance and is also connected to supplier collaboration. The research areas within the literature framework are further explained within this chapter.

Figure 3 Literature framework for this thesis.
3.2 Quality as a Strategic Issue

Quality and continuous improvement are important aspects in business strategy and both can provide a competitive advantage. Since this thesis has a focus on quality and quality assurance, these areas need to be defined and described as a basis to discuss implications and methods that concern quality assurance. In order to describe a method for continuous improvement, the PDCA-cycle is further described within this section.

There are many definitions of the term quality. One well-known definition is stated by Juran (1951, p. 2-2) and is formulated as “fitness for use”. Crosby (1979, p. 17) defines quality as “conformance to requirements”. Another example is “the quality of a product is its ability to satisfy, and preferably exceed, the needs and expectations of the customers” by Bergman and Klefsjö (2007, p. 26). When evaluating the quality of purchased parts in the automotive industry, the most important aspect is that specifications are met. Therefore, the definition stated by Crosby (1979), conformance to requirements, is used in this thesis since it is considered the most appropriate definition of quality for the study.

Quality is often used as a multi-dimensional term where the definitions of the dimensions vary between different authors (Curkovic et al., 2000). Garvin (1984) presents eight dimensions of quality where the dimensions are independent of each other. Although, the author argues that the total quality is dependent on all dimensions. The dimensions and their explanation are presented Table 2.

Table 2 Quality dimensions. Based on (Garvin, 1984).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>The primary operating characteristics of a product</td>
</tr>
<tr>
<td>Features</td>
<td>Additionally functions that are added to the product</td>
</tr>
<tr>
<td>Reliability</td>
<td>The accountability of a product</td>
</tr>
<tr>
<td>Conformance</td>
<td>A measure of consistency</td>
</tr>
<tr>
<td>Durability</td>
<td>The economical and physical life of the product</td>
</tr>
<tr>
<td>Serviceability</td>
<td>Speed of repair</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>Subjective experience of a product’s look, smell, sound and taste etc.</td>
</tr>
<tr>
<td>Perceived quality</td>
<td>Subjective experience of the total quality</td>
</tr>
</tbody>
</table>

Madu, Kuei, and Jacob (1996) describe three dimensions of quality: customer satisfaction, employee satisfaction, and employee service quality. Customer satisfaction concerns price, product features, product reliability, services, company culture, and overall customer satisfaction (Madu et al., 1996). Employee satisfaction depends on, for example, politics, leadership, financial rewards, non-financial rewards, and training and education programs (ibid.). Finally, the dimension of employee service quality covers responsibility, availability, timeliness, completeness, and pleasantness (ibid.). Forker (1991) states that there are four approaches to quality: user-based, product-based, value-based, and manufacturing-based. The user-based approach is founded on a definition of quality that states that the product’s quality is determined by the degree to which it meets the customer’s expectations and needs (Forker, 1991). The product-based approach focuses on the products usefulness and properties, while the manufacturing-based approach is connected to conformance of requirements (ibid.). The value-based approach does not only take conformance to requirements and performance in to consideration, but also the cost and price (ibid.). In an empirical study by Curcovic et al. (2000) the presented dimensions were investigated and two core dimensions of quality where supported by empirical results: product quality and service quality. Product quality, according to Curcovic et al. (2000), consists of features, product performance, conformance to specification, reliability, and durability, while service quality consists of pre-sale customer service, responsiveness, and product support. These results, as well as other theories, support many of the dimensions presented by Garvin (1984). Therefore, these dimensions, together with Crosby’s (1979) definition of quality, are the bases of the approach to quality used throughout this thesis.

Companies can consider quality as an integrated strategic function of the overall organization, this phenomena is often called Total Quality Management, TQM (Bergman & Klefsjö, 2007; Kiella & Golhar, 1997; Morris, 1989). Summers (2010, p. 12) defines TQM as; “a management approach that places emphasis on continuous process and system improvement as a means of achieving customer satisfaction to ensure long-term company success”.

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Cali (1992, pp. 3-4) describes TQM as a “foundation of continuous improvements; a philosophy for running business; the right way to manage, total people-empowerment, a focus on the customer, a commitment to quality and an investment in knowledge”. TQM is dependent on all employees and their commitment to work with continuous improvements (Bergman & Klefsjö, 2007; Summers, 2010). According to Bergman and Klefsjö (2007), committed leadership is an essential value of TQM as well as customer focus, to make decisions based on facts, and to work with process management. Kiella and Golhar (1997) also mention teamwork and experimentation with new ideas as elements of TQM. Mak (1999) argues that managers and employees must understand the importance of quality regarding the survival of the company in order to be successful. Vermeulen (1997) states that TQM can only be successfully implemented if there is a quality culture among employees. Quality culture is, according to the author, the way quality is viewed, interpreted and talked about in an organization. Hoogervorst, Koopman, and van der Flier (2005) mention employee participation and quality mindset as important factors in the quality culture. Vermeulen (1997) states that this is the first aspect to consider when evaluating the current state of quality in the company. The authors of this thesis use these values and elements to describe the mindset of quality and continuous improvement, even for organizations that do not have an explicit TQM strategy.

Many authors, for example Bergman and Klefsjö (2007), Curkovic et al. (2000), Dominic et al. (2010), Kroll et al. (1999), Rapert and Wren (1998), and Ziggers and Trienekens (1999), have stated that quality can create competitive advantage and be a means to achieve long-term profitability. Bergman and Klefsjö (2007) argue that improved quality can lead to decreased absence from work and lower employee turnover. The commitment of employees leads to motivation and improved results, and ultimately to a better working environment (ibid.). This is consistent with the description of the quality dimension of employee satisfaction by Madu et al. (1996). In a study conducted by Jun, Cai, and Shin (2006) the results showed that empowerment, teamwork, and compensation lead to increased employee satisfaction that in turn leads to employee loyalty. Yee, Yeung, Cheng, and Lee (2012) found that quality has a significant impact on customer satisfaction, which has a positive impact on employee satisfaction that in turn affects the quality in a positive loop.

### 3.2.1 PROCESS AND BUSINESS IMPROVEMENT

Continuous improvements are an essential part of TQM and a way for a company to increase the satisfaction of customers and employees (Summers, 2010). Berman and Klefsjö (2007) argue that companies need to continuously improve in order to keep up with competition, and that even the companies that can be considered good, risk losing their advantage if they do not continuously improve. There are different methods for process and business improvements. One example is Six Sigma that focuses on statistical analysis to minimize waste (Knowles, Johnson, & Warwood, 2004; Schön, 2006). A method for continuous improvement and problem solving described by Bergman and Klefsjö (2007), Moen and Norman (2006), Petersson et al. (2009), and Summers (2010), is the PDCA cycle, where PDCA stands for Plan-Do-Check-Act. This method is further described and used for this thesis since it is feasible with qualitative data. PDCA cycle is illustrated in Figure 4. The method is described as a cycle where the first phase is Plan that includes definition of the problem (Moen & Norman, 2006; Summers, 2010). The second phase, Do, includes the implementation of actions that where planned in the previous phase (Moen & Norman, 2006; Petersson et al., 2009). For the third phase, Check, the actions taken in the Do-phase are evaluated (Moen & Norman, 2006). According to Petersson et al. (2009), the third phase also includes control against the Plan-phase. The last phase of the PDCA cycle is Act. Bergman and Klefsjö (2007) describe the Act-phase to include lessons learned from problems to be able to avoid them in future projects. If results are unsatisfactory then a new loop of the PDCA cycle should be made to find a solution to the defined problem (Moen & Norman, 2006). The method can help any company to create an organized system for improvement of processes, products, and services (ibid.).

![Figure 4 PDCA-cycle method for continuous improvements. Source: (Moen & Norman, 2006).](image-url)
3.3 Supply Chain Management

Supply chain management is an essential strategic aspect in today’s competitive environment. Purchasing is one of the functions in the supply chain and receives more focus in this thesis than other functions due to the aim of the thesis. This is also a strategic function in a company that has a significant impact on downstream activities in the supply chain. In order to improve supplier quality, supplier collaboration and development are important aspects.

Supply chain management, SCM, is defined by Janvier-James (2012, p. 196) as "the strategic and efficient coordination of the conventional business functions and the strategies across these business functions within a specific corporate and across businesses within a supply chain, for the aim of developing the long-term performance of the corporate and the supply chain as an entire". Srinivasan, Mukherjee, and Gaur (2011) describe the supply chain as all activities connected to the flow of goods and information, from sourcing to the end customer. According to Segerstedt (2008), SCM aims to increase value and reduce cost by integration of the whole supply chain, and to make it more efficient. Benton (2014) states that SCM has evolved to be a means to enhance continuous improvements, improve customer satisfaction and the competitive position, increase efficiency, and serve as a communication channel. Cao et al. (2010) and Mikkola and Skøtt-Larsen (2006) argue that companies are no longer competing against each other, competition now concerns supply chains. Srinivasan et al. (2011) describe supply chain performance as the performance of all connected processes in the supply chain. Measures that can be used to evaluate supply chain performance are for example, customer satisfaction, on-time deliveries, and inventory cost (Srinivasan et al., 2011). Gadde et al. (2010) state that the efficiency and effectiveness of a company is dependent on operations within the supply chain. Well-functioning long-term relationships in the supply chain can be an important competitive advantage (Mikkola & Skøtt-Larsen, 2006).

3.3.1 Purchasing as a Strategic Issue

In the global marketplace of today, companies need to improve purchasing and supply chain management in order to sustain their competitiveness and increase profitability (Benton, 2014). To be able to achieve this, the purchasing function needs to be consistent with a firm’s overall strategy (ibid.). Gadde and Håkansson (2007) state that purchasing represents the major part of a company’s total costs. This is due to increased differentiation and specialization and gives the purchasing function increased responsibility in the company’s strategy (ibid.). Gadde and Håkansson (2007) also mention the impact purchasing has on profitability, as well as the benefits from well-developed relationships with suppliers as reasons for the increased importance of purchasing. Benton (2014) describes that one way to integrate purchasing in the overall strategy is to use the company’s competitive priorities as sourcing criteria; for example, if quality is a priority it will be an important criteria when evaluating and handling suppliers. Tomaru, Nakano, and Nishimura (2013) argue that quality, delivery, cost, and flexibility are important evaluation criteria in purchasing activities, and that purchasing managers often prioritize quality as the most important supplier attribute. Sadeghieh et al. (2012) also mention quality, cost, and delivery as important factors, and that lead-time, service, and customization of the product are often used as evaluation criteria of suppliers.

3.3.2 Supplier Collaboration

Srinivasan et al. (2011) mention the importance of good relationships with suppliers and states that these relationships can make a company more prepared for change, create better solutions to organizational problems, and reduce costs. Cao et al. (2010) describe the term supply chain collaboration as two or more companies that develop a long-term relationship where they work closely in order to plan and execute supply chain operations, as a way to reach common targets and objectives. In this way, the companies involved achieve better results than working independently (Cao et al., 2010). Supplier collaboration is advantageous in new product development (Mikkola & Skøtt-Larsen, 2006). By involving the suppliers early, companies can improve quality, reduce cost and development time, and create innovative technologies (ibid.). In order to succeed with supplier collaboration, communication is an important parameter (Cao et al., 2010). Cali (1992) argues that in a quality focused environment, the purchaser sees the supplier as a customer who needs information about drawings, specifications, and dates to be able to deliver what is expected. The author further argues that in a quality culture, the purchaser wants to help the supplier develop and improve.
3.4 Quality Management Systems

Many customers want their suppliers to be certified with a Quality Management System, which is also a foundation and standardized work method for the quality assurance process. This section of the Literature Review highlights important aspects regarding Quality Management Systems that affect the quality assurance process. Furthermore, there is a description of ISO/TS 16949, which is a Quality Management System in the automotive industry that is studied in this thesis.

A standard is an agreement of how a business, in detail, should be conducted (Petersson et al., 2009, p. 69). The authors explain that a standard is necessary for performance of a work method and a way of creating a learning organization. The authors further state (p. 70) "where there is no standard, problems are not noticeable". The standard is in many organizations used as a method to predict the results (Petersson et al., 2009). A Quality Management System, QMS, like ISO 9000 – Quality Management, is a standard that requires an organization to ensure that supplied parts will meet the requirements and specifications of the customer (Bayo-Moriones, Bello-Pintado, & Merino-Díaz-de-Cerio, 2011). The International Organization for Standardization, ISO, established the ISO 9000 Standard in 1987 (Naveh & Marcus, 2005), which is one of the best-known standards of ISO (International Organization for Standardization, 2014). According to ISO (2014), the aim of the ISO 9000 Standard is to provide guidance and tools for organizations that want to ensure that product quality will meet customer requirements. According to Singh, Power, and Chuong (2010), the tools of ISO 9000 can be used for both internal organizational processes and external organizational-environment activities. As a result of implementation of the standard, profits can increase and the organization can gain competitive advantage, whether or not they improve their operational performance (Naveh & Marcus, 2005; Terlaak & King, 2005).

Within a purchasing department, a QMS can be used to evaluate suppliers, monitor performance, and to write definitions of requirements and specifications (Bayo-Moriones et al., 2011). Frequent and timely communication is also an important factor for resolving disputes and alignment of perceptions and expectations in the customer-supplier relationship (ibid.). Additionally, due to Bayo-Moriones et al. (2011), the QMS can also be used to control suppliers and by that means reduce defective parts delivered. Furthermore, communication requirements are specified within the Standard of ISO 9001:2008. According to ISO (2008), it is important for an organization to determine and implement arrangements for communication with customers. This should be done in relation to product information, enquiries, contracts or order handling, and customer feedback. Another requirement is that management must ensure appropriate communication processes within the organization, which also affects the effectiveness of the quality management system. Feedback of information is suitable regarding manufacturing, engineering, and design activities and even more important is feedback to the supplier if a nonconforming product has been shipped (ibid.).

3.4.1 ISO/TS 16949 Automotive Quality Management

ISO/TS 16949 is prepared by the IATF, International Automotive Task Force, with support from ISO/TC 176 that considers quality management and quality assurance (International Automotive Task Force, 2009). According to ISO (2013), the standard can be used throughout the supply chain within the automotive industry. The standard of ISO/TS 16949 develops the existing provisions of ISO 9001:2008, with a focus on the automotive industry. In order to fulfill the standard, a customer needs to conduct a product and manufacturing process review (International Automotive Task Force, 2009). Two methods for this are explained in Section 3.5.2 and Section 3.5.3. The documents needed for those processes are presented, and circumstances and requirements are explained within ISO/TS 16949. Additionally but not specified by ISO 9001:2008, communication should be made regarding necessary information, including data, in a language and format that is specified by the customer (International Automotive Task Force, 2013), an example is computer-aided design data and electronic data exchange (ibid.).

3.5 Quality Assurance

Since the aim of the thesis is to look at quality assurance this is an essential part of this chapter. This section investigates the implications and aims of quality assurance. There is a presentation of different methods for quality assurance as well as limitations that need to be considered in any process or project.

According to Bayo-Moriones et al. (2011), quality management practices can help firms to ensure that supplied quality meets the requirements.
Bayo-Moriones et al. (2011) define quality assurance as “a set of activities and attitudes in the firm that promotes collective involvement to work together in a process of continuous improvement and product and service quality assurance” (p. 257). Benton (2014) claims that the systems used for quality assurance must be consistent with in-house quality requirements of the customer. That is, the targets and expectations must meet the minimum level of performance. According to Bergman and Klefsjö (2007), the modern approach to quality assurance is to prevent the production of defective parts. Therefore, it is not as relevant as before to control already produced items when they arrive at the customer (Bergman & Klefsjö, 2007). The authors describe this method as Acceptance Inspection. Bergman and Klefsjö (2007) mean that through active work on improvements, the control system can be eliminated. Furthermore, the authors explain that defective items should be prevented or if they exist, they must be captured directly.

Quality assurance is a well-known expression within the health care industry. Morgan and Everett (1990, pp. 24-25) define quality assurance as “a system of activities for ensuring production of a defined service to agreed standards within given resources”. This definition is similar to the one written by Bayo-Moriones et al. (2011), which means that there are similarities between different industries. An important part of quality assurance is said to be the relationship between the customer and the supplier (Grocock, 2000; Renwick, 1992), which further indicates similarities between the healthcare sector and the automotive industry. Grocock (2000) furthermore describes the relationship as a consequence of the strength of the customer. A powerful customer can impose systems on the supplier in order to control the quality of products (Grocock, 2000). Quality assurance consists of three parts, where the first part is requirements of the specifications, the second part is methods for determining if conformance has been achieved, and the final part is sanctions for non-conformance (ibid.).

For the automotive industry, different methods have been developed in order to work with preventive quality and meet the requirements of the customers. The first method explained is a method developed by DaimlerChrysler, Ford Motor Company, and General Motors Corporation. The second method described was developed by the Automotive Industry Association with the original name Verband der Automobilindustrie, from now on called VDA.

### 3.5.1 Advanced Product Quality Planning

Advanced Product Quality Planning, APQP, is a method to define and establish steps that are necessary to make sure that the supplied product will satisfy the needs of the customer (Wang, Jha, Gong, Hou, & Chiu, 2009). Li, Chang, Chen, and Liu (2011) describe the method as a robust production strategy and a method of real time improvement. It consists of activities, such as statistical tools and technologies, in order to improve the quality of the produced parts (Li et al., 2011; Wang et al., 2009). The method of APQP is used to lower costs, shorten the production cycle, and eliminate deficiencies (Li et al., 2011). According to Li et al. (2011) and Munro (2002), APQP is divided into five different phases:

1. Plan and define phase
2. Product design and development phase
3. Process design and development phase
4. Product and process validation phase
5. Feedback corrective action phase

The first phase, aims to investigate customer needs and expectations in order to define quality goals and create a preliminary plan of production (Chrysler Corporation; Ford Motor Company; General Motors Corporation, 2008). In the next phase, technical information and engineering requirements are reviewed. This includes an analysis of the feasibility and potential risks connected to manufacturing of the product. The third phase concerns the development of an effective manufacturing process that meets the customer’s needs and assures product quality. The fourth phase, describes the evaluation of manufacturing processes though a significant production run. In this way, the three first phases can be validated. The last phase, Feedback, Assessment and Corrective Action, is a phase of evaluation and improvement, of the product, manufacturing and the quality planning itself. (ibid.) The overall reason for usage of APQP is to have better control of supply chain operations (Wang et al., 2009). Singh, Goodyer, and Popplewell (2007) explain that APQP includes Production Part Approval Process and Initial Sampling Inspection Report.
3.5.2 Production Part Approval Process

As a part of the APQP process there is a requirement to perform a Production Part Approval Process, PPAP (Singh et al., 2007). According to Harrison (1996), PPAP was developed to help suppliers with their quality process in order to meet customer requirements. The purpose is to determine if the customer's design records and specification requirements are understood by the supply organization, and that the manufacturing process is able to produce the product (DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation, 2006). PPAP is required whenever a production run for a new product is being established (Singh et al., 2007). The authors explain that the significant production run is made so the customer can approve the first samples, to make sure that the rest of the production will run smoothly, and to make sure that the rest of the quantity is approved for manufacturing of the product. According to Harrison (1996), many problems occur within the design phase. Conflicting dimensions is one of the most common problems and implementing a document control system has reduced such conflicts (Harrison, 1996). Within the PPAP documentation, one action is to review the drawing together with the supplier in order to also assess the supplier's ability to meet the specifications on the drawing (ibid.). Furthermore, Harrison (1996) explains that the review of the drawing is a way to ensure that the specifications will be met.

PPAP requirements

The customer shall evaluate and approve PPAP if one or more of four different circumstances occur. The first reason is for a new product, for instance a specific part that is not yet supplied to the customer. The second reason for approval from the customer is if there is a correction of discrepancy on a previously submitted part. The third reason is if an engineer modifies the product and there is a change of design records, specifications, or materials. The final reason for need of an approval is if there are any situations that require a change described in reason three. (DaimlerChrysler Corporation et al., 2006) According to DaimlerChrysler Corporation et al. (2006) PPAP consist of 18 different documents. They are all presented and further described in Appendix B Documents within PPAP. The documents that are submitted in order to meet customer specifications, are required at different levels, one to five, where level three is the default level for all submissions unless specified otherwise by the customer representative. Level three includes all documents except number 15 and 16, in Appendix B. Once submitted, the supplier shall continue to assure that future production and products will meet customer requirements. The submitted documents are approved on the basis of showing that the organization will assure that the future production will continue to meet customer requirements (DaimlerChrysler Corporation et al., 2006).

3.5.3 Production Process and Product Approval

The Production Process and Product Approval, PPA, process is developed by Verband der Automobilindustrie, VDA, which represents the German car manufacturers. The PPA process comprises approval of processes and approval of product (Verband der Automobilindustrie, 2012). The reason for conducting the PPA process is to provide evidence of an effective product and production process, where the approval covers evaluation of processes and products based on relevant documents. The timing of the PPA must be agreed between the supplier and the customer and the process is initiated by new parts and products, or modifications such as modifications to the production process, the product, or a long-term production stop. After an initiation of PPA, a plan is agreed between the customer and the supplier. The reason for this is to reach consensus. The most important is the customer's ability to trace investigations, measurements, and conduct tests of the product (ibid.).

The customer evaluates documents that are submitted by the supplier. Available documents and procedures are presented in Appendix C Documents within PPA. There are three levels of submission: OK, means that all the agreed requirements are met, Conditionally OK, means that all requirements are subtotal complied and that deliveries can be made for limited period of time and quantity. Finally, NOK means that the requirements are not satisfied and production cannot proceed. The customer informs the supplier of the results of the evaluation. In cases of deviation, the supplier must obtain a written approval in advance from the customer. The documents are submitted on different submission levels, zero to three. Unless otherwise agreed, the documents will be submitted on level two includes all documents except number three, nine, ten, eleven, 14, and 15, see Appendix C. The documents that are not requested from the customer should be archived at the supplier (Verband der Automobilindustrie, 2012).
3.5.4 Limitations

Limitations of how much effort can be put into a project is often illustrated by a method called project triangle, which is described by Tonnquist (2012). An illustration of the project triangle is presented in Figure 5. Quality, time, and resources represent the corners of the triangle. Quality represents the ambitions of the project, time represents available deadlines, and resources represent the budget and available time from people working on the project. With help from the project triangle, it is possible to visualize which parameter has the highest priority. For those involved, it is important to know which parameter is most important to be able to plan their work properly. The priority is visualized by a smaller triangle, within the triangle, the closer the small triangle is to a corner of the larger triangle the higher the priority of that corner. (Tonnquist, 2012) The project triangle is used in this thesis, even though it does not focus on projects, since these limitations are considered important in other activities as well.

Figure 5 Project triangle for priority of project parameters. Source: (Tonnquist, 2012).

3.6 Communication in the Supply Chain

Communication is an important aspect of all organizations. When it concerns quality assurance, it has been found to have a major impact on the performance of suppliers and therefore has potential to improve the quality of purchased parts if handled and used properly. In this section, the importance of communication is explained. There is also a description of parameters of communication, channel conditions and methods to improve communication.

Communication is said to be "the glue that holds together a channel of distribution" (Mohr & Nevin, 1990, p. 36). In today's businesses, communication processes underlie most aspects of organizational functions (Fulk & Boyd, 1991; Mohr & Spekman, 1994). Communication is therefore a key for organizational success (Mohr & Spekman, 1994). Communication within the purchasing unit of a company is primarily concerned with the transmission of measurements and targets to the supplier (Gadde & Håkansson, 2007; Prahinski & Benton, 2004). Communication also creates an awareness of differences between current performance and customer's expectations (ibid.). Research has shown that communication has an impact on technical and functional quality, and therefore strong communication skills are needed to ensure that clients understand investments (Sharma & Patterson, 1999). Moreover, communication is also a method for customers to help suppliers through problems due to investment performance (Sharma & Patterson, 1999), to achieve the benefits of collaboration (Mohr & Spekman, 1994). Mohr and Spekman (1994) and Sharma and Patterson (1999) describe how high levels of participation, information sharing, and communication quality (which includes accuracy, timeliness, adequacy, and credibility of information exchange) are associated with a good partnership and a strong relationship. According to Sharma and Patterson (1999), timely communication fosters trust to help in resolving disputes and to align perceptions and expectation between customer and supplier. This is also discussed by Mohr and Spekman (1994), who claim that communication quality works to better align expectations, goals, and objectives. Carr and Kaynak (2007) state that effective communication increases understanding of both the supplier and the customer, which often results in a more committed relationship. This can be seen in Figure 6. In order to evaluate whether a communication initiative is effective, a measurement should be developed (Prahinski & Benton, 2004). Research has furthermore shown that internal communication and coordination is a prerequisite for communication with external suppliers (Stanley & Wisner, 2001).

Communication is identified as a critical factor in the development of suppliers (Carr & Kaynak, 2007). Sharma and Patterson (1999) state that communication effectiveness is a key driver of the other variables shown in Figure 6. It is also described as a powerful determinant of relationship commitment. It can also be seen that communication between supplier and buyer improves the quality of supplied products, which also affects relationship commitment.
A good relationship with suppliers improves quality by enabling suppliers to be involved early in the customer's design of products (Carr & Kaynak, 2007). Franke (1988, p. 228) states, “improving quality plays a powerful role in improving customer's views about service quality”. Research has also shown that the use of face-to-face, telephone, fax, e-mail, and written communication methods is indirectly related to product quality, improvement, and financial performance due to information sharing between firms (Carr & Kaynak, 2007).

![Diagram showing communication effectiveness and its components]

**Figure 6** Determinants of relationship commitment. Source: (Sharma & Patterson, 1999).

### 3.6.1 Parameters of Communication

According to Mohr and Nevin (1990), ineffective communication often leads to misunderstandings, incorrect strategies, and a mutual feeling of frustration that can cause conflicts among the people involved. Therefore, it is said that many of the current problems within firms can be solved by appropriate methods and strategies for communication, within and between firms (ibid.). This is called effective communication by Sharma and Patterson (1999) and can be seen in regular contact between buyer and supplier. Mohr and Nevin (1990) describe communication using four different parameters: frequency, direction, modality, and content. Communication strategies are presented in Table 3.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Method</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>&quot;amount of communication&quot;</td>
<td>The amount of contact in relation to amount of contact necessary to conduct activities adequately</td>
<td>Some contact is necessary, too much can overload organizational members.</td>
</tr>
<tr>
<td><strong>Direction</strong></td>
<td>&quot;vertical and horizontal movement of communication within the organizational hierarchy&quot;</td>
<td>“Unidirectionality” (downward or upward) &quot;bidirectionality” (both downward and upward)</td>
<td>Manufacturer is upward communication. Reseller is downward.</td>
</tr>
<tr>
<td><strong>Modality</strong></td>
<td>“method used to transmit information”</td>
<td>Formal and informal distinction</td>
<td>Formal communication through written modes. Informal communication is more personalized (word-of-mouth).</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>“the message that is transmitted”</td>
<td>Direct and indirect influence strategies</td>
<td>Direct strategies are designed to change behaviors (requests, recommendations, and promises). Indirect strategies are designed to change beliefs and attitudes.</td>
</tr>
</tbody>
</table>

The four parameters of communications describe strategies that together with channel conditions work to improve performance of the outcomes (Mohr & Nevin, 1990). Channel conditions consider structure, climate, and power. Channel structure refers to two different structures; relational and market. Relational structure involves joint planning between parties, shared activities, it is long term, and interdependence is high. (ibid.)
3 Literature Review

Market structure is more ad-hoc, the relationship is on a short-term basis and interdependence is low. Channel climate has implications for communication; in a channel with high trust and supportiveness, more frequent communication will be used, and vice versa within channels with lower trust. Channel climate is associated with organizational culture, which for example includes leadership, trust, respect, autonomy and responsibilities and reward orientation of management. Channel power can be either symmetrical or asymmetrical. When the power is symmetrical the power is balanced between the different parties, with asymmetrical power there is imbalance. In order to improve the performance of the outcome the organization should consider both communication strategy and conditions of the channel, in combination. How communication should be conducted is further shown in Table 4. (Mohr & Nevin, 1990)

Table 4 Relationship between channel conditions and strategies of communication.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Frequency</th>
<th>Direction</th>
<th>Content</th>
<th>Modality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relational</td>
<td>Higher</td>
<td>More bidirectional</td>
<td>More indirect</td>
<td>More informal</td>
</tr>
<tr>
<td>Market</td>
<td>Lower</td>
<td>More unidirectional</td>
<td>More direct</td>
<td>More formal</td>
</tr>
<tr>
<td><strong>Climate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supportive</td>
<td>Higher</td>
<td>More bidirectional</td>
<td>More indirect</td>
<td>More informal</td>
</tr>
<tr>
<td>Unsupportive</td>
<td>Lower</td>
<td>More unidirectional</td>
<td>More direct</td>
<td>More formal</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Higher</td>
<td>More bidirectional</td>
<td>More indirect</td>
<td>More informal</td>
</tr>
<tr>
<td>Asymmetrical</td>
<td>Lower</td>
<td>More unidirectional</td>
<td>More direct</td>
<td>More formal</td>
</tr>
</tbody>
</table>

Communication methods are described by Carr and Kaynak (2007) and Larson and Kulchitsky (2000), where Carr and Kaynak (2007) divide the methods into traditional and advanced methods. Traditional methods are listed as face-to-face, telephone, fax, e-mail, and written (Carr & Kaynak, 2007). Advanced communication methods are identified to be computer-to-computer links, electronic data interchange, and enterprise resource planning (ibid.). Face-to-face communication is the most important method (Carr & Kaynak, 2007; Fulk & Boyd, 1991; Larson & Kulchitsky, 2000), because it allows multiple cues, direct feedback, and personal focus (Larson & Kulchitsky, 2000). Telephone communication has lower richness than face-to-face because fewer cues are available and it is less personal. Mail, fax, and other written communication are said to be less rich than telephone due to even fewer cues and no direct feedback. Advanced communication methods are impersonal and the poorest medium (ibid.). Therefore, it is not possible for advanced communication methods to replace traditional methods due to the importance of the richness of those methods. Advanced methods just offer additional opportunities to spread information. Therefore, traditional methods are still more useful for sharing information between firms. (Carr & Kaynak, 2007) Larson and Kulchitsky (2000) explain that advanced methods can be used for routine communication that does not require transmission via rich media. Non-routine communication is better via rich media and should therefore use traditional methods (Larson & Kulchitsky, 2000).

Figure 7 shows how communication methods are related according to media richness.

Figure 7 Communication methods due to media richness. Based on (Larson & Kulchitsky, 2000).
3.6.2 How to improve communication

Communication can be improved by several methods. One way is to develop smooth, cordial, and ongoing communication between supplier and customer in order to develop the relationship between them (Sharma & Patterson, 1999). The more interaction between customer and supplier, the stronger the relationship will be in relation to knowledge transfer activities, where the goal is to improve the capabilities of the supplier (Wagner & Krause, 2009). It can be seen that suppliers and buyers interact more frequently when information technology is used, because it facilitates communication (Carr & Kaynak, 2007). Managers should assess internal and external purchasing and supplier relationships and take action where communication needs to be increased. They should also be sure to solve problems and increase general awareness of the relationship between communication, service, and product quality (Prahinski & Benton, 2004). Another method that is used within the Japanese automaker’s industry is that selection of supplier is based partly on willingness to share information with the buyer (Carr & Kaynak, 2007).

3.7 Theoretical frame of reference

The theoretical frame of reference presented in Figure 8 aims to develop understanding of the literature’s perspective of how communication, and other problem areas, can be improved within the quality assurance process. The definition of quality in this thesis is stated as conformance to requirements. This view of quality is the foundation for the quality culture. Quality culture is in turn essential in order to understand the importance of quality and quality assurance. After the definition of quality supply chain management is presented as the foundation where the purchasing function exists. The next level studied in the Literature Review is that a QMS is a standardized work method and a support to quality assurance. Quality assurance processes underlie a QMS and include defined processes such as APQP, PPAP, and PPA. Since communication is presented as an important problem area, this is presented as the central point of the theoretical frame of reference that is affected by quality assurance process, QMS, supply chain management, and quality. This thesis aims to explain how quality assurance can be characterized and what problem areas have potential for improvement. One method for continuous improvement is the PDCA cycle, which is the center of the frame of reference, which will be used in order to improve communication in the quality assurance process.

"Conformance to requirements"

Figure 8 Theoretical frame of reference for this thesis.
3 Literature Review
This chapter aims to describe the case study of Scania CV AB. Since the aim of the thesis is to investigate the quality assurance process of purchased parts, the company presentation focus is on Scania Purchasing and its quality function. There is a description of the current situation and the problems identified. A deeper investigation about communication is presented due to its importance, as shown in the analysis of the current situation. Finally, a supplier visit is observed and the results presented.

4.1 COMPANY PRESENTATION

Scania is a global company in the automotive industry, founded in 1891 (Scania CV AB a, 2014), with approximately 39,000 employees in more than 100 countries (Scania CV AB b, 2013). Scania provides trucks, busses and engines to its customers (Scania CV AB a, 2014). Figure 9 shows an image of a Scania truck. Volkswagen Group AG, see Section 5.1, is majority owner of Scania. The head office is located in Södertälje, Sweden where most of the research and development and the purchasing organization are situated (ibid). Scania has nine production units, mainly in Sweden where Södertälje is the largest but also in the Netherlands, France, Poland, Argentina, and Brazil (Scania CV AB c, 2013). The company’s mission is “to deliver optimized heavy trucks and buses, engines and services that enable its customers to achieve the best earning capacity and operating economy - thereby becoming the leading company in its industry” (Scania CV AB a, 2014). Scania’s vision is to “be the leading company in its business by creating lasting value for its customers, employees, shareholders and stakeholders” (Scania CV AB d, 2014). Most customers are located in Europe, approximately 43 percent, and Latin America, approximately 27 percent. There are also customers in Asia and Africa (Scania CV AB a, 2014).

Figure 9 Scania truck. Photographer: Christopher Crookes 2013. Copyright: Scania CV AB

Scania’s strategic platform, culture, and leadership are based on their core values: customer first, respect for the individual, and quality (Scania CV AB a, 2014). By putting the customer first, Scania can assure that the right solution is delivered, which contributes to profitability and environmental impact. Therefore, the customer’s requirements and needs are central in all operations from research and development to delivery of services. By showing respect for the individual, their knowledge, ambition, and experience can be utilized continuously to improve operations and working methods. In this way, quality and employee satisfaction can be obtained. Last, quality is essential in Scania’s strategy. By providing high-quality products the customer can receive higher value. With a good knowledge of the requirements and needs from the customer Scania can improve quality. Scania is continuously working to eliminate non-value-adding activities in order to achieve higher quality. By focusing on deviations, Scania can improve continuously from the current state. The strategy of Scania is described as a house with continuous improvements as the roof and the core values as the foundation. (Scania CV AB e, 2013)
Continuous improvement is Scania's main focus to achieve competitive advantage and to create value to the customer (Scania CV AB a, 2014). To support the strategy, the leadership aims to attract competent people with diversified backgrounds, and to coach and stimulate individual development (Scania CV AB f, 2014). Since Scania is considered a premium brand, quality is very important for sustaining a good reputation and to achieve customer satisfaction (Scania CV AB a, 2014). Purchased parts represent approximately 75 percent of the total value of a vehicle produced by Scania (Scania CV AB a, 2014), which puts a great responsibility on the purchasing function concerning quality assurance of these purchased parts.

### 4.1.1 Scania Purchasing

Scania’s Purchasing vision is “continuously being the most efficient and attractive purchasing operation in the industry” (Scania CV AB a, 2014). The mission is “to provide value to our customers by supplying required material, equipment and services to the right quality, delivery and cost” (ibid). Scania’s three core values are the foundation of Scania’s Purchasing strategy 2013 (Scania CV AB f, 2014). The priorities of Scania purchasing strategy are safety, health and environment, quality, delivery, and cost (ibid.). The target is zero deviations concerning both quality and delivery and to fulfill all cost targets and optimize Scania's investments (ibid.). The purchasing strategy is described as a house, like Scania's strategic platform, as illustrated in Figure 10.

Scania Purchasing's head office is situated in Södertälje, Sweden where both automotive products and non-automotive products are purchased for all Scania's production units in the world, with help from local purchasing offices (Scania CV AB a, 2014). This thesis focuses on purchasing of automotive parts and therefore there is no further description of the organization of non-automotive purchasing. Automotive purchasing at Scania is split into three units: Purchasing of components for chassis and cab; Purchasing of components for powertrain; and Quality, projects, and strategy (Scania CV AB a, 2014). Projects and strategy will not be considered since it is beyond the scope of this thesis but the organization of the quality unit will be described in Section 4.1.2.

![Continuous Improvement Diagram](image)

**Figure 10 Purchasing strategy 2013. Source: Scania CV AB h.**

Purchasing of chassis and cab is split into purchasing of chassis and metal components and cab components, and purchasing powertrain into engines and, axles and gearbox see Figure 11. In each of these groups, there are both commodity purchasers and project purchasers. The project purchasers are responsible for introduction of new products and the commodity purchasers for parts in production. The commodity purchasers are also responsible for determining strategy and its fulfillment. These different purchasers work in close collaboration in different segments together with a Supplier Quality Assurance employee, SQA, from the quality organization. The role and responsibility of the SQA will be described further in Section 4.1.2. These teams of three different roles in the purchasing organization are called “three-rings” and each team is responsible for the strategy of their segment concerning quality, delivery, and cost (Scania CV AB f, 2014). The organization of Scania Purchasing is illustrated in Figure 11.
Figure 11 Organization of Scania Purchasing. Source: (Scania CV AB f, 2014).

4.1.2 Quality Assurance of Purchased Parts

The organization of quality assurance at Scania Purchasing is split into two functions, one preventive and one reactive. The reactive function is focused on problems concerning quality on delivered parts from the supplier. This includes immediate deviation handling and supplier development. Since reactive actions concerning quality deviations are excluded from this thesis, there will be no further description of this function. The preventive function consists of commodity SQAs, subsequently called SQAs, with the responsibility to assure the suppliers’ processes and thereby the parts. The SQAs are each responsible for one or more segments and work in close collaboration with the purchasers in the three-rings. The organization is split in the same way as for purchasing into four units, engines, axles and gearboxes, chassis and metal, and cab. An illustration of the quality organization at Scania Purchasing is presented in Figure 12 where SQF, Quick-teams and Purchasing on Line, and SQD, Supplier Development, are a part of the reactive function and marked with grey background color. (Scania CV AB g, 2014)
According to the Purchasing Strategy 2013, Scania should continuously improve quality, delivery, and cost by challenging the suppliers. One of the key performance indicators of 2014 is to reduce the number of technical reports due to deviations on delivered parts. This makes improved quality a focus area in the purchasing process and supply chain. (Scania CV AB h, 2014)

The quality assurance process at Scania is illustrated in Figure 13. The first step is data collection and analysis. The purpose of this step is to understand the part and to analyze and evaluate different suppliers. This includes learning about the design of the part, evaluating manufacturing processes of the part, setting classification to the part, and creating a quality assurance plan for further activities. The outcome of step one is that part concept and supplier’s manufacturing processes are agreed (Scania Inline a, 2014). The next step is to secure the supplier’s understanding and to assure manufacturability. The purpose is to assure that the supplier understands Scania’s requirements for the part. This includes activities such as reviewing the requirements, process and validation with the supplier and then confirming manufacturability of the part. Thereafter, a PPAP agreement, see Appendix B Documents within PPAP, for the part is created and the quality assurance plan is reviewed. (Scania Inline b, 2014) Step three concerns assurance of the production process. The purpose is to assure the supplier’s production process and eliminate risks. This is managed by a follow-up on the PPAP activities and plans, eliminating risks in the manufacturing process, reviewing the quality assurance plan and evaluating deviations. (Scania Inline c, 2014) The fourth and last step is to approve the part for serial production. This means evaluating the supplier’s PPAP, approving it and fulfilling the quality assurance plan. After this step, PPAP is approved and parts can be delivered. (Scania Inline d, 2014)

In order to assure the quality of purchased parts, the SQA use the Scania internal standard APM147, Automotive Purchasing Manual. The standard describes the quality assurance of parts, more specifically PPAP as described in Section 3.5.2, which is an essential part of the overall quality assurance process. This process starts when the supplier is selected and ends when the PPAP is approved for the specific part. The first step is to select the submission requirements, what PPAP documents should be sent from the supplier. The supplier should always be in possession of all documents. Three of the 18 PPAP documents should always be submitted to Scania, Part Submission Warrant, Control Plan, and Process Flow Diagram. The SQA should also determine and set quality assurance classification to critical, high, or normal. If critical is selected, a quality assurance plan is mandatory, otherwise it is optional. (Scania CV AB i, 2013) After the submission requirements are set, an order is sent to the supplier.
This order must include, according to APM147, a PPAP request date that is set to 50 days before start of production, SOP, at the latest. After the PPAP is submitted from the supplier, the SQA has ten working days to evaluate the documents. If the PPAP is fully approved or interim approved then delivery is permitted. (Scania CV AB, 2013)

At Scania there are two different statuses of full approval depending on the drawing status. If the drawing status is S, standard, and part and process are approved, the status of the PPAP is fully approved. When the drawing status is PR, preliminary, restrictive, and part and process is approved the PPAP status is PR approved. Interim approval can be selected with three different conditions. The PPAP approval status interim process is selected by the SQA when the part conforms to specification but is produced in a non-series process. Interim product is selected when the part is non-conforming to specifications but the process is conforming to specifications. When both part and process are approved but the material and composition is not reported in the IMDS system the PPAP approval status is interim IMDS. The approval or rejection will be registered in the digital system ePPAP. In cases of interim approval, the period of the approval must be registered. If the PPAP is interim approved or rejected, a new PPAP request is sent to the supplier. (Scania CV AB, 2013)

4.2 CURRENT SITUATION AND IDENTIFIED PROBLEM AREAS

As a data collection method, eight initial interviews were conducted in order to identify relevant problem areas as research question two seeks to answer. The questionnaire is presented in Appendix D Interview Form for Problem Identification, and in the original language Swedish in Appendix E Interviewformulär för problematisering. Eight SQAs were selected to participate in the individual interviews with the aim of achieving a representative selection. The role of each SQA and date of interview are presented in Appendix F Conducted Interviews. The respondents were not prepared for the questions before the interviews, other than about the purpose, which was also explained at the beginning of each interview. Based on the result of these interviews a cause-and-effect diagram was developed. The analysis is illustrated in Figure 14. The diagram is created according to the method described by Bergman and Klefsjö (2007). The problem, in this case, concerns the quality assurance process of purchased parts, which is shown in the front of the figure. Every category of cause has its own branch. Each branch is then divided into more detailed causes related to the problem area. The more detailed cause-and-effect diagram is presented in Appendix G Cause-and-Effect Diagram.

![Figure 14 Cause-and-effect diagram of initial problem definition.](image)

In Sections 4.2.1 to 4.2.6, each of these problem areas is further presented and explained, based on the results of the interviews conducted for problem identification.

4.2.1 SQA’S COMPETENCE

Each SQA’s competence differs due to different experience and background concerning quality assurance. This leads to different assessments of PPAP documents and at what level these are approved. Some of the SQAs state that the submission requirements differ due to previous experience and knowledge about the supplier and that it is rare that all 18 PPAP document are required. Knowledge about the part and the segment is also important. Complex parts are often managed better and the SQA has to consider how much quality assurance effort the part needs. If the part is not categorized, it is up to the SQA to decide and manage what is needed. When it comes to special characteristics, that are critical functions of the part, the SQA needs to understand the function of the part in the vehicle, if the design engineer has not set these.
Previous experience and knowledge about the supplier also affects the evaluation of the PPAP and the level at which it is approved. Knowledge of the second tier supplier, that is the next supplier upstream in the supply chain after the supplier, is mentioned as important to assure quality in the whole supply chain. There is different experience and knowledge of the PPAP documents. One SQA argued that the SQAs should continue to improve their competences and to gain deeper knowledge concerning the documents that are most valuable for Scania. Measurement system analysis, MSA, and capability audit are mentioned by several SQAs as examples of important documents. Process FMEA is also mentioned as one of the most important documents, and a basis for the other documents, and should therefore be continuously updated when changes or deviations occur. This is also a requirement in ISO/TS 16949.

One SQA felt there is a difference between generations concerning how the work is managed. Several of the interviewed SQAs mentioned the lack of cross-functionality in the quality organization. Currently, the daily work is individual, except from the three-rings. Another SQA stated that cross-functionality can not only improve SQA’s competence, but can also be helpful in project planning in order to keep the same pace in the whole organization including development, production and after-sales services, and thereby be able to keep to deadlines.

4.2.2 Communication

The majority of the interviewed SQAs mentioned regular communication with the supplier as crucial for a well-functioning quality assurance process. It is important to communicate expectations and requirements that Scania has on the supplier concerning PPAP documents and to make sure that the supplier understands. Some SQAs mentioned that regular communication should start early in the quality assurance process when PPAP requirements are set. The benefits that both Scania and the supplier can achieve from PPAP are something that needs to be communicated. In order to help the suppliers with PPAP, the SQA’s competence needs to be improved. Visits and face-to-face communication are considered important to make sure that suppliers understand requirements and expectations, and to support them with PPAP. During the visits, the most important requirements and documents can be discussed. Due to the workload, it is not possible for the SQA to be present at every startup for new parts, even if this is preferable. Thus, the SQA needs to trust the documentation and the supplier. A few of the interviewed SQAs believed that there are changes in the supplier’s manufacturing processes or second tier suppliers that are not reported to Scania, and this can cause problems with quality assurance.

4.2.3 Supplier’s Competence

The size of the suppliers varies and, according to some SQAs, so do their quality organizations. Some SQAs stated that PPAP could be expensive for a small organization with less resources concerning quality assurance. Other SQAs argued that there is no significant difference between larger or smaller suppliers, that possible differences relate to previous experiences regarding the part and how they prioritize Scania as their customer. One SQA stated that larger suppliers could be better because they often deliver to the car industry where the margins are narrower. Because of the high volumes and short life cycles in the car industry, their suppliers are often better at quality control. Car manufacturers often have higher expectations and requirements on their suppliers. Due to the high volumes, automatic manufacturing and automatic quality control are used within the car manufacturing industry, but for suppliers that only deliver to truck manufacturing, with lower volumes, automatic production and automatic quality control are less frequent. One SQA stated that it is not easy in a manual quality control to detect all defects and therefore it would have been better with an automatic quality control.

The complexity of the part can have an impact on how well developed the supplier’s processes are. A few SQAs felt that there is no difference in the work with PPAP whether the part is complex or not, but believe that there should be a difference. Others believed that complex parts often have better processes because of the critical functions and comprehensive consequences of deviations, and that non-complex parts do not have the same risk management. The complexity of the part also affects the SQA’s work. If the supplier does not have previous experience of PPAP the SQA has to thoroughly go through the process and its activities. In these cases, it is important to explain the document or activity and its purpose. Lack of cross-functionality at the supplier can cause problems if they take on tasks for which they do not have the competence or capacity to manage.
4.2.4 Supplier’s quality mindset

The supplier’s quality mindset has an impact on the performance concerning quality assurance. If the supplier understands the importance of the part and its quality, the result of the quality assurance process is generally better. This was stated by several of the interviewed SQAs. The quality mindset depends on the organization and if the management are involved and value quality. As it has been stated by several of the SQAs, suppliers with other customers in the automotive industry often understand the importance of quality and have a quality mindset. One SQA said that it is important to have suppliers that are excited and competent to fulfil all of Scania’s requirements. The second tier suppliers to Scania are also important but, according to one SQA, it is difficult to control these. Therefore, the supplier’s quality mindset is important to make sure that their suppliers in turn meet the set requirements. It has been shown that some suppliers are slightly careless concerning non-complex parts, which result in lower quality. What other industries the supplier delivers to have an impact. In the automotive industry, the requirements are tough and these suppliers understand the importance of quality.

One SQA argued that Scania’s and the SQA’s quality mindset has an effect on the supplier’s quality mindset. If Scania does not communicate the importance of quality, the supplier will not understand it. Scania requires that all of the delivered parts conform to the specification, because there is no room for deviations in Scania’s production processes. This is something that the supplier does not always understand. Thus, the SQA mentions the importance of quality to make sure that the suppliers understand the requirements and that Scania shows interest in the supplier.

4.2.5 Time aspects

The majority of the interviewed SQAs mention lack of time in their work with the quality assurance process. Some feel that there is excessive administration in the process and that they have too many parts to handle. One problem seems to be that the process sometimes starts late and that this causes problems that delay the final approval date. For example, the suppliers lack respect for deadlines for the submission of PPAP documents, which is a problem if the document is incorrect and needs rework. Often the production units need the parts shortly after the PPAP approval date, which means that there is often time pressure when the PPAP is handled by the SQA just before the last approval date. This can lead to an approval of a PPAP when it should be rejected or reworked. In these situations the SQA base that decision on the supplier’s previous performance. The lack of time is one of the reasons that not all 18 PPAP documents are set as submission requirements; there is not enough time to handle them all.

4.2.6 Internal management and organization

The majority of the SQAs thought that PPAP is a good process that is flexible and a good support. The digital system ePPAP is mentioned as a useful tool in their daily work and communication with suppliers. Problems with the internal management and organization are, besides lack of cross-functionality, inadequate drawings from the designer and employee turnover. According to one SQA, one way to improve cross-functionality is through improved leadership. Visual planning is also mentioned as a potential improvement area. Additionally, the continuous improvement process in the quality organization can be improved, for example with specific improvement groups.

4.3 Analysis of current situation

To analyze the current situation to find relevant problem areas, two different analysis methods were used. Firstly, a relationship analysis was conducted, according to the methodology described by Klefsjö, Eliasson, Kenmerfalk, Lundbäck, and Sandström (2003), to illustrate how the different problem areas are connected and affect each other. Then, a priority analysis was presented with the aim of investigating the impact and feasibility to improve each identified problem area. With these two analysis methods, the current situation was analyzed and evaluated, and finally a foundation for further investigation created. This is the answer to research question two.

4.3.1 Relationship analysis

To investigate the relationships between the problem areas the authors of this thesis conducted a relationship analysis. Figure 15 illustrates the result. The arrows show how one problem area affects another. If the relationship is reversed, the arrow is directed in the direction of the strongest impact. For each problem area, the number of ingoing and outgoing arrows is counted.
The result shows that communication has the highest total number of arrows and the most ingoing arrows. This makes communication a bottleneck, which has a high impact on the other problem areas. Thus, it is highlighted with a bold line in the figure. Internal management and organization has the most outgoing arrows, which makes it a pusher and thus shown with a dashed line in the figure. The rest of the problem areas has two arrows each, both outgoing and ingoing. This indicates that all problem areas affect each other.

4.3.2 PRIORITY ANALYSIS

In order to prioritize the different problem areas a priority analysis was made. For each problem area, an estimation of the impact and the feasibility was rated on a scale between zero and five. The estimate of impact was based on the relationship analysis and results from the initial interviews. If the problem area causes other problems, the impact of improving it is greater. The feasibility rating was based on the scope of the thesis, which actors will be involved and the authors' judgment. A high feasibility generates a high rating in the priority analysis. The feasibility rating was verified with managers at Scania. In Table 5, an explanation of what each rating represent is given. This table was developed by the authors of this thesis and was the basis for the final rating of the problem areas.
Table 5: Explanation of rating in priority analysis.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Impact</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Has no specific relationship with other problem areas. Is not mentioned as a major problem in the interviews</td>
<td>Will require comprehensive research on improvement methods. Will require effort from employees, managers and suppliers.</td>
</tr>
<tr>
<td>2</td>
<td>Has between one and two significant relationships with other problem areas. Is not mentioned as a major problem in the interviews</td>
<td>Can be improved through evaluation and investigation of different methods. Will require effort from employees.</td>
</tr>
<tr>
<td>3</td>
<td>Has between two and three significant relationships with other problem areas. Is mentioned as a problem in the interviews.</td>
<td>Can be improved through evaluation and investigation of different methods. Will require effort from managers and employees.</td>
</tr>
<tr>
<td>4</td>
<td>Has between three and four significant relationships with other problem areas. Is mentioned as an important problem area in the interviews.</td>
<td>Can be improved through known methods. Will require effort from managers and employees.</td>
</tr>
<tr>
<td>5</td>
<td>Have five or more significant relationships with other problem areas. Is mentioned as a major problem in the interviews.</td>
<td>Can be improved through known and used methods. Will require effort from employees.</td>
</tr>
</tbody>
</table>

The score is the rating of impact multiplied with the rating of feasibility. The priority is set so the problem area with the highest score gets the highest priority. The analysis by the authors is shown in Table 6.

Table 6: Priority analysis of initial problem definition.

<table>
<thead>
<tr>
<th>Problem area</th>
<th>Impact</th>
<th>Feasibility</th>
<th>Score</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>4</td>
<td>4</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Internal Management and Organization</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>SQA’s Competence</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Supplier’s Competence</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Time Aspects</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Supplier’s Quality Mindset</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

SQA’s competence gets a low impact rating due to the results in the relationship analysis where this problem area does not show more than two significant relationships. This area has been mentioned in the initial interviews as something that could differ between SQAs but not something that can cause major problems concerning the quality assurance process. However, this is something that has potential to be improved after an investigation of relevant methods and therefore gets a higher rating of feasibility. Communication affects all the other problem areas and was mentioned by the majority of the interviewed SQAs as an important factor in the quality assurance process. Therefore, this problem area gets a high rating on impact. The feasibility is also high because communication is considered to have high potential to be improved with available resources and known methods.

The supplier's competence has an impact on the quality assurance process. This is shown primarily in the initial interviews where problems caused by supplier's competence are mentioned. The relationship analysis shows that supplier's competence only has one outgoing and one incoming arrow.
However, this area is more difficult for Scania, or other automotive companies, to improve since it depends on the supplier. Therefore, it gets a low rating of feasibility. For the same reason, supplier's quality mindset gets a low rating of feasibility. The quality mindset of the supplier is mentioned as a very important factor and has therefore been assigned three on the rating of impact.

Most of the SQAs mention time as an issue that affects the ability to conduct a well-functioning quality assurance process. Thus, this problem area gets a relatively high impact rating. Concerning feasibility, time can be complicated to improve because of limited resources and because time planning is dependent on the suppliers. Internal management and organization is, according to the relationship analysis, a pusher and affects many of the other problem areas, such as communication, competence, and time. Even though this is not something that the initial interviews emphasize as a major problem, it is assigned with a relatively high impact rate. This is an area that can be improved easily at Scania, hence the high rating for feasibility.

Based on the score of each problem area, a priority is set. Communication has the highest score and has thus the highest priority. Internal management and organization has the second highest priority. Thereafter, SQA's competence, suppliers competence, and time get the same score, hence the same priority. Supplier's quality mindset gets the lowest score and priority, mainly because of the low feasibility. Due to this result in the priority analysis and the fact that it affects other areas, communication is the problem area that is investigated further within this thesis.

4.4 Communication at Scania Purchasing

Research question three aims to find improvements to communication within quality assurance. In order to investigate external and internal communication more thoroughly, two focus group interviews were arranged, in which seven and three SQAs participated. The purpose of the interviews was to discuss how communications with suppliers are handled today, how the starting point, concerning suppliers performance and parts complexity, differ from each other when it comes to communication and how communication can improve the supplier's performance. It was also interesting to discuss how communication is followed up and evaluated in order to improve it. The participating SQAs and date of each focus group is presented in Appendix F Conducted Interviews. The participating SQA's were sent an agenda of the structure and purpose of the focus group interview and questions to be covered, which is presented in Appendix H Preparing for Focus Group Interview and Appendix I Förberedelse för fokusgruppintervju in the original language Swedish. The structure and questions of the focus group interviews are presented in Appendix J Interview Questions for Focus Group and Appendix K Intervjufrågor för fokusgrupp in Swedish.

In the following sections, the results from the focus group interviews are compiled. First, there is a presentation of issues that concern communication. Thereafter, an explanation of how suppliers and parts are categorized and prioritized is presented. There is then a discussion about communication connected to the quality assurance process and to follow-up and evaluation. In the discussions, communication is defined as all interaction and creation of relationships between individuals, including visits, e-mail, telephone, discussions, and documents that are sent back and forth.

4.4.1 Issues with current communication processes

During focus group interviews one and two, issues regarding supplier understanding, communication differences, time aspect, and internal communication were discussed and the outcome is presented here. A summary of issues concerning communication at Scania is presented in Table 7, both improvement areas and best practice.

Supplier’s understanding

Scania’s standards and requirements are the foundation for communication and procurement with the supplier concerning quality. The SQAs are involved in requirements definition. According to the participating SQAs, it is important to make sure that the suppliers fully understand the requirements. All participating SQAs in the focus group interviews agreed that it is important to communicate expectations and requirements early in a project and that it is too late when PPAP starts. One SQA in the first session said that the first level of requirements is standards and the second is the technical specification. In the current situation, there are no standard presentations of the technical specifications, only of the first level of requirements. According to one SQA in the first focus group interview, Scania expects the suppliers to be aware of the first level of requirements if they have delivered parts to Scania in a previous project. If they are not aware of the requirements, the supplier is not considered adequate.
Underlying processes are an important issue to communicate with suppliers. Recently, a checklist of potential underlying processes, such as heat treatment, was developed for the supplier to use in procurement. One SQA in the first interview argued that this is a good method to investigate second tier suppliers early in the quality assurance process. Since this is a new method for Scania, it is used to a varying degree for different segments. Due to the lack of trust in second tier suppliers and underlying processes, standards are important to use and communicate. An important step in procurement is to understand the supplier's concept if they are responsible for the design. It is also important to communicate what their view of the part is and how they are planning to handle manufacturing.

One SQA in focus group two stated that a large proportion of the reports on quality deviations in 2013 were caused by poor communication and too few visits to the supplier. One problem with present communication, according to one SQA in session one, is the lack of understanding due to both language differences and different perceptions on important issues, for example design. Scania's suppliers are expected to understand English but that is not always the case, which creates problems. Even when language is not a problem, different perceptions can cause problems. Therefore, one SQA stated, frequent communication is important to ensure that the supplier understands the requirements. Another problem is that the supplier does not always communicate their limitations and therefore agrees on producing a part without taking time to make sure this is feasible. A compliance matrix is mentioned by one SQA in focus group one as a useful tool to ensure that Scania and supplier reach consensus concerning requirements and expectations. This tool works as a checklist of each important issue. From the rest of the participating SQAs, it seems that this tool is rarely used in the quality assurance process.

**DIFFERENCES IN COMMUNICATION**

All SQAs in the two focus group sessions stated that there are differences between the suppliers and parts that affect communication in the quality assurance process. SQAs in the second focus group stated that a supplier that performs a good PPAP does not require as much communication. The SQA can early in the process get a perception of the suppliers knowledge of PPAP and the different steps in the quality assurance process. Often this perception is based on previous experience from the supplier and the part. How they work with FMEA and the control plan are good indicators of their performance. In cases where the supplier has good knowledge about PPAP and previous experience of the part, the SQA does not put much effort into communication with that supplier. If the supplier's performance is inadequate and the part is complex it takes more effort from the SQA, according to focus group one. This means, in general, more communication through meetings, visits, controls, e-mail, and telephone.

**TIME ASPECT**

SQAs in the first focus group interview stated that it is important to discuss industrialization, when the part is produced in serial production, early in the project in order to reach consensus concerning the concept and manufacturing. The time plan is also important to communicate and agree. Currently, too many activities are conducted late in the project. At the beginning of a project, inadequate design and suppliers that require improvement have the most potential to be corrected. Focus group two discussed the time aspect of communication and argued that it is not possible to have well-functioning communication with all suppliers. Many SQAs have many parts and suppliers and it can be hard to keep track of them all. Due to the time constraints, suppliers can have difficulties in contacting the SQAs. SQAs in the second focus group argued that this is disrespectful to the supplier and that this can lead to the same treatment in return, that the supplier is hard to reach. Therefore, the SQAs argue that there should be a standard for handling messages about absence from work in e-mails and telephone.

**INTERNAL COMMUNICATION**

SQAs in focus group interview one mentioned technical expertise as important when communicating with suppliers. One SQA argued that there has to be someone that has competence about the technology when visiting the suppliers, otherwise there is a risk that the supplier is approved too easily. Many of the SQAs in the interviews feel that there is a lack of cross-functionality when it comes to technical issues. Everyone knows the expertise in the group they work in, but not in the rest of the organization. SQAs in focus group two stated that well-functioning internal communication is essential in order to have good communication with the supplier. It is important for the SQA to understand special characteristics and the function of the part in the vehicle. At internal design reviews, the SQA can get input from designers, production engineers, and purchasers and thereby be more prepared when communicating with the supplier. SQAs from both focus groups argue that it is rare that they are invited and participated in the design review, both internal and with supplier, even if this is considered important. The responsibility to organize the design review should belong to the project purchaser, according to SQAs in the first focus group. In the current situation, the responsibility to make sure that the supplier understands specifications is put on the SQAs.
This should be, according to the SQAs in interview one, the designer’s responsibility. That the supplier requests changes in the design late in the project is mentioned as a problem. This causes time delays and additional work for the SQA. It can be improved by better internal communication.

A benefit with the current way of working is the three-rings, which according to both focus groups can be helpful if the collaboration is working well between the purchasers and SQAs. By this means, responsibilities in communication can be specified and the SQA gains insight into the commercial issues. In cases where collaboration in the three-rings is not functioning well, it can lead to misunderstandings about responsibilities in the communication process. The SQAs in the second focus group argued that communication has potential to function well with existing processes and that the internal process development department at Scania Purchasing is a benefit. Although, the problem is that the processes are not used in the best way. The second focus group had the impression that suppliers appreciate Scania’s way of communicating and that Scania is trying to help them improve.

Table 7 Summary of issues with the current communication process.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Improvement areas</th>
<th>Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier’s understanding of requirements</td>
<td>Different language</td>
<td>Standards and technical specifications from Scania</td>
</tr>
<tr>
<td></td>
<td>Different perception</td>
<td>Supplier appreciate Scania’s help</td>
</tr>
<tr>
<td></td>
<td>Underlying processes</td>
<td>Compliance matrix</td>
</tr>
<tr>
<td></td>
<td>Design review with supplier</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplier’s limitations are not communicated</td>
<td></td>
</tr>
<tr>
<td>Difference in communication</td>
<td>Differences in supplier performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differences due to part complexity</td>
<td></td>
</tr>
<tr>
<td>Time aspect</td>
<td>Too many activities conducted late in projects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Request for changes in design late in projects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discuss industrialization early</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hard to reach SQAs</td>
<td></td>
</tr>
<tr>
<td>Internal communication</td>
<td>Responsibility</td>
<td>Internal process development</td>
</tr>
<tr>
<td></td>
<td>Cross-functionality</td>
<td>Three-rings</td>
</tr>
<tr>
<td></td>
<td>Internal design review</td>
<td></td>
</tr>
</tbody>
</table>

4.4.2 Planning of Communication

As a foundation for discussions about the planning of communication, a tool at Scania Purchasing called qMap is used. The purpose of qMap is to prioritize supplier activities, primary audits. The tool is developed as a matrix where the x-axis depends on supplier’s performance and the y-axis depends on part risk. qMap is illustrated in Figure 16. Part risk consists of the knowledge of the technical concept, material complexity, complexity regarding processes and what happens if the part fails in the finished vehicle. The evaluation of supplier’s performance is based on results from audits, number of reports due to poor quality, defective parts per million and supplier escalation. (Scania CV AB J, 2012) The results of qMap determine the frequency of audits of the supplier (Scania Inline e, 2014).
Figure 16 Scania’s qMap. Source: (Scania Inline e, 2014)

During the discussion of qMap and its applicability in focus group session one, it became clear that the tool is used in different ways and can be interpreted differently. Some SQAs argued that evaluation of the supplier’s performance is based on previous experience and the SQA’s judgment and some state that it is only based on number of defect parts and reports due to poor quality. The SQAs also argued that qMap is used to a different extent depending on segment. Nevertheless, all SQAs agreed that there are differences between suppliers in different fields in qMap and that communication with these should differ. In the grey and dotted areas, the focus is on preventive activities, and in the striped area, the activities are more reactive. For an adequate supplier of a part with normal complexity the communication does not have to be as close and intense as for a supplier requiring improvement with a more complex part. According to SQAs in the second focus group, poor communication in the grey area can lead to a more inadequate supplier and that communication with a supplier requiring improvement can help them to become satisfactory. There is no structure of communication with adequate suppliers today. According to SQAs in focus group two, a visit to an adequate supplier can be an inspiration and a knowledge source for future visits at more inadequate suppliers. The SQAs in focus group session one argued that qMap is a good tool for planning visits if they can evaluate the supplier performance on their own experience and judgment. The SQAs in focus group two stated that qMap is a helpful tool to prioritize their work effort between suppliers. However, qMap does not state how to communicate, only how to prioritize.

4.4.3 Communication with Suppliers in the Quality Assurance Process

The discussions about how communication can be improved were bounded. The focus of discussions was on new parts and did not consider supplier selection. Based on the discussion of qMap, there was no further discussion about communication with inadequate suppliers since this is regarded primarily as a responsibility of the reactive organization and that no new orders will be placed on an inadequate supplier. These delimitations are due to time constraints and feasibility for further recommendations.

Communication Connected to the Quality Assurance Process

The stages about which communication was discussed is based on the process of PPAP, see Appendix L Process Map PPAP. In Figure 17, the three chosen stages are marked with arrows. They were selected by the SQAs as three of the most important stages concerning communication. The SQAs in the first focus group session argued that communication with the supplier should start before the supplier is selected. Although supplier selection was precluded from the discussions, this step is important.
According to the SQAs in the first session, it is too late to start communication concerning quality when PPAP starts. In the second focus group, the SQAs argued that they are not a part of that stage and that their work starts when submission requirements are set. Therefore, the first stage discussed is the period between supplier selection and PPAP initiation. The second stage in PPAP discussed is when the supplier is working with PPAP documents since this is the major part of the process. The last stage discussed is when the SQA has made a decision concerning PPAP status, whether it is approved or not.

**Figure 17 Part of PPAP discussed during focus group session. Based on (Scania CV AB i, 2013).**

In stage one, it is important to communicate requirements such as standards and technical specifications, according to the SQAs in session one. It is also important that the supplier communicates its requirements, expectations, and conditions. SQAs in session one argued that the supplier has to understand what the SQA’s role in the process is and that they are going to have continuous communication through the process. Specific PPAP documents that should be handled during this stage are Design Record, Process Flow Diagram and Design FMEA. This is also the stage where underlying processes and second tier suppliers should be investigated. Time plan and deadlines should be communicated here, according to SQAs in the first session. It has to be taken into consideration that it takes a long time to complete the whole PPAP even if not all 18 documents are required by Scania. Therefore, it is important for the supplier to communicate their requirements concerning time plan. It is relevant to discuss cost and who is responsible for financing and inventories. One SQA in focus group two mentioned a good example where the SQA, together with a purchaser, designer and project leader visited the supplier early in the project. Together with the supplier, they gave their input to a process FMEA, which was helpful during the project.

In the second stage the importance and frequency of communication is lower, according to the SQAs in focus group session one. Since communication in the previous stage is more comprehensive and thorough, all expectations and requirements should already be communicated.
Nevertheless, there is continuous status review through this stage. The frequency of these reviews depends on the part risk. A high part risk requires higher frequency, even up to once a week. PPAP documents and activities that are important to communicate in this stage are Initial Process Studies including special characteristics, Process FMEA and Control Plan. According to the SQAs in interview two, the frequency can increase again when nearer to the deadline. The third stage is the least comprehensive when it comes to communication. If the PPAP status is set to approve, the reasons are not often communicated. However, the reasons are communicated if the PPAP is not approved or interim approved. The SQAs in the first focus group interview argued that the supplier is often aware of the reasons if the PPAP is not approved. Suppliers should not submit PPAP documents if there are deviations or low capability in the process. In case of a non-approved PPAP, the SQA and the supplier discuss actions and a new time plan.

**Communication methods**

The focus group interview covered communication methods and appropriate ways to communicate in each stage. In stage one, visits to the supplier are important, according to SQAs in the first interview. Especially when the part is new and complex or the supplier does not have experience of similar parts. Visits are less important if the part is similar to a previous version. Other kinds of face-to-face interaction, such as the supplier visiting Scania, are also preferred in this stage. In focus group session two, one SQA argued that *visits to Scania could be a good opportunity to educate the supplier in for example tools used in Lean production*. It is also a good way to create relationships with the suppliers. The SQAs in the first session agreed that it is always better for face-to-face communication if there is enough time and resources. Telephone can be good to use if there are problems in PPAP, according to the second focus group. The frequency of these telephone meetings decreases with time. In the second stage, the continuous status reviews are often conducted through e-mail and telephone, according to the SQAs in focus group one. Sometimes the SQA visits the supplier just before they start the work with PPAP to see if they have reached consensus. If the supplier is prepared for a visit, they have often progressed further in their work. *The visit is a way to set demands*, according to a SQA in the first focus group. The SQAs in focus group one mentioned specific quality meetings as a useful tool to meet the right people and discuss quality. In stage three, the PPAP approval status is set in the system ePPAP. In cases when PPAP is not approved, it is possible to write a comment concerning the reasons behind the decision. The SQAs in focus group two often call the supplier to prepare them for a rejection of PPAP and to explain the decision.

**Responsibilities**

In the first focus group interview, the SQAs argued that it is important to clarify the responsibilities in communication. The right person from Scania should communicate with the right person from the supplier, for example designer from Scania with designer from the supplier. A well functioning three-ring is essential for clear responsibility in communication. In the first stage discussed, the project purchaser should be involved more, according to the SQAs in focus group one. The purchaser should be present during the discussions concerning time plan. The supplier is responsible for accepting the PPAP request in ePPAP. In the second stage, both supplier and Scania have the responsibility to understand the other organization and the person they interact with. In the last stage, the SQA is responsible for communicating the PPAP approval status and possible comments about the decision. The discussion of communication with suppliers is summarized in Table 8.
Table 8 Summary communication in PPAP.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Content</th>
<th>Communication methods</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Requirements, expectations and conditions</td>
<td>Visits important if part is complex and supplier is new</td>
<td>Greater involvement of project purchaser</td>
<td>Relatively high frequency</td>
</tr>
<tr>
<td></td>
<td>Role and responsibility of SQA</td>
<td>Supplier visits at Scania</td>
<td>Supplier is responsible for accepting PPAP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPAP documents:</td>
<td>Telephone if problems with PPAP</td>
<td>Project purchaser responsible for design reviews</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Design Record</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Process Flow Diagram</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Design FMEA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Underlying processes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time plan and deadlines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost, financing and inventories</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Continuously status reviews</td>
<td>E-mail and telephone for status reviews</td>
<td>Scania and supplier are responsible for understanding each other</td>
<td>Depends on part risk</td>
</tr>
<tr>
<td></td>
<td>PPAP documents:</td>
<td>Sometimes visits just before Significant Production Run</td>
<td></td>
<td>Lower than stage one</td>
</tr>
<tr>
<td></td>
<td>• Initial process studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Process FMEA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Control plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality meetings</td>
<td></td>
<td></td>
<td>Increases close to deadline</td>
</tr>
<tr>
<td>3</td>
<td>PPAP approval status</td>
<td>ePPAP</td>
<td>SQA</td>
<td>Once during the process</td>
</tr>
<tr>
<td></td>
<td>Sometimes reason to rejected PPAP</td>
<td>Telephone if PPAP is rejected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4.4 Follow-up and evaluation

The supplier’s understanding of requirements is stated by both focus groups as an important issue. To ensure understanding of the supplier a design review can be helpful, according to focus group one. Focus group one argued that this is better with face-to-face communication than with telephone. It is also important to discuss time plan and processes; the Process Flow Diagram is an important PPAP document. The SQAs in focus group two stated that they ask questions to verify supplier understanding. Another method mentioned by focus group two is to let the supplier write the summary of the meeting. In that way, it is clear whether the supplier has the same perception as the SQA and other people involved. The SQA can also show the supplier where the part is on the vehicle or engine and its function. The participating SQAs stated that follow-up of communication is not working well today. One SQA argued that PPAP is a kind of follow-up of the process and specifications. SQAs in focus group one argued that the supplier should be responsible for follow-up of activities.
Evaluation of communication is seldom done, according to the first focus group. In larger projects, this is possible. Some use Lessons Learned as a method to discuss and document improvements. Due to time limitations, this is not done to a great extent. There are also problems with changes of employees in the projects. Therefore, there is a risk that information is not passed on. A suggestion of improvement concerning communication in the quality assurance process, from focus group two, is to have gates in the process where follow-up should take place.

4.5 Observation at Supplier Visit

To gain a deeper understanding of how communication is characterized, a visit to a supplier was observed. The purpose of the visit was to follow up the time plan of a project and cover additional issues concerning the project. The supplier is a company that develops and manufactures parts for the automotive industry. It has factories in Europe and South America; in this case, a factory in Sweden is visited. This is where Scania’s part will be developed and produced. The supplier is working with Lean manufacturing and has a focus on continuous improvement. Quality is its highest priority followed by delivery and cost. Participating roles from the supplier at the meeting are presented in Appendix M Observation at Supplier Visit. From Scania, one SQA, one project purchaser and the two authors of this thesis participated. The authors were not active in discussions but observed the communication between representatives from Scania and the supplier. The agenda of the visit is, in brief:

1. Information about the company and the product
2. Visit the production line
3. Visit mock up line
4. Review of preliminary PPAP document
5. Other issues
6. Summary and end

4.5.1 Presentation of Company, Part, and Production

First, the Factory Manager gave a brief presentation about the company and the factory so that everyone was updated and had the same perception of the company. After that, the Industrialization Project Manager presented the part, requirements they have concerning quality and time plans. By so doing, the supplier had an opportunity to present their view on the project. The Industrialization Project Manager presented requirements on quality that are not set by Scania but concern internal work with principles in Lean Manufacturing. Furthermore, the Industrialization Project Manager presented the layout of the production line and explained differences in production between different models of the product. The SQA questioned some aspects of the production line and the supplier had the opportunity to answer and explain. The Industrialization Project Manager further highlighted risks and difficulties in the production line and explained that the plans are not definite. The SQA asked questions to verify points. There was also a discussion concerning quality controls on the production line, in which both the Industrialization Project Manager and Sales Manager were involved. The Lean Coordinator explained issues concerning material handling. After this presentation, the whole group was given a guided tour of the current production line where representatives from Scania were given the opportunity to see it working and to ask questions. Since the production line of the new product was not built yet, a so-called mock up line had been developed. This prototype line was in natural size and built from cardboard boxes. The aim of the mock up line was to visualize what the finished production line would look like and to have workshops with operators and thereby find areas of improvements. The SQA and project purchaser from Scania had the opportunity to evaluate risks with the production line and ask questions about material handling for example.

4.5.2 Review of PPAP Documents

A review of preliminary PPAP documents was also conducted. The Product Quality Assurance, PQA, Engineer presented the Process Flow Diagram step by step and the SQA and project purchaser asked questions if anything was unclear. Some major defects in the Process Flow Diagram were mentioned by the SQA. The supplier argued that they had considered it and explained the reasons. The Process FMEA was too comprehensive to cover during the meeting. Therefore, the PQA Engineer and Industrialization Project Manager only presented the ten most severe risks. During the discussions, the supplier had a prototype to visualize the risks on the product. During a presentation of a drawing, a critical factor was identified. However, this risk is not handled in the FMEA, which according to the SQA is a severe problem. The supplier understood the criticism and stated that the problem would be corrected.
A change in design was mentioned by the supplier as due to a requirement from Scania. This is not something that the SQA was aware of because of a lack of internal communication at Scania. To review the PPAP document took more time than scheduled and therefore the control plan and rest of the process FMEA were not handled during the meeting.

4.5.3 Other issues, summary, and end

After the review of PPAP documents, other issues about the project were discussed. One topic was design and development of the part, which according to the project purchaser from Scania is not relevant at this meeting. Therefore, this issue will be further handled with the object leader at Scania. Changes in the supplier's organization had been made since the last meeting, which were presented to the representatives from Scania. According to the project purchaser at Scania, it is important to assure the same quality if changes in the organization are made. This change could create problems in the future and the project purchaser asked about the plan concerning this change and set a deadline for the submission of the information. Finally, an action plan was reviewed and discussed. The action plan covers issue, possible solution, responsible person, and date when resolution is expected. In this way, the supplier and representatives from Scania can reach consensus. The action plan was sent to all participants after the meeting. There was a discussion about next meeting but nothing booked.

4.5.4 General observations

Some general observations about the visit are that the SQA and project purchaser from Scania already knew some of the representatives from the supplier, which makes the atmosphere more relaxed. The representatives from Scania acted professionally and put pressure on the supplier concerning deadlines and information. They also questioned plans and documents from the supplier and gave them feedback. Both the SQA and the project purchaser were concerned and involved in quality issues. The supplier accepted feedback and seemed to appreciate the input from Scania. They were also professional and showed they had relevant competence about the product and that they could identify risks and difficulties with the processes. Scania has more power in the relationship than the supplier, which is shown in the way they set requirements. Except for the action plan that the Industrialization Project Manager writes, some of the participants took notes for their own use that were not reviewed or shared after the meeting. There is no evaluation or follow-up from previous meetings at the visit. After the visit, a short interview was conducted with the SQA and project purchaser about their opinion of the visit, the questions are presented in Appendix N Interview after Supplier Visit. They both thought that the meeting could be more structured. According to the SQA, it is common that meetings with suppliers located near Scania are less structured because it is relatively easy to solve things that are not covered. Both purchaser and SQA argued that time constraints affected the meeting and that it would be good if there were more time to review PPAP documents. The SQA believed that the meeting was good to put pressure on the supplier to continue with the project. Next time the supplier gets a visit from Scania they know what is expected. The agenda was set by the supplier after a discussion with Scania about issues to cover. The SQA argued that it is important to let the supplier discuss issues that they see as major problems and that Scania needs to listen and try to help them. After the meeting, the action plan will be reviewed and followed-up.
5 CASE 2 VOLKSWAGEN NUTZFAHRZEUGE AG

This chapter aims to describe the situation of quality assurance of purchased parts at Volkswagen Nutzfahrzeuge AG in Hannover. The focus is on communication between the customer and the supplier but partly also internal communication.

This chapter first considers information from standards, presentations, and other documents from Volkswagen Group AG. Secondly, an interview was conducted with a Scania employee, Strategic Developer, with experience from Volkswagen Group AG in order to understand its purchasing and quality department. As a final way to collect information about this case, a visit was made to Volkswagen Nutzfahrzeuge AG in Hannover, Germany. Respondents during these interviews were employees from the quality assurance department and their roles can be seen in Appendix F Conducted Interviews. Before the visit to Volkswagen Nutzfahrzeuge AG, the respondents were informed about the aim of the thesis and visit, the information sent out can be found in Appendix O Visit to Volkswagen. Questions discussed during the visit are presented in Appendix P Questions During Visit at Volkswagen Nutzfahrzeuge. The authors were prepared through a study of internal documents.

5.1 COMPANY PRESENTATION

The Volkswagen Group AG, from now on called Volkswagen, is one of the largest automobile manufacturers in Europe. The group comprises twelve different brands; for example, Volkswagen Passenger Cars, Porsche, Audi, Bugatti, Volkswagen Nutzfahrzeuge, and Scania, where each brand works as its own independent entity (Volkswagen AG a, 2013). Volkswagen started its first production of cars in Wolfsburg, Germany in 1950 (Volkswagen Nutzfahrzeuge a, 2014). Besides production of vehicles, the group also works in other fields e.g. large bore diesel engines for machine and stationary applications, turbo machinery, and compressors. Volkswagen has 572 800 employees and the vehicles are sold in 153 different countries worldwide (Volkswagen AG a, 2013). Volkswagen produces 44 000 vehicles each day, spread over 106 production plants in 26 different countries (Strategic Developer, 2014). Its goal is "to offer attractive, safe and environmentally sound vehicles which can compete in an increasingly tough market and set world standards in their respective class"(Volkswagen AG b, 2013). Volkswagen’s vision is to be in 2018 "the global economic and environmental leader among automobile manufacturers" (Volkswagen AG c, 2013).

5.1.1 PURCHASING AT VOLKSWAGEN

Purchasing at Volkswagen is divided in eight different commodities, where five of these are associated with procurement of parts, raw materials and engines. These are divided into Purchasing metal, Purchasing powertrain, Purchasing electric components, Purchasing interior and Purchasing exterior. The purchasing offices have 4 400 employees who are located worldwide. The organization of purchasing works as a matrix organization, Figure 1B, where all brands are responsible for global purchasing but the offices are under central observation and steering. Common and transparent decisions within the group are taken at the Corporate Sourcing Committee, CSC. A similar structure for the different brands enables communication, cooperation, and commitment among the brands, and allows a common corporate sourcing committee within the Group. Regions, group purchasing, brands, and areas that nominate suppliers together represent the committee (Strategic Developer, 2014). The purchasers are divided into project and product purchasers (Volkswagen Nutzfahrzeuge a, 2014).
The two transporters from Wolfsburg generation 1, transporter model was born in Wolfsburg and was called the "twelve brands of Volkswagen. The first factory was established in Hannover 1956 and took then over the production of Volkswagen Nutzfahrzeuge AG.

14 milestones that are worked through in four years. The process is broken down into activities to a detailed level to enable users to see responsibilities and requirements of documents, market, finance, styling, product, production and suppliers and quality assurance. The nomination of the supplier is done early in the process, which enables more time for changes of product and process. The process is followed-up continuously in order to see if changes and extra effort are needed (Strategic Developer, 2014).

**Figure 18** The organization of Purchasing Volkswagen Group. Source: (Strategic Developer, 2014).

Product emergence process, PEP48, was developed due to changes within the world market, to avoid delays, and secure the production and market launch. The process is shown in Figure 19. Using this, Volkswagen also wants to avoid unnecessary costs and secure profit and survival. The process consists of 14 milestones that are worked through in four years. The process is broken down into activities to a detailed level to enable users to see responsibilities and requirements of documents, market, finance, styling, product, production and suppliers and quality assurance. The nomination of the supplier is done early in the process, which enables more time for changes of product and process. The process is followed-up continuously in order to see if changes and extra effort are needed (Strategic Developer, 2014).

**Figure 19** Product emergence process at Volkswagen. Source:(Strategic Developer, 2014)

### 5.1.2 Volkswagon Nutzfahrzeuge AG

Volkswagen Nutzfahrzeuge AG, Commercial Vehicle, from now on called Nutzfahrzeuge, is one of the twelve brands of Volkswagen. The first factory was established in Hannover 1956 and in 1954 the first transporter model was born in Wolfsburg and was called the "Bully", which belongs to the Transporter generation 1, T1. The first factory was established in Hannover 1956 and took then over the production of the transporters from Wolfsburg (Volkswagen AG d, 2014). The transporter models continue to develop and today the T5 is produced in the Hannover plant. By last year, the factory had produced more than nine million vehicles. Every day, 600 T5s are produced in the plant. In 2015, production will start on the next generation of the transporter, T6. Nearly 12 000 people work at the factory in Hannover and two additionally factories are established in Poland and Brazil (Volkswagen Nutzfahrzeuge a, 2014). The five generations of transporter produced by Nutzfahrzeuge are presented in 20.
Since Nutzfahrzeuge belongs to the brand of Volkswagen and their strategy until year 2018, the brand of Volkswagen should be "among the world's best automakers with regards to customer satisfaction and quality" (Volkswagen AG e, 2013).

20 Five generations of the transporter produced by Nutzfahrzeuge. Copyright: (Press and Public Relations Volkswagen UK, 2008)

QUALITY DEPARTMENT

The department for quality assurance of purchased parts belongs to the quality assurance department of Nutzfahrzeuge, which belongs to the central quality department of Volkswagen, which is responsible for activities such as official audits. The respondents explain that the quality department of purchased parts in Hannover is responsible for assurance of quality of all purchased parts at Nutzfahrzeuge. This includes all activities from suggestions and discussions of supplier nomination, to field problems due to purchased parts that occur when the vehicle is delivered to the customer. The engines and the gearboxes are not produced in Hannover and the responsibility of these parts belongs to the quality department at those production sites. The department of quality in Hannover consists of six sub-departments where five are responsible for quality assurance of parts and one is responsible for projects and coordination. The organization of quality assurance is presented in Figure 21. The most common way of working with development and manufacturing of new parts is that the parts are owned and designed by Volkswagen engineers, who are stationed at Volkswagen’s headquarters in Wolfsburg. When Volkswagen engineers design the part, the supplier can develop sub-drawings to the original drawing, which is not managed by Volkswagen (Volkswagen Nutzfahrzeuge a, 2014).

Figure 21 Organization Chart for quality assurance of purchased parts for Volkswagen Nutzfahrzeuge. Based on (Volkswagen Nutzfahrzeuge b, 2014).

The quality and purchasing department in Hannover have worked separately since about 20 years ago. However, since they still have discussions on the same topics they work together at some level. Purchasing is divided into project and commodity purchasers where the commodity purchasers are situated in Hannover and work closely together with the quality assurance of purchased parts. (Volkswagen Nutzfahrzeuge a, 2014)
5.2 PROCESS AND ACTIVITIES FOR QUALITY ASSURANCE OF PURCHASED PARTS

Communication with potential suppliers starts early in the process, before the supplier is nominated and selected. According to the group of employees working with quality assurance of purchased parts (2014), three or four suppliers that are able to produce the product are selected and presented to the CSC. These are suggested by the purchasing department, and approved by all other departments. The committee categorizes the different suppliers into A, B, and C classification, where A is considered as good, B as not so good, and C as not appropriate for an order. No order is placed on a C classified supplier; to do that would be against the regulations of Volkswagen. The quality department has the right to approve or reject the supplier based on aspects other than cost. Previously, the choice was normally based only on costs and therefore the cheapest supplier was chosen in most cases. Now however, partly because of the increased importance of quality, the choice is considered more carefully and the cheapest is not always selected. Before a supplier is nominated, an audit is performed by the central quality assurance of purchased parts department in Wolfsburg. If the audit is approved then a Quality Technical Requirement, QTR, is done by the quality department. The QTR requires supplier, logistics, engineers and quality to review drawings and the production of the part. The supplier is invited to Nutzfahrzeuge for the QTR. The QTR enables Nutzfahrzeuge to see differences between the offers. Classification related to groups of parts is done before the work with the supplier is started and the engineers in Wolfsburg do this. The QTR is done mostly for critical parts and parts with a long duration in large projects. If the supplier or the part is known to the company, the QTR is seldom done. After these activities, Volkswagen places an order with the supplier (Volkswagen Nutzfahrzeuge a, 2014).

5.2.1 QUALIFICATION PROGRAM NEW PARTS

After the supplier is nominated and the order is placed, the communication with the supplier starts with the Qualification Program New Parts, QPN. This process normally takes two years to complete (Volkswagen Nutzfahrzeuge a, 2014). The QPN is a system for tracking purchased parts and it aims to achieve the agreed quality and the right quantity of purchased parts for a specific vehicle on time for production. The program consists of a standardized procedure that is used throughout Volkswagen and its suppliers. QPN is used for all new parts in new projects, except for standard parts, and new suppliers for existing parts. In some cases, individual parts of a project scope are managed as a product family, to reduce processing effort. Before the QPN starts, Volkswagen prioritizes parts with respect to fixed criteria, which consists of questions that are answered Yes or No by Volkswagen. If all questions are answered with No the part gets Priority 3 which is the lowest priority. In the case of any Yes answers, Volkswagen have to answer additional questions. The part gets the highest priority, Priority 1, if all questions are answered by a Yes (Volkswagen AG f, 2006). The description and impact of the different priorities are further described in Table 9.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1</td>
<td>Important parts that require special monitoring.</td>
<td>Project is jointly evaluated at the production site of the supplier in all phases of QPN after coordination with the part’s manager of the QA department of the customer plant.</td>
</tr>
<tr>
<td>Priority 2</td>
<td>Parts that require general monitoring.</td>
<td>The supplier evaluates all phases of QPN as his own responsibility, at the latest by deadlines provided by the customer.</td>
</tr>
<tr>
<td>Priority 3</td>
<td>Parts where monitoring is not required.</td>
<td>The supplier evaluates all phases of QPN at his own responsibility, at latest by project deadline specified by the customer.</td>
</tr>
</tbody>
</table>

PPA, which is a part of the VDA standard, is conducted during this phase and assured by the quality department. ISO/TS 16949 is also considered by Volkswagen but, according to participants in the interview, the VDA standard is more important in Volkswagen to assure quality of purchased parts. All relevant documentation from Volkswagen needs to be passed down to second tier suppliers, which is a responsibility of the supplier. (Volkswagen Nutzfahrzeuge a, 2014)
Volkswagen does not do any visits to second tier suppliers because it is a requirement for supplier to handle this. Sometimes when a problem has occurred and it is related to the second tier supplier, it is possible for Volkswagen to visit the second tier supplier together with the supplier. (Volkswagen Nutzfahrzeuge a, 2014)

ROUND TABLE ACTIVITY
Seven to eight times during those two years of QPN, a group with representatives from logistics, quality assurance, R&D, and participants involved in the phase from both supplier and customer sit together in a Round Table, RT, meeting. Participants involved in the phase can be for example production, tool planning, after sales, service, or sales (Volkswagen AG g, 2012). The RT meeting lasts around two to three hours and the supplier is invited to Volkswagen (Volkswagen Nutzfahrzeuge a, 2014). The RT activity is illustrated in Figure 22. The RT meetings are on the same time line as the milestones of the PEP displayed in Figure 19. Still, this is only done for critical parts and currently quality assurance employees have one to three parts per person to work with (Volkswagen Nutzfahrzeuge a, 2014). During the RT meeting, topics regarding project contents and objectives are discussed and it gives the organizations the possibility to coordinate and organize such things as reviews or previews. Since it is cross-functional, it is an efficient body involving company and supplier parties and is seen as a factor for success (Volkswagen AG g, 2012).

During the interview with employees from the quality assurance department (2014) it was said that the RT activity was founded and started in 2013, and the employees saw positive outcomes from the activities and the value of meeting each other face-to-face to discuss critical factors and gain understanding of the product and its processes. Unfortunately, this takes a lot of time and effort from the supplier, which they do not always enjoy, but it has to be done for critical parts. Quality department is responsible for the RT activity. Respondents at Nutzfahrzeuge are satisfied with RT because it enables them to see responsibilities and work in a cross-functional way. QPN is widely used for new products where capacities and suppliers are assessed (Volkswagen Nutzfahrzeuge a, 2014).

2-DAY PRODUCTION RUN
The final step of the QPN is a 2-day production run. This is done between OS and SOP, see Figure 19. The 2-day production is done for all parts, this is considered the release process at the supplier and it is very important. Quality assurance employees are responsible for the activity and they look at quality and capacity and do different types of tests (Volkswagen Nutzfahrzeuge a, 2014). They also check the first parts that are produced, where the supplier conducts an Initial Sample Inspection Report (Volkswagen AG h, 2012; Gust-Meinhardt, 2010). The parts are inspected carefully by the supplier and by Nutzfahrzeuge where they have a dedicated measurement room. Durability tests and tests in a climate chamber are also performed, in Hannover. Sometimes and due to resources and time limitations, Nutzfahrzeuge have to rely on the tests conducted by the supplier. This means that the quality department is the last that approves the release. After 2-day production, the supplier gets a red or a green light for approval (Volkswagen Nutzfahrzeuge a, 2014). The approval and release acts as the final confirmation that a part meets the requirements described in the specifications (Volkswagen AG h, 2012). Furthermore, Nutzfahrzeuge does no inspection of incoming products. Measurement reports are mostly done by the supplier and sent to Nutzfahrzeuge (Volkswagen Nutzfahrzeuge a, 2014).
5.2.2 Reactive work with quality assurance

After 2-day production, it is possible to approve mass production of the part. It remains the responsibility of the quality assurance department to work with problems that occur during production or after the product has reached the customer. The same people are also participants when suppliers are escalated due to inadequate quality and substandard processes, which mean that Volkswagen uses its special program formulated to develop suppliers and their ability to produce parts that meet requirements. This means that quality assurance is not only responsible for the preventive quality but also the reactive work relating to quality. Interview respondents stated that normally people who are employed by the quality department tend to stay for a long time in their position; this is because a large knowledge base is necessary for handling the position and the responsibilities (Volkswagen Nutzfahrzeuge a, 2014).

5.2.3 Communication platforms

Different communication platforms are used within Nutzfahrzeuge and Volkswagen. The platforms spread update information between, for example, supplier and buyer organization but it is also used as a tool for internal communication within the firm and group of brands. A platform developed for communication between customer and supplier is the B2B Communication Platform (Volkswagen Nutzfahrzeuge a, 2014). The platform was launched in 2001 to ensure more efficient and transparent cooperation with partners (Volkswagen AG i, 2013) and gives the supplier the ability to download drawings and descriptions of materials etc. (Volkswagen Nutzfahrzeuge a, 2014). The platform enables communication between supplier and firm in order to secure understanding of the part and the process. Through the B2B Communication Platform it is possible for the supplier to request training. According to respondents working with quality assurance of purchased parts, the platform is a good way to keep the supplier updated. Nutzfahrzeuge claims that suppliers are satisfied with the existing systems for communication that are offered (Volkswagen Nutzfahrzeuge a, 2014).

At Nutzfahrzeuge in Hannover there is a special system developed for supplier history, where it is possible for employees to see improvement plans and see reports that are communicated through the system. The general internal communication system is called TEVON and gives employees the ability to see all parts and responsibilities for logistics, purchasing, quality etc. The system is linked to all changes of parts and systems where changes are written. This platform is also linked to the platform of supplier history and B2B communication. According to the interviewed group at Nutzfahrzeuge, it is possible to see if someone from one of the other brands of Volkswagen has visited the same supplier before and what the outcome was. Another communication system that is used in Hannover is a system that holds technical drawings and 3D models of the product. This system is called KVS and is connected to B2B Communication Platform. Another system, called BEON, Bemusterung Online, enables sample inspection online. BEON is used for communication related to first samples from the supplier, who is able for entering data into the system, and for getting final results of the sampling process from Volkswagen. For other cases, this system is not accessible to the supplier but it is possible for the engineers in Hannover to show parts with results within the system to the supplier to further increase understanding. The B2B Communication Platform is used to communicate drawings to the supplier. Normally, Nutzfahrzeuge do not communicate that changes have been made; it is the responsibility of the supplier to be updated with drawings by continuously viewing the platform (Volkswagen Nutzfahrzeuge a, 2014). The communication systems within Volkswagen are described in Table 10.
Table 10 Summary of communications systems within Volkswagen.

<table>
<thead>
<tr>
<th>Name of platform</th>
<th>Description</th>
<th>Used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2B Communication</td>
<td>Enables Volkswagen to communicate and exchange documents, standards, drawings etc. with the supplier.</td>
<td>External communication</td>
</tr>
<tr>
<td>TEVON</td>
<td>Enables employees to see all parts, responsibilities etc. It is the connection between the other platforms.</td>
<td>Internal communication</td>
</tr>
<tr>
<td>BEON</td>
<td>Enables sample inspection online.</td>
<td>Internal communication and external communication</td>
</tr>
<tr>
<td>KVS</td>
<td>Technical drawings are stored, 3D models can be displayed.</td>
<td>Internal communication with possibility for external communication</td>
</tr>
</tbody>
</table>

5.2.4 FOLLOW-UP AND EVALUATION

Evaluation of projects is called Lessons Learned at Volkswagen and is considered part of the QPN system. The method of Lessons Learned is to discuss problems concerning a product and production and the aim is to learn from problems for planning future projects. Discussion of the design of the product and the way it is produced is an important part of the evaluation. Other important topics of Lessons Learned can be viewed in the QPN system before subsequent activity. Furthermore, the evaluation also can be used to categorize parts for future work. This is always related to the experience of the people who worked within the project and their ability to do this kind of evaluation. When start of a new project is considered, a group of people discusses the design of the part and the conclusions from Lessons Learned are taken into consideration. Employees at Volkswagen can look in the B2B Communication Platforms and find out what is relevant to discuss. Often the supplier gets an update about the outcome of the evaluation, and if it is a supplier related problem the supplier is asked to do their own evaluation to investigate different sides of the problem (Volkswagen Nutzfahrzeuge a, 2014).
6 Analysis

The analysis chapter aims to compare results from empirical data and literature. The purpose is to use the outcome of analysis to answer the research questions. The chapter presents a pattern matching and a cross-case synthesis that are conducted for the Literature Review and the studied cases at Scania and Nutzfahrzeuge.

Figure 23 shows the analysis framework that is used throughout this thesis and presented in Chapter 2 as a part of the thesis process seen in Figure 2. This framework is used to analyze the Literature Review presented in Chapter 3 and empirical results, presented in Chapter 4 and Chapter 5. The purpose of this chapter is to present an analysis to answer the third research question, which is presented in Chapter 1. The third research question is concerned with how to improve internal and external communication within quality assurance process of purchased parts in the automotive industry.

![Figure 23 Analysis framework for thesis.](image)

Research question three aims to find suggestions regarding improvements to internal and external communication within the quality assurance process. This is answered through a comparison between literature and empirical results through pattern matching, together with a cross-case synthesis where the two case studies are compared. The structure of the analysis and results are based on the frame of reference presented in Figure 24. The chapter starts with an overall analysis based on the definition of quality and how the studied companies value quality. Thereafter, an analysis is presented on Quality Management Systems, standardized work and the quality assurance process. The PDCA cycle described by Bergman and Klefsjö (2007), Moen and Norman (2006), Petersson et al. (2009), and Summers (2010) is used to describe how quality assurance and communication can be continuously improved. In the Plan phase, factors that are important to consider when entering a process or project are analyzed. The Do phase concerns the implementation of the results from the Plan phase and will not be dealt with in this analysis. The last two phases, Check and Act, are handled together and concern follow up and evaluation that can be used in the next Plan phase. In this way, the cycle contributes to continuous improvement.

![Figure 24 Frame of reference from Literature Review.](image)
6.1 Analysis of Quality Culture

Mak (1999) argues that the importance of quality should be understood by managers and employees in an organization; Vermeulen (1997) discusses how this is important if an organization wants to have a quality culture. Since quality can create competitive advantage and be a means for long-term profitability, it is essential to analyze how quality is valued at Scania and Nutzfahrzeuge. Both organizations value quality highly, as an organizational core value and a goal. The importance of quality is supported through a separate quality department at both Scania and Nutzfahrzeuge. Cali (1992) argues that it is essential to work in a quality-focused environment, which has an effect on how quality is communicated to suppliers. Benton (2014) argues that quality assurance of purchased parts must be consistent with the quality requirement of the customer. Thus, how quality is valued in the organization is important. Table 11 summarizes the analysis that regards understanding of quality in organizations.

<table>
<thead>
<tr>
<th>Literature</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the importance of quality and its competitive advantage</td>
<td>Quality valued high in the organization</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Quality as an own department</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (N) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable

6.1.1 Quality Management System

Bayo-Moriones et al. (2011) describe how QMS can be used to evaluate suppliers, monitor performance, and to write definitions or requirements and specifications. The usage of QMS enables the organization to set requirements for the supplier, which is important in communicating with them since it affects the outcome from them. QMS requires communication through a language that is specified by the customer according to IATF (2008). Different language can, according to SQAs at Scania, cause problems with understanding of requirements. As shown in Table 12, both Scania and Nutzfahrzeuge demand their suppliers use ISO/TS 16949, which is a QMS specific to the automotive industry. Nutzfahrzeuge uses the system developed by VDA as their primary form of QMS. The QMS makes sure that an organization determines and implements appropriate arrangements for communication with customers and internally. Good internal communication affects effectiveness of the QMS.

Standardized Work Methods

During the initial interviews for problem identification and the focus group interviews about communication held at Scania, problems were discussed about how work with quality assurance of purchased parts and communication are performed. Notably differences related to how SQA’s previous experience of the part and supplier affects the work done by the SQA. According to Petersson et al. (2009), it is favorable to have a standard that in detail explains how the work should be conducted. The authors also discuss how standard makes it possible to detect problems with a process. As this analysis also shows, Scania uses different types of standards to achieve a standardized way of working with quality assurance of purchased parts. Literature review shows that it is easier to predict the results, keep track of projects, and find potential problems when the work is based on a standard that explains how it should be done. This enables extra resources to be put on the project to create a rapid change if a problem has occurred. Also found during the interviews held at Scania was that there is no common way to evaluate the complexity of a part. Some input is given from the design engineer but not in all cases. This means that the SQA has to make a judgment on part complexity, related to previous experience of the part and supplier’s performance. This also affects the quality assurance process and the effort put into the project. However, Scania has standardized models, like qMap, which are not utilized in the daily work of the SQA. Based on the authors’ judgment and the empirical results there is a more common way of working at Nutzfahrzeuge, which has a standardized method for classifying parts and suppliers that enables the prioritization of resources used in the organization.
### Table 12 Use of QMS and standardized work methods

<table>
<thead>
<tr>
<th>Literature</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use of QMS</strong></td>
<td>ISO/TS 16949</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>VDA</td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td><strong>Standardized work method</strong></td>
<td>Common way to work with quality assurance</td>
<td>I</td>
<td>Y</td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (No) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable

### 6.2 QUALITY ASSURANCE PROCESS

The quality assurance process used at Scania is PPAP, which is a part of APQP. How communication is conducted in the PPAP process is described in Table 8, Section 4.4. Nutzfahrzeuge uses QPN as their version of PPA, which was developed by VDA. ISO/TS 16949 requires a product and manufacturing process review like PPAP and PPA, according to International Automotive Task Force (2013). The aim of the different quality assurance processes, PPAP and PPA, are similar; to assure and provide evidence of a capable production process and assure that all requirements are understood (DaimlerChrysler Corporation et al., 2006; Verband der Automobilindustrie, 2012). Thus, a quality assurance process has potential to help ensure understanding of customer’s requirements by the way it is developed. One interviewed SQA at Scania argued that PPAP is a kind of communication method itself. Furthermore, QMS facilitates communication since these systems state requirements of communication in order to secure appropriate communication processes, according to ISO (2014).

There are many similarities between the documents required in the different quality assurance processes. Documents that have been identified by SQAs at Scania as important, for example Process FMEA, Control Plan and Process Flow Chart, are a part of both PPAP and PPA. See Appendix B Documents within PPAP for documents in PPAP and Appendix C Documents within PPA for documents in PPA. Based on this, there is nothing that suggests that one or other quality assurance process is more appropriate.

### Table 13 Analysis of Quality assurance process

<table>
<thead>
<tr>
<th>Literature</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality assurance process</strong></td>
<td>PPAP</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>QPN (PPA)</td>
<td></td>
<td>Y</td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (No) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable

### 6.3 PLAN PHASE

This section presents a comparison between literature and the two case studies of factors that need to be considered in the Plan phase of communication in the quality assurance process. First, there is an analysis of parameters in communication and then limitations that needs to be considered.

#### 6.3.1 PARAMETERS OF COMMUNICATION

Table 14 illustrates an analysis of parameters of communication presented by Mohr and Nevin (1990) and how these parameters are represented at Scania and Nutzfahrzeuge.

**FREQUENCY**

Table 14 shows the differences between the two cases in terms of the parameters of communication presented in the Literature Review. Concerning frequency, both Scania and Nutzfahrzeuge are able to use different methods to categorize suppliers and parts, and thereby prioritize the communication. Previous experience of the quality engineer has an impact on the classification of the supplier or part, which in turn affects the frequency of communication. Limitations that affect prioritization are further discussed in Section 6.3.2.
As Mohr and Nevin (1990) argue, a certain amount of communication is necessary but too much can overload organizations. Bayo-Moriones et al. (2011) state that frequent and timely communication is essential to assure the perception of expectations and requirements from the customer. According to SQAs at Scania, it is important that the supplier fully understands the requirements early in the process. Sharma and Patterson (1999) argue that strong communication skills are needed to ensure supplier understanding. Therefore, communication should start early and be frequent. However, this is not the case at Scania today, according to respondents in focus group interviews, too many activities are conducted late in the process. At Nutzfahrzeuge the process starts early, even before the supplier is nominated. RT meetings are conducted at relevant milestones during the process, see Figure 19. SQAs at Scania argue that evaluation can be conducted at different gates or milestones in the quality assurance process.

**DIRECTION**

At Scania, communication is both unidirectional and bidirectional. The design reviews enable several functions to give their input concerning a part, which makes this method bidirectional. RT meetings at Nutzfahrzeuge are also bidirectional. Harrison (1996) describes how reviewing the design together with the supplier is important to assure that the supplier understands requirements. Communication of requirements is primarily unidirectional. The same goes for understanding the supplier’s concept and the limitations the supplier might have. With a compliance matrix, understanding can be assured and customer and supplier can reach consensus. At Scania, it was stated that it is important to find the right person from the supplier to communicate with. Three-rings or other communication with purchasers or other functions at Scania and Nutzfahrzeuge cannot be defined as unidirectional or bidirectional since it is a horizontal, internal communication. This kind of communication will further be defined as internal communication. According to Carr and Kaynak (2007), well-functioning internal communication is essential for conducting good external communication. This is something that has also been stated by interviewed SQAs at Scania. One major difference between the two cases is the organization of quality assurance. At Scania the SQAs belong to the purchasing department and have a close collaboration through the three-rings on a daily basis. At Nutzfahrzeuge the quality assurance of purchased parts belongs to the quality department and is separated from the purchasing department. This can have an impact on internal communication.

**MODALITY**

According to ISO (2008), management should ensure that there are appropriate communication processes within the firm. Mohr and Nevin (1990) argue that ineffective communication can lead to misunderstandings and frustration among involved parties. Therefore, it is important to use the appropriate method at the right time. Both formal and informal methods are used at Scania and Nutzfahrzeuge. Formal communication is mainly conducted through information technology. Both companies have computer-to-computer aided systems to enable easy communication with suppliers; ePPAP at Scania and B2B Communication Platform at Nutzfahrzeuge. These systems have similar functions for the communication of quality issues, even though it seems that Nutzfahrzeuge’s platform has a larger range of possibilities than Scania’s. Carr and Kaynak (2007) state that information technology enables customer and supplier to communicate more frequently. However, Larson and Kulchitsky (2000) argue that these methods have lower richness and are not to replace traditional methods. Informal communication is conducted mainly in stage one and two discussed in PPAP, see Figure 17 in Section 4.4. Methods used are visits, meetings, and telephone and also formal communication through e-mail. SQAs at Scania argued that visits are more important early in the process and if the part is complex or the supplier does not have previous experience of similar parts. They further argued that the supplier can visit Scania and that this is a good way to educate them. Due to lack of time and resources, telephone is an appropriate communication method, according to SQAs at Scania. At Nutzfahrzeuge, informal communication is conducted frequently in the process through RT meetings, which are a kind of face-to-face communication where all parties affected by the project are invited. Scania has a similar working structure with for example three-rings and design reviews, but some people, for example SQAs, are not always invited to the design reviews. Harrison (1996) argues that reviewing the design together with the supplier is a way to avoid conflicts and assure understanding from both parties. It is supported by researchers such as Carr and Kaynak (2007), Fulk and Boyd (1991) and Larson and Kulchitsky (2000) that face-to-face communication through meetings and visits is the most important communication method.

**CONTENT**

Most of the information that is communicated from both Scania and Nutzfahrzeuge is direct, for example standards, requirements, time plans, and documentation in PPAP and PPA. At Scania, SQAs stated that there is lack of trust of second tier suppliers and that this makes standards more important.
This content aims to change behavior rather than beliefs and attitudes. However, communication that aims to improve the supplier's performance can, in a long term, change the quality mindset of the supplier. Mak (1999) and Vermeulen (1997) both state that the employees in an organization must understand the importance of quality to be able to create a quality mindset. Therefore, it is difficult for customers such as, Scania and Nutzfahrzeuge in this case, to use an indirect communication strategy. Differences in content between the two cases are due to different quality assurance processes, which are further discussed in Section 6.2.

Table 14: Analysis of parameters of communication.

<table>
<thead>
<tr>
<th>Parameters in literature</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>Method for classification of supplier</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Amount of communication</strong></td>
<td>Method for classification of part complexity</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Method for prioritization</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Communication connected to time plan</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Start communication early</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Direction</strong></td>
<td><strong>Unidirectional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unidirectional</strong></td>
<td>Communicate with right person at supplier</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Bidirectional</strong></td>
<td>Supplier's understanding of requirements</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td><strong>Bidirectional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross-functional meetings in the organization or with supplier</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Internal communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration with purchasing department</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td><strong>Modality</strong></td>
<td><strong>Formal methods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Formal and informal methods</strong></td>
<td>Advanced communication system</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>E-mail</td>
<td>I</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td><strong>Informal methods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telephone and visits</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Cross-functional meetings</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td><strong>Direct strategies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Direct and indirect influence strategies</strong></td>
<td>Standards and requirements</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Underlying processes</td>
<td>I</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Time plan</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Roles and responsibilities</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Documents from PPAP/PPA</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Approval status</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Cross-functional meetings</td>
<td>I</td>
<td>Y</td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (No) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable
6.3.2 Limitations

Limitations in projects presented by Tonnquist (2012) and additionally limitations found in the case studies are presented and analyzed in Table 15. The limitations in Tonnquist’s (2012) project triangle are similar to Scania’s competitive priorities, quality, cost, and delivery where delivery depends on time. It is clear from the competitive priorities that quality has the highest priority. These are supported by the evaluation criteria presented by Sadeghi et al. (2012) and Tomaru et al. (2013). This means that cost and delivery time are put aside if there is a risk of poor quality. Even though quality in the project triangle represents quality of the work, this can be defined in practice as quality of purchased parts. Concerning Nutzfahrzeuge, they do not have as many parts per quality engineer as Scania. This enables them to put more effort into each part and the time aspect is put at less risk when quality problems occur. SQAs at Scania expressed their perception of time constraints. Competence can be seen as a resource and can be a limitation in projects. Due to frequent changes of employees, mainly purchasers, at Scania it is difficult to reach consistency, which affects the communication with supplier. Additionally, the SQAs competence and cross-functionality is found to be an important issue in the quality assurance process, see Section 4.2. At Nutzfahrzeuge, neither consistency nor cross-functionality are mentioned as a major problem. Tonnquist (2012) argues that prioritization is important for planning the project. How these limitations are handled in practice is primarily through the prioritization of suppliers and parts at each company, as presented in the case studies in Chapter 4 and Chapter 5 and in Table 15.

Table 15 Limitations that affects communication in the quality assurance process.

<table>
<thead>
<tr>
<th>Limitations in literature</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible to have well-functioning communication with all suppliers</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Perception of time constraints</td>
<td>Y</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Priority of delivery-time in organization</td>
<td>Y</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority of cost in organization</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Consistency in projects, employee turnover purchasing</td>
<td>I</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Employee competence</td>
<td>I</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority of quality in organization</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (No) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable

6.4 Check and Act Phase

This section presents a comparison between literature and cases concerning factors that need to be considered in the Check and Act phase of the PDCA-cycle. Since these phases are not covered well by the literature review in this thesis, there will be a cross-case analysis presented in the table below.

In Table 16 is a comparison of methods for follow-up and evaluation between Scania and Nutzfahrzeuge. The table presents results of what the both organizations do regarding Check and Act in the PDCA-cycle. Check and Act phases are analyzed together because the empirical findings show that these two can be handled as one. Since during the interviews the Check and Act phases mostly covered follow-up and evaluation of quality assurance and communication within it, this phase is from now on called Follow-up and Evaluation.

Table 16 shows that there are similarities and differences between Scania and Nutzfahrzeuge when considering follow-up and evaluation. Firstly, Scania sees the PPAP process as a method for evaluation of supplier’s understanding of requirements since the supplier is required to think through and archive documents concerning part and production. The same philosophy is also used within PPA, used by Nutzfahrzeuge, which is seen as a way to evaluate projects continuously. More about this analysis is seen in Section 6.2. During the supplier visit, see Section 4.5, leading questions are asked by Scania representatives of the supplier in order to evaluate whether the supplier understands requirements set by Scania.
This follow-up concerns supplier understanding of requirements from the customer and a way to ensure that both parties understand everything. At Nutzfahrzeuge, evaluation is included in the QPN system. Within the system, it is possible to find relevant topics to discuss; for example, the part and how it is produced. If any problems have occurred during the process it is possible to track them and raise the problem when Lessons Learned is conducted. According to ISO (2008), feedback is important if nonconforming products have been delivered.

The difference between Scania and Nutzfahrzeuge is that Nutzfahrzeuge makes more use of the outcome of evaluation for categorization of future parts and suppliers. The evaluation is also a part of the startup for a new part purchased from suppliers or produced in-house. This shows that Nutzfahrzeuge have a consistency in their way of working that is missing in Scania’s. At Scania, Lessons Learned is only conducted in large projects but evaluation of communication is not a part of it. The empirical data shows that Lessons Learned is not performed due to lack of time and other resources, which is discussed in Section 0. It is also possible for the supplier to see the outcome of Lessons Learned from Nutzfahrzeuge. If problems with the evaluated project are related to the supplier, it is asked to conduct an evaluation of its own in order to get different perspectives of the same problems. This also shows a difference between Scania and Nutzfahrzeuge. At Nutzfahrzeuge there is a common way of working with evaluation and follow-up, where problems are tracked and avoided in subsequent projects.

Table 16 Analysis of methods for follow-up and evaluation.

<table>
<thead>
<tr>
<th>Follow-up and Evaluation</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPAP/PPA for evaluation</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Follow-up supplier’s understanding</td>
<td>Y</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Evaluation of communication</td>
<td>I</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Lessons Learned for large projects</td>
<td>I</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Use of evaluation outcome</td>
<td>I</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Supplier takes part of evaluation</td>
<td>No</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Supplier conduct their own evaluation and share results</td>
<td>No</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (No) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable

6.5 Supplier Collaboration

Supplier collaboration is connected to all phases in the PDCA-cycle. This is mostly affected by the channel conditions presented in Literature Review. These channel conditions are analyzed in this section.

In Table 17 there is a comparison between conditions, presented by Mohr and Nevin (1990), related to supplier collaboration for Scania and Nutzfahrzeuge.

Structure

As is seen in Table 17, both Scania and Nutzfahrzeuge strive to have a relational structure with their suppliers. They have both confirmed that they have joint planning internally and with suppliers. Audits, meetings, and advanced communication methods such as computer-to-computer links are all evidence of a relational structure. According to Mohr and Nevin (1990), high interdependence between parties and shared activities, along with a vision of long-term collaboration are all aspects of a relational structure since it enables all parties to communicate with each other. Nutzfahrzeuge has, besides the discussed factors, a system for evaluation, see Section 6.4, which also affects the collaboration between customer and supplier so that they try to improve themselves for future cooperation. Mohr and Nevin (1990) argue that in a channel with high trust, more frequent communication is needed. Wagner and Krause (2009) state that the relationship will be stronger if interactions between customer and supplier are more frequent.
CLIMATE

Table 17 shows that both Scania and Nutzfahrzeuge have their own quality departments, which demonstrates that quality are an important aspect for both. Seen during the supplier visit was that Scania’s supplier values quality highly also, see Section 4.5. At Scania, quality is one of their core values and at Nutzfahrzeuge quality is a part of Volkswagen's strategy for 2018, which also affects them since they are supported by the central quality department of Volkswagen regarding for example supplier’s performance. In Scania’s strategy for 2013, it is stated that they should challenge the suppliers in order to achieve higher quality. In both cases, the firms trust suppliers to handle PPAP and PPA and also to assure that they set requirements and assure second tier suppliers, which is supported by the literature where Srinivasan et al. (2011) and Cao et al. (2010) highlight the importance of long-term relationships and common targets and objectives. Sharma and Patterson (1999) argue that well-functioning communication fosters trust and develops long-term relationship. Cali (1992) states that in a quality focused environment, the customer wants to help the supplier to improve and develop and sees the supplier as a customer with needs as well. This can be seen as a supportive climate. The climate at Scania shows a supportive management where responsibilities are given to the three-rings for introduction of new products, parts running in production, and quality assurance of processes and parts. Three-rings enables a tight relation between quality and purchasing that together maintain contact with related suppliers. The climate at Scania is considered supportive. Since no supplier visit is made to a supplier of Nutzfahrzeuge, no further analysis can be made upon the findings from the case study conducted.

POWER

No deeper studies have been made on the last condition for supplier collaboration, power. During the supplier visit, the authors of this thesis saw that requirements are set by both Scania and the supplier, which indicates that the power is symmetric and there is a balance between the power of Scania and the supplier. The main difference that can be seen between Scania and Nutzfahrzeuge is that Nutzfahrzeuge takes no responsibility for second tier suppliers. Requirements are set from Nutzfahrzeuge to supplier and after that the supplier needs to set requirements to the second tier supplier. Nutzfahrzeuge can be seen as supportive if there are any problems, otherwise the responsibility always belongs to the supplier to handle and assure quality from second tier suppliers. Scania also requires their suppliers to set requirements to second tier suppliers, but the system is not as developed as it is for Nutzfahrzeuge, which means that Scania do not have the same power to set those requirements on the suppliers and second tier suppliers. Groocock (2000) argues that a powerful customer has more control over the supplier and the quality of their parts. Therefore, companies in the automotive industry could benefit from having a bit more power than their suppliers.
### Table 17 Analysis of supplier collaboration based on three different conditions.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Empirical results</th>
<th>S</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td><strong>Relational</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relational or market</td>
<td>Collaboration with purchasing department</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Audits and visits</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Communication platforms</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Cross-functional meetings</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Follow-up and evaluation</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Climate</strong></td>
<td><strong>Supportive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supportive or unsupportive</td>
<td>Quality department</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Quality valued high</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Collaboration with purchasing department with responsibilities</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Supplier’s responsibility of PPAP/PPA documents</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Supplier is responsible for second tier suppliers</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Supplier values quality</td>
<td>Y</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td><strong>Symmetrical or Asymmetrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symmetrical or Asymmetrical</td>
<td>Requirements are set by organization to supplier</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Requirements are set by supplier to organization</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Requirements are set by supplier to second tier supplier</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

*(S) Scania, (N) Nutzfahrzeuge, (Y) Yes/exist, (N) No/do not exist, (I) Requiring improvement, (N/A) Not Applicable*
6 Analysis
7 RESULTS AND RECOMMENDATIONS

The purpose of this chapter is to present the results of the thesis based on conducted analyses. Further, recommendations based on the thesis results, concerning communication in the quality assurance process, are given to companies in the automotive industry.

7.1 RESULTS

One of the major results of this thesis is the problem identification presented in Section 4.3. These areas are SQA’s competence, communication, supplier’s competence, supplier’s quality mindset, time aspect and internal management and organization. This answers research question two and shows what issues have an impact on the quality assurance process of purchased parts and gives an indication to companies on what to improve. Since the thesis focuses on communication there are no findings concerning other problem areas. The result is based on the analysis of empirical results and literature review.

Literature shows that a quality culture and mindset is important to sustain high quality and the competitive advantage that comes with it. In both case studies, quality is valued highly and there is a separate quality department. This indicates that the studied cases have a strong quality culture and understand the importance of quality. In the analysis of QMS and quality assurance processes there are some differences between the two cases. However, the results give no indication that one of the QMS or quality assurance processes is more appropriate than the other. However, standardized work methods are shown to be important in order to find a common form of prioritization and a better method to identify problems or deviations in the process.

As regards parameters of communication, the four parameters presented by Mohr and Nevin (1990) can be identified in different extent in the empirical results. Concerning frequency, it is shown that what needs to be considered is not only the amount of communication but also the timing. Internal communication is stated by both literature and respondents in the case studies to be essential for well-functioning communication. Therefore, this together with responsibility is suggested to be a part of decisions about direction. Modality and content should consist of formal and informal methods and direct and indirect strategies. However, some methods are preferred in some situations, which are further discussed in the recommendations presented in Section 7.2. Limitations affect communication in the quality assurance process and thus have to be considered. To maintain competitive advantage in the tough global market, quality should have the highest prioritization. It has been stated by many respondents that there are time constraints in the quality assurance process and this must be considered in the planning phase. Resources not only consist of cost, it is shown that projects depend on consistency in competence. Therefore, competence is presented as an important resource.

Follow-up and Evaluation is shown to be important and applied differently in the two cases. For continuous improvement in the quality assurance process and communication with suppliers, the results need to be evaluated and communication followed-up. The Literature Review does not give any indication of how this can be conducted, but results from case studies shows that Lessons Learned can be a useful method, and that this should be implemented in daily work. Additionally, the results from evaluation must be used in order to improve quality and the quality assurance process.

Concerning channel conditions, this is difficult to analyze due to the scope of this thesis. However, the results indicate that a relational structure is preferable in a quality assurance process. This is supported by cross-functionality, joint planning, shared activities, and long-term relationships etc. A supportive climate is preferable, which includes good leadership and trust in employees. Power is the most difficult channel condition to evaluate, due to lack of information about this area. Balanced power is appropriate since both supplier and the company have requirements and the supplier should be seen as a customer who needs information as well. Nevertheless, the result from the Literature Review indicates that the customer, in this case Scania and Nutzfahrzeuge, should have a bit more power than the supplier in order to better control the quality of purchased parts.
7.2 Recommendations

Based on the results of the analysis in Chapter 6, recommendations for quality assurance of purchased parts are developed that companies in the automotive industry might benefit from. Table 18 presents these recommendations. From interviews at Scania and Nutzfahrzeuge, it is clear that the quality assurance process and communication within it differ depending on the part complexity, supplier performance and the previous experience of the quality engineer. Therefore, it is difficult to give specified recommendations for each case. However, a prioritization model can be based on these factors that affect communication in the quality assurance process, for example qMap at Scania. Using such a tool, these differences are taken into consideration.

**Table 18 Recommendations**

<table>
<thead>
<tr>
<th>Parameters of communication</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>• Use a prioritization model to determine appropriate frequency of communication.</td>
</tr>
<tr>
<td></td>
<td>• Start communication early in the quality assurance process to assure that the supplier fully understands requirements.</td>
</tr>
<tr>
<td>Direction</td>
<td>• Participate in cross-functional meetings.</td>
</tr>
<tr>
<td></td>
<td>• Find the right person to communicate with from the supplier.</td>
</tr>
<tr>
<td>Modality</td>
<td>• Improve internal communication and cross-functionality.</td>
</tr>
<tr>
<td></td>
<td>• Use advanced communication methods for frequent communication, both with supplier and internal, rather than e-mail.</td>
</tr>
<tr>
<td>Content</td>
<td>• Visits and audits are appropriate early in the quality assurance process.</td>
</tr>
<tr>
<td></td>
<td>• Use a prioritization model to determine where visits should be made.</td>
</tr>
<tr>
<td></td>
<td>• Use standards and QMS as a support in communication.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>• Use a prioritization model to prioritize time and effort between suppliers and parts.</td>
</tr>
<tr>
<td>Resources</td>
<td>• Consider competence as a resource in a project and try to keep competence consistent through the project.</td>
</tr>
<tr>
<td>Quality</td>
<td>• Cost should have the lowest priority.</td>
</tr>
<tr>
<td>Quality should have the highest priority.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow-up and evaluation</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lessons Learned</td>
<td>• Develop a method for continuous evaluation of the quality assurance process and communication.</td>
</tr>
<tr>
<td></td>
<td>• Make evaluation a natural part of the quality assurance process.</td>
</tr>
<tr>
<td></td>
<td>• If needed, use the prioritization model to determine which projects to evaluate.</td>
</tr>
<tr>
<td></td>
<td>• Use the outcome of the evaluation to improve suppliers and internal performance that concerns quality.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier Collaboration</th>
<th>Channel conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>• Strive for a relational structure with long-term relationships and joint activities to improve supplier performance.</td>
</tr>
<tr>
<td>Climate</td>
<td>• Retain and manage the supportive climate with quality as a core value, both internal and in the supply chain.</td>
</tr>
<tr>
<td>Power</td>
<td>• Use power to control quality of purchased parts.</td>
</tr>
<tr>
<td></td>
<td>• Show respect to the supplier’s needs and requirements.</td>
</tr>
</tbody>
</table>
7.2.1 MANAGING QUALITY CULTURE

Researchers state that quality can help companies achieve competitive advantage and long-term profitability. It is therefore essential to understand the importance of quality and create a quality culture. This can be done by valuing and prioritizing quality and having a separate quality department that gives these issues focus and special resources. It is shown in the results of this thesis that it does not matter which QMS or quality assurance process is used, as long it is handled in the best possible way and continuously improved. Both QMS and quality assurance processes are an appropriate base for a standardized way of working and a support to requirements on suppliers. With this foundation there is potential for continuous improvement to the quality assurance of purchased parts.

7.2.2 PLAN PHASE

Recommendations are made for the Plan phase about parameters of communication and limitations.

PARAMETERS OF COMMUNICATION

In order to have an appropriate frequency of communication, a prioritization model that considers supplier performance and part complexity should be used; for example, qMap at Scania and as presented in Section 4.4.2. More complex parts and inadequate suppliers require higher frequency communication in order to maintain required quality while an adequate supplier with a less complex part can be overwhelmed if frequency of communication is too high. It is also necessary to start communication early in the quality assurance process, preferably before the supplier is selected, in order to ensure understanding of the requirements from both customer and supplier. Thus, too many activities late in the project can be avoided.

By participating in cross-functional meetings, both internal and with suppliers, important input is given to the quality engineer that is helpful for requirement setting and future work with the part. This also has potential to improve internal cross-functionality. By communicating with the right person from the supplier, understanding can be reached and communication can be more efficient. Thus, responsibilities should be set internally. Internal communication is essential in order to have a good communication with suppliers. Therefore, this should be improved through, for example, improved advanced communication systems like TEVON at Nutzfahrzeuge, presented in Section 5.2.3. An improved advanced communication method can also be useful for frequent communication with suppliers and is more structured and user-friendly than e-mail systems since information can be sorted and available to more people.

The mentioned prioritization model can be used to determine which suppliers should be visited, since it is difficult to visit all suppliers due to time constraints. Critical parts should have higher prioritization when it comes to visits. However, it is important not to forget to visit adequate suppliers with less critical parts. They also have potential to improve or can be an inspiration for collaboration with other suppliers. Since visits are considered a rich communication method, where requirements can be communicated and feedback given, these should be placed early in the quality assurance process, preferably before the supplier starts working with the required documents. Standards and QMS provide an appropriate foundation of requirements on the supplier. This also contributes to a standardized way of working.

LIMITATIONS

Since there are time constraints that affect the quality assurance process, the mentioned prioritization model can prioritize effort between parts and suppliers, as it has been stated. Effort is focused on the most relevant projects. To avoid problems due to changes of employees in projects, competence should be considered as a resource when planning a project. Knowledge must be passed on to replacements. Cross-functionality is also essential in order to maintain a required level of competence in the organization overall. Cost should be subjugated to quality and time when it comes to quality assurance of purchased parts. Quality itself has potential to increase profitability and customer satisfaction for a company and is often a competitive priority that should be implemented in the purchasing function.

7.2.3 FOLLOW-UP AND EVALUATION PHASE

As is seen in the analysis of the Check and Act phase, see Section 6.4, it is important for the companies operating within the automotive industry to have a method for follow-up and evaluation of projects and communication within quality assurance process of purchased parts. Evaluation should be a natural part of the process with the aim of continuous improvement and less defective purchased parts delivered from the supplier.
7 Results and Recommendations

Follow-up should be seen as a method to keep track of projects and be a part of a standardized way of working with QMS, presented in Section 6.2. This makes it possible to detect problems early and, through internal and external communication, facilitate action to get the project on track and assure delivery on time. A recommendation is also given for final evaluations in order to learn from problems and success stories and to give insights to future projects. Including the supplier in evaluation is recommended in order to improve their performance regarding quality assurance. Follow-up and Evaluation is then seen as the end of the cycle presented in Figure 24 where the outcome affects the Plan phase of subsequent projects. Depending on how outcome is evaluated relative to supplier performance and part complexity, the Plan phase will be affected regarding the parameters of communication and limitations, as analyzed in Section 0.

7.2.4 Supplier collaboration

The first recommendation is to strive to have a relational structure with suppliers, which requires internal communication and cross-functionality. It is important to have common activities and joint planning with suppliers. The analysis, presented in Section 6.5, shows that audits and visits are important factors for a good relation with suppliers. Advanced communication methods are helpful tools to maintain daily communication that does not have to be face-to-face or telephone communication. Evaluation should also be used as a method to improve relation and collaboration with suppliers, see Section 7.2.3.

The second recommendation is that the climate should be supportive both internally and within the supply chain. When quality is one of the organization’s core values it enables understanding of the importance of quality among the whole organization, which should also affect the selection of supplier based on the supplier’s position on quality. During the first analysis of the Scania case, see Section 4.3, supplier’s quality mindset was one of the identified problems. It is important for organizations operating within the automotive industry to find suppliers that value quality in a similar way to themselves.

As a final recommendation regarding supplier collaboration, the organization should use its power to control quality of purchased parts. At the same time, it is important to remember that the supplier has expectations and requirements. This is a way for collaboration to reach a common goal and to strive for continuous improvements. Requirements should be respected and fulfilled by both parties, which means that mutual strengthening of the requirements are necessary.

7.2.5 Short-term and Long-term recommendations

Many of the recommendations are based on the assumption that there is a developed prioritization model that is used when planning for communication. Thus, this model should be developed in the short-term. Internal communication, such as Direction in Plan phase and Follow-up and Evaluation phase, is an essential factor for communication with supplier, and recommendations that concern this should be handled on a short-term basis. Other recommendations can be handled when there is enough available time and resources to implement them properly. Long-term recommendations mostly concern channel conditions that imply changes in behavior and attitudes. This can take a long time to change but to strive for it is important. Another long-term recommendation is to consider other identified problem areas such as internal management and organization or SQA’s competence. The prioritization analysis in Section 4.3.2 can be helpful when addressing these problems. Possibly, the prioritization analysis can be updated if relevant conditions are changed. Suggestions for further research are presented in Section 8.2.4.
8 Conclusions and Discussion

The purpose of this chapter is to answer the aim and research questions of this thesis. The chapter also aims to present a discussion about the results and trustworthiness of the thesis. Further, suggestions for further research are given.

8.1 Conclusions

The aim of this thesis was to contribute to increased understanding concerning quality assurance processes conducted at companies operating in the automotive industry. Further suggestions regarding improvements for quality assurance of purchased parts will be developed, with the long-term goal to reduce the number of deviations on delivered parts. The aim was based on three research questions, which are developed and presented in Section 1.3.1, are based on a problem discussion presented in Section 1.2. In this section, the three research questions are answered based on the results from the thesis.

RQ 1: How can quality assurance of purchased parts be characterized?

In the Literature Review in Chapter 3, relevant theories concerning quality assurance of purchased parts and related areas are presented. The focus of the Literature Review is on communication due to its importance as identified in the initial problem identification, see Section 4.2 and Section 4.3. The Literature Review results in the theoretical frame of reference model, see Figure 8 in Section 3.7. This model helps to answer research question one since it presents theories and methods that can be used to describe the quality assurance process of purchased parts and to continuously improve the process and communication associated with it. In order to understand how quality assurance is managed in the automotive industry, a multiple case study at two companies in Volkswagen Group AG, Scania and Nutzfahrzeuge, was conducted. Data was collected through interviews, focus group interviews, and observations. Chapter 4 and Chapter 5 presents the empirical results from the two cases where quality assurance processes are described as well as issues that influence the process. The Literature Review and empirical results are compared to each other in a pattern-matching analysis that is presented in Chapter 6. Thereby, research question one, concerning how quality assurance of purchased parts can be characterized, has been answered.

RQ 2: How can problem areas within quality assurance of purchased parts be characterized?

Through initial interviews with SQAs at Scania, six major problem areas were identified as communication, SQA's competence, supplier's competence, supplier's quality mindset, time aspect, and internal organization and management. These are presented in Section 4.2 and are further analyzed in Section 4.3 using a relationship analysis and a priority analysis. The priority analysis shows which problem areas have the greatest impact on quality assurance and potential to be improved. It is shown that communication is an important aspect in the quality assurance process and this area is therefore investigated further in both cases.

RQ 3: How can communication within quality assurance of purchased parts be improved?

The result from the analysis in Chapter 6 is based on the theoretical frame of reference with input from empirical results. This is the basis of recommendations to companies in the automotive industry on how to improve communication within quality assurance process of purchased parts, which are presented in Section 7.2. The result shows that QMS and quality assurance processes are a good foundation for communication and a standardized work method. The recommendations further suggest that important factors that concern communication should be a part of the Plan phase and then implemented in the quality assurance process. These factors concern frequency, modality, direction, content, and limitations. Internal communication and cross-functionality are essential in order to have a well-functioning external communication with the supplier and should therefore be improved. Follow-up and evaluation is important for continuous improvement and the results should be considered in the next Plan phase. By following an improvement cycle, communication and quality assurance can be continuously improved.
8. Conclusions and Discussion

8.2 Discussion

In this section, a discussion concerning the thesis’s results and trustworthiness is given. Additionally, there are suggestions for further research areas presented in this chapter.

8.2.1 Generalization and Meaning of the Study

In Section 8.1, the answers to the aim and research questions are presented. The answers are based on a comprehensive literature review and a multiple case study. Researchers have mentioned purchasing as a strategic function with high impact on a company’s overall performance and profitability. It is also stated that collaboration within the supply chain is essential since competition now often concerns suppliers as well as customers. Quality on purchased parts thus has an important role in quality delivered to the customer. In the automotive industry, competition is tough and quality often considered as a competitive advantage. Therefore, quality assurance of purchased parts is considered important to study. During the work on this thesis, it has been shown that there is lack of research in this area. This thesis thereby contributes with a description and discussion of quality assurance of purchased parts. Due to tough competition, continuous improvement to quality and customer satisfaction is important, and this thesis describes how to improve continuously the quality of purchased parts through communication.

Communication is important in all organizations and supply chains and does not affect only quality. Other areas that have been identified as important in this thesis, for example competence, time aspects, and internal management and organization, can be affected and improved by communication. The results of the thesis suggest that internal communication should be improved and that a standardized way of working should be implemented. This can improve the internal management and organization and time aspects. Focus on cross-functionality can improve the overall competence in an organization.

The results and recommendations of this study are developed for a company in the automotive industry. However, the authors believe the result can be adapted to other industries. Quality assurance is, for example, a well-known term in the health care industry. The biggest obstacle is that ISO/TS 16949 and quality assurance processes such as PPAP and PPA, which are presented in this thesis, are developed by and for the automotive industry. Therefore, similar systems and processes need to be found or developed for other industries.

Sustainable development has increased its importance in the supply chain and researchers argue that this area needs to be considered when handling suppliers. The results of this thesis do not show how this can be done. Nevertheless, it is possible to evaluate factors that have an impact on sustainability in connection with the quality assurance process. Since this has not been explored there are no further recommendations concerning sustainable development.

Research has shown that quality can lead to employee satisfaction. To work within an improved quality assurance process will also improve internal communication and efficiency of working. The results of this thesis therefore have potential to increase employee satisfaction in the organization if implemented.

8.2.2 Discussion of the Thesis Process

The iterative thesis process has helped the authors to evaluate literature and empirical findings continuously in order to narrow the scope of the thesis. Based on the result from the initial study, communication was identified as the most relevant problem area to study further. Therefore, a deeper literature review in this area was made. This iterative process has enabled the authors to focus on relevant areas and give recommendations that concern a specific problem for the companies studied and other companies in the automotive industry. However, this structure of the thesis process affected the research area during the process, which made the study more complex. For the authors this has been stimulating and created a deeper understanding of challenges in these kinds of research processes.

Even though the iterative process helped the authors to narrow the scope and the recommendations, the relatively wide research area, quality assurance of purchased parts, made it difficult to give recommendations that are more specific. It would have been desirable to study the communication process and activities connected to quality assurance more thoroughly and give more precise recommendation. However, this was not possible with available resources and the scope of this thesis.
8.2.3 Evaluation of trustworthiness

The reliability of this study is strengthened by triangulation of both empirical data and literature that verifies the results. Since the thesis is based on a multiple case study the reliability increases. Additionally, the methodology of the research is described thoroughly in Chapter 2 and is evaluated so that readers are well aware of how it was conducted. To improve internal validity, the results from interviews were transcribed and sent to the respondent. By so doing, they could give their feedback if something was incorrect or interpreted wrongly. The respondents were also given an explanation of the interview and the purpose of it when they were invited and before the interview started. In order to find a representative sample of respondents for interviews and focus group interviews, supervisors from Scania suggested names of potential respondents. This was helpful due to lack of knowledge about the organization and time constraints. However, it might have affected the trustworthiness of the sample since the authors of the thesis did not have full control of the selection. The number of respondents in the two focus groups differs. The main reason is that the authors felt that seven respondents in one focus group were too many and not everyone got the chance to talk. In the second focus group, there were some late withdrawals. There is also a risk of bias since interviewers could have affected the respondents. There are differences between how interviews in the two cases were conducted due to time constraints and geographical location. One major difference is that only one supplier visit was conducted at a supplier to Scania and none at a supplier to Nutzfahrzeuge. In order to strengthen the internal and external validity, the case studies should have been done the same way. External validity was increased by triangulation in both empirical data and literature, which increases the potential for the result to be generalized to other cases in the same industry.

Ethics has been an important issue for the authors and anonymity has been protected for all respondents. In the transcription of the interviews, the respondents were anonymous so even the authors would not be affected of who the respondent was. Supervisors and managers at Scania and Nutzfahrzeuge are not able to discover the identity of the respondents. Before the work with the thesis started a stakeholder analysis was conducted, the authors were thus aware of different interests in the results and were able to consider that during the work process.

8.2.4 Suggestions for further research

During the work process of this thesis, the authors found other interesting research areas for further research. The suggestions are presented in this section as following.

Many interesting problem areas were identified during the initial interviews conducted at Scania. The first suggestion considers these problem areas, presented in Section 4.3.2. Since all of these areas, for example Internal Management and Organization and Supplier’s Quality Mindset, were discussed during the initial interviews they are of interest for further research because they affect the outcome from suppliers. Therefore, it is also of interest for the automotive industry to consider how these areas can be improved in order to reduce the number of deviations sent to the customer, in this case Scania and Nutzfahrzeuge.

A second suggestion that is given for further research is how issues can be evaluated regarding sustainability in the quality assurance process or similar. Since sustainable development has increased its significance within the supply chain, it is important for all departments within a company to consider to what implications their decisions lead. This is little more than mentioned in this thesis, although it is important to see how this affects the work with quality assurance of purchased parts and how the suppliers are handled and evaluated. Sustainable development can also be associated with the different areas identified during the initial interviews. For example, Supplier’s Quality Mindset in which sustainable development could also be seen as a factor of the supplier’s mindset.

Since supplier selection was excluded from this thesis, this can be interesting for further research. The result from the initial study of this thesis indicates that supplier’s competence and quality mindset is important but complicated to change after the supplier is selected. Therefore, these issues need to be further evaluated and considered in the supplier selection to assure required quality.
A final suggestion for further research regards the focus of communication with suppliers. This thesis provides implications for the preventive part of quality assurance process of purchased parts. The suggestion is to investigate further the reactive part of the quality assurance process since, it was delimitated from this thesis. Even though the preventive part of the department of quality strives to eliminate deviations on parts delivered by the supplier, problems of deviations do occur in production. This is where the reactive quality department works to solve problems with suppliers. How their communication with suppliers is handled was not investigated but it seems to affect the overall quality sent to the end customer.
REFERENCES


Chrysler Corporation; Ford Motor Company; General Motors Corporation. (2008). Advanced Product Quality Planning (APQP) and Control Plan. AIAG.


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Luleå universitetsbibliotek/LRC. (n.d.). *Primo.* Retrieved February 18, 2014, from Luleå tekniska universitet:


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References


Ulfsdotter, L., & Zakrisson, A. (2014, April 14). Supplier Visit. (Sourcing Manager Projects; SQA12; Factory Manager; Quality Manager; Industrialization Project Manager; Production Engineering Manager; Lean Coordinator; Production Leader; Sales Manager; Production Engineer 1; Production Engineer 2; PQA Engineer, Performer) Örebro, Sweden.


References


APPENDICES

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APPENDIX H PREPARATION FOR FOCUS GROUP INTERVIEW XVII
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## APPENDIX A LITERATURE SEARCH

Table 1 Table with literature search words for master thesis.

<table>
<thead>
<tr>
<th>Search word</th>
<th>Relevant hits</th>
<th>Title</th>
<th>Date</th>
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<tbody>
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<td>LTU PRIMO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bradley &amp; Pritts (2001)</td>
<td>Industrywide shakeout</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ziggers &amp; Trienekens (1999)</td>
<td>Quality assurance in food and agribusiness supply chains: Developing successful partnerships</td>
<td></td>
</tr>
<tr>
<td>Global purchasing strategy</td>
<td>Quintens, Pauwels &amp; MatthysSENS (2006)</td>
<td>Global purchasing strategy: Conceptualization and measurement</td>
<td>2014-01-29</td>
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<td>Sustainability supply chain</td>
<td>Xia &amp; Tang (2011)</td>
<td>Sustainability in supply chain management: suggestions for the auto industry</td>
<td>2014-02-17</td>
</tr>
<tr>
<td></td>
<td>Berke &amp; Satir (2011)</td>
<td>Sustainability in supply chain management: a literature review and a conceptual flow cycle</td>
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<td></td>
<td>Ahi &amp; Searcy (2013)</td>
<td>A comparative literature analysis of definitions for green and sustainable supply chain management</td>
<td></td>
</tr>
<tr>
<td>Quality leads to employee satisfaction</td>
<td>Yee, Yeung, Cheng &amp; Lee (2012)</td>
<td>Market competitiveness and quality performance in high-contact service industries</td>
<td>2014-02-19</td>
</tr>
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<td>Topic</td>
<td>Reference</td>
<td>Summary</td>
<td>Date</td>
</tr>
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<td>-------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
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<td>Supplier quality</td>
<td>Tomaru, Nakano and Nishimura (2013)</td>
<td>Supplier quality assessment to identify depth technical knowledge of component reliability</td>
<td>2014-02-11</td>
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<tr>
<td>PPAP Automotive</td>
<td>Harrison (1996)</td>
<td>A report from the automotive trenches</td>
<td>2014-02-21</td>
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<td></td>
<td>Singh, Goodyer, Popplewell (2007)</td>
<td>Integrated environmental process planning for the design and manufacture of automotive components</td>
<td>2014-02-21</td>
</tr>
<tr>
<td></td>
<td>Munro (2002, January)</td>
<td>Future of APQP and PPAP in Doubt</td>
<td>2014-03-06</td>
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<tr>
<td>Google Scholar</td>
<td>What is quality mindset</td>
<td>Communication methods purchasing</td>
<td>Communication + purchasing + quality</td>
</tr>
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<td>-------------------------------------</td>
<td>-------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------------</td>
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<td>Hoogervorst, Koopman and van der Flier (2005)</td>
<td>Hoogervorst, Koopman and van der Flier (2005)</td>
<td>Total quality management – the need for an employee-centered, coherent approach</td>
<td>Total quality management – the need for an employee-centered, coherent approach</td>
</tr>
<tr>
<td>Vermeulen (1997)</td>
<td>Vermeulen (1997)</td>
<td>Cultural change: crucial for the implementation of TQM</td>
<td>Cultural change: crucial for the implementation of TQM</td>
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<td>Sharma and Patterson (1999)</td>
<td>Sharma and Patterson (1999)</td>
<td>The impact of communication effectiveness and service quality on relationship commitment in consumer, professional services</td>
<td>The impact of communication effectiveness and service quality on relationship commitment in consumer, professional services</td>
</tr>
<tr>
<td>Stanley and Wisner (2001)</td>
<td>Stanley and Wisner (2001)</td>
<td>Service quality along the supply chain: implications for purchasing</td>
<td>Service quality along the supply chain: implications for purchasing</td>
</tr>
</tbody>
</table>
# Appendix B Documents within PPAP

Table 1 Documents within PPAP. Based on (DaimlerChrysler Corporation et al., 2006, pp. 3-12).

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design Record</td>
<td>The organization shall have a design record for the saleable product, which includes material composition and markup of polymeric parts, identified with ISO symbols.</td>
</tr>
<tr>
<td></td>
<td>- For proprietary components/details</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- For all other components/details</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Authorized Engineering Change Documents</td>
<td>The organization shall have authorized engineering change documents, for changes not yet recorded in the design record but already included in product, part, or tooling.</td>
</tr>
<tr>
<td>3</td>
<td>Customer Engineering Approval</td>
<td>Shall be specified by the customer and the organization shall have evidence of this approval.</td>
</tr>
<tr>
<td>4</td>
<td>Design Failure Mode and Effects Analysis, Design FMEA</td>
<td>The organization, that is design responsible, shall develop a Design FMEA in order to show customer-specific requirements.</td>
</tr>
<tr>
<td>5</td>
<td>Process Flow Diagram</td>
<td>The organization shall have a process flow diagram that describes the steps in the production process to show how it will meet customer needs and requirements.</td>
</tr>
<tr>
<td>6</td>
<td>Process Failure Mode and Effects Analysis, Process FMEA</td>
<td>The organization shall have a Process FMEA in order to show customer-specific requirements and how they affect the process.</td>
</tr>
<tr>
<td>7</td>
<td>Control Plan</td>
<td>The organization shall have a control plan that defines all methods used for process control to make sure that customer requirements are met.</td>
</tr>
<tr>
<td>8</td>
<td>Measurement System Analysis Studies</td>
<td>The organization shall have applicable Measurement System Analysis studies, as example gauge R&amp;R, linearity, and stability.</td>
</tr>
<tr>
<td>9</td>
<td>Dimensional Results</td>
<td>The organization shall provide evidence that dimensional verifications required within the design record and control plan have been completed. The results should compliance with the specified requirements from the customer.</td>
</tr>
<tr>
<td>10</td>
<td>Records of Material / Performance Test Results</td>
<td>The organization shall have records of material and/or performance test results. Those tests should be specified on the design record or control plan.</td>
</tr>
<tr>
<td>11</td>
<td>Initial Process Studies</td>
<td>The level of initial process capability or performance shall be determined to submission for all Special Characteristics. The organization shall perform measurement system analysis to understand how error affects the measurement studies.</td>
</tr>
<tr>
<td>12</td>
<td>Qualified Laboratory Documentation</td>
<td>Inspection and testing PPAP shall be performed by a laboratory that is qualified. The laboratory can be either internal or external and should make use of laboratory scope and proper documentation that show that the laboratory is qualified.</td>
</tr>
<tr>
<td>13</td>
<td>Appearance Approval Report, AAR</td>
<td>A separate document shall be performed for each part if the part has appearance requirements on the design record.</td>
</tr>
<tr>
<td>14</td>
<td>Sample Production Parts</td>
<td>The organization shall provide sample product as specified by the customer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>15</strong></td>
<td><strong>Master Sample</strong></td>
<td>The organization shall provide the customer a master sample that is produced in the same period as the PPAP records, until a new master sample is produced for the same part, or where master sample is required by design record, control plan, inspection criteria. The master sample shall show the customer approval date on the sample.</td>
</tr>
<tr>
<td><strong>16</strong></td>
<td><strong>Checking Aids</strong></td>
<td>The organization shall submit with the PPAP any part-specific assembly or component checking aid.</td>
</tr>
<tr>
<td><strong>17</strong></td>
<td><strong>Customer-Specific Requirements</strong></td>
<td>The organization shall have records of compliance to every applicable customer-specific requirement.</td>
</tr>
<tr>
<td><strong>18</strong></td>
<td><strong>Part Submission Warrant, PSW</strong></td>
<td>Except completion of PPAP documents, the organization shall also complete the PSW, which will be completed for each specific part number unless anything else is agreed upon with authorized customer representative.</td>
</tr>
</tbody>
</table>
## Appendix C Documents within PPA

Table 1 Documents within PPA. Based on (Verband der Automobilindustrie, 2012, pp. 17-18).

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test results for product approval</td>
<td>Geometry, dimensions, function, materials, weight, haptics, acoustics, odours, appearance, surface, reliability, EDS test, electrical reliability</td>
</tr>
<tr>
<td>2</td>
<td>Samples</td>
<td>Quantity, delivery quantity as agreed</td>
</tr>
<tr>
<td>3</td>
<td>Technical specifications</td>
<td>Customer's drawings, specifications, approved design changes</td>
</tr>
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<td>4</td>
<td>Product Failure Mode and Effect Analysis, Product FMEA</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Design release</td>
<td>Design / development approval by the customer</td>
</tr>
<tr>
<td>6</td>
<td>Compliance with legal requirements</td>
<td>Confirmation of environment, safety, recycling, national certificates</td>
</tr>
<tr>
<td>7</td>
<td>Material data sheet / IMDS</td>
<td>International Material Data System</td>
</tr>
<tr>
<td>8</td>
<td>Software test report</td>
<td></td>
</tr>
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<td>9</td>
<td>Process Failure Mode and Effect Analysis, Process FMEA</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Process flow chart</td>
<td>Production and test/inspection operations</td>
</tr>
<tr>
<td>11</td>
<td>Control plan</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Confirmation of process capability</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Achievement of special characteristics</td>
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</tr>
<tr>
<td>14</td>
<td>Test/inspection equipment list</td>
<td>Specific to the product</td>
</tr>
<tr>
<td>15</td>
<td>Capability study testing equipment</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Tooling list</td>
<td>Quantities/number of cavities and information on tooling concept</td>
</tr>
<tr>
<td>17</td>
<td>Confirmation of agreed capacity</td>
<td>Process validation</td>
</tr>
<tr>
<td>18</td>
<td>Written self-assessment</td>
<td>On the criteria as evaluation matrix for maturity of a product and process</td>
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<tr>
<td>19</td>
<td>Part history</td>
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<tr>
<td>20</td>
<td>Confirmation of suitability of transport equipment</td>
<td>Carrying units, incl. storage</td>
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<tr>
<td>21</td>
<td>PPA status of the supply chain</td>
<td>Purchased parts, directed parts by the customer and in-house parts</td>
</tr>
<tr>
<td>22</td>
<td>Approval of coating systems</td>
<td>To customer requirements</td>
</tr>
</tbody>
</table>
APPENDIX D INTERVIEW FORM FOR PROBLEM IDENTIFICATION

Unstructured interviews that aim to find eventual problems that could be used for master's thesis.

BASIC QUESTIONS

1. Describe your roll at Scania
2. Do you have any previous experiences within the quality assurance area?
3. For how many years have you been working within the automotive industry?
4. What is your education?
5. Which parts do you work with?

QUESTIONS REGARDING WORK

6. Which processes do you work with?
7. Could you briefly describe the processes?
8. Have you identified any problems with the process?
   a. How comprehensive are these problems?
   b. How often do they occur?
   c. What do you think is the cause of the problems?
      i. Do you think it is because of you (time constraints etc.)?
      ii. Do you think problems occur because of the supplier?
   d. Are you having any other problems with the process?
9. Have you identified differences between different parts?
   a. Developed by Scania
   b. Developed by the supplier
   c. Why do you think there are differences?
10. Have you experienced any differences between suppliers?
11. Have you identified any benefits with the process?
12. Do you have any suggestions for improvements of the process?
APPENDIX E INVJUFORMULÄR FÖR PROBLEMATISERING

Ostrukturerade intervjuer i syfte att utreda eventuella problem för inriktning av examensarbete.

GRUNDLÄGGANDE FRÅGOR

1. Beskriv din roll på Scania
2. Vad har du för tidigare erfarenhet inom kvalitetssäkringsområdet?
3. Hur många år har du arbetat inom fordonsbranschen?
4. Vad har du för utbildning?
5. Vilka artiklar arbetar du med?

FRÅGOR GÄLLANDE ARBETE

6. Vilka processer arbetar du med?
7. Skulle du kunna beskriva processerna kortfattat?
8. Har du identifierat några problem med processen?
   a. Hur omfattande är dessa problem?
   b. Hur vanligt förekommande är dessa problem?
   c. Vad tror du är orsaken till problemen?
      i. Upplever du att det är på grund av dig (tidsbrist)?
      ii. Upplever du att det är problem på grund av leverantören?
   d. Ser du några andra nackdelar med processen?
9. Har du identifierat några skillnader mellan olika artiklar?
   a. Egenutvecklade
   b. Leverantörsutvecklade
   c. Varför tror du att det finns skillnader?
10. Upplever du skillnader mellan olika leverantörer?
11. Har du identifierat några fördelar med processen?
12. Har du några förbättringsförslag för processen?
## Appendix F Conducted Interviews

Table 1 Interviews conducted for the master's thesis

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Aim</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>February 4, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Cab</td>
</tr>
<tr>
<td>February 5, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Cab</td>
</tr>
<tr>
<td>February 11, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Chassis</td>
</tr>
<tr>
<td>February 13, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
</tr>
<tr>
<td>February 17, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
</tr>
<tr>
<td>February 18, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Chassis</td>
</tr>
<tr>
<td>February 19, 2014</td>
<td>Semi structured interview</td>
<td>Problem identification</td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
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<td>March 21, 2014</td>
<td>Unstructured interview</td>
<td>Learn about Volkswagen</td>
<td>Strategic developer</td>
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<td>March 25, 2014</td>
<td>Focus group interview at Scania</td>
<td>What is communication?</td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How is it working today?</td>
<td>SQA Product Quality Cab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How can it be improved?</td>
<td>SQA Product Quality Engine</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
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<td></td>
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<td></td>
<td>SQA Q-team &amp; POL SEU</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>SQA Product Quality Cab</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SQA Product Quality Chassis</td>
</tr>
<tr>
<td>April 4, 2014</td>
<td>Focus group interview at Scania</td>
<td>What is communication?</td>
<td>SQA Product Quality Axles &amp; Gearbox</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How is it working today?</td>
<td>SQA Product Quality Chassis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How can it be improved?</td>
<td>SQA Product Quality Chassis</td>
</tr>
<tr>
<td>April 8, 2014</td>
<td>Unstructured group interview at Nutzfahrzeuge</td>
<td>Description of quality assurance process.</td>
<td>Project Coordinator, Controlling</td>
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<tr>
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<td></td>
<td>Communication between firm and supplier.</td>
<td>Parts Responsible, Chassis</td>
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<td></td>
<td></td>
<td>Visit to factory:</td>
<td>Parts Responsible, Exterior</td>
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<tr>
<td></td>
<td></td>
<td>Handling of deviations (from supplier and</td>
<td>Parts Responsible, Interior</td>
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<td></td>
<td>field problems)</td>
<td>Parts Responsible, Electric</td>
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<td></td>
<td></td>
<td>Cubic room (supplier parts are tested and</td>
<td>Department Projects Responsible</td>
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<tr>
<td></td>
<td></td>
<td>measured)</td>
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</table>
APPENDIX G CAUSE-AND-EFFECT DIAGRAM

Figure 1 Detailed Cause-and-Effect diagram.
Appendix H Preparation for Focus Group Interview

The aim of this document is to prepare you for the upcoming focus group interview you are invited to. Together with several SQAs, you will discuss communication with supplier within the quality assurance process. Below, the aim and discussion topics for the focus group interview are described. This is a part of the master’s thesis conducted by Agnes Zakrisson and Lovisa Ulfsdotter, SQG, spring 2014. You do not have to prepare any answers, but we want to give you the possibility to reflect on how your work is conducted today and how it can be improved before the focus group interview is conducted.

If you have any questions regarding the focus group interview or this document, please write us an email or visit us at our desks.

We look forward for your participation!

/Agnes and Lovisa

AIM OF THE FOCUS GROUP INTERVIEW

The aim of the focus group interview is that through discussion develop material that could be used for our development of a model for communication related to the Production Part Approval Process, PPAP. The starting position is the original PPAP that is explained within APM 147, page 3. With help from the model, Scania’s requirements can be better communicated, the supplier can understand steps in PPAP, and improve their performance regarding quality. The goal is to use communication as a tool for continuous improvements on quality of purchased parts.

Figure 1 Analysis model

Figure 1 shows the overall analysis that should be made. The starting position determines which type of communication is appropriate, what should be communicated and how. The starting position is based on the supplier's former performance and part complexity, which the authors have seen affect how the quality assurance process should be conducted. During this meeting, the group will focus on communication and how it can be improved regarding supplier’s performance. Finally, supplier’s performance will be evaluated in order to affect the next starting position.
STARTING POSITION

Starting position is based on supplier’s position in qMap, see Figure 2. Focus is on preventive work regarding quality, which aims to make sure that suppliers within the green and yellow fields do not get into the red field. Therefore, the green and the yellow fields will be used for discussion regarding starting positions.

Figure 2 qMap.

*Hint: Please think through different examples of suppliers that we can use for discussion as hands-on cases.*

COMMUNICATION

Based on chosen steps from the quality assurance process, PPAP, with starting position as described above, we will discuss the following questions:

- How should we communicate?
  - Visit, telephone, or digital?
- What should be communicated?
  - Requirements and expectations?
  - Which PPAP-documents are relevant for discussion?

In addition, we will discuss how a SQA can assure that the right information is communicated based on the starting position and how communication is evaluated.

SUPPLIER’S PERFORMANCE

During this focus group interview, we will not discuss supplier’s performance. However, it is important to keep in mind that this is the topic for improvements. Supplier’s performance is evaluated through qMap, which affects the starting position. Through this, work with continuous improvement continues regarding quality, with communication as a tool.
APPENDIX I FÖRBEREDELSE FÖR FOKUSGRUPPSINTERVJU


Om du har några frågor kring workshopen eller dokumentet hör gärna av dig via e-mail eller besök oss vid våra skrivbord.

Vi ser fram emot ditt deltagande!

/Agnes & Lovisa

SYFTET MED FOKUSGRUPPSINTERVJUN

Syftet med fokusgruppsintervjun är att gemensamt ta fram underlag, genom diskussion, för att vi senare ska kunna utveckla en modell gällande kommunikation kopplat till PPAP. Utgångspunkten är den befintliga PPAP processen som beskrivs i APM 147, sida 3. Med hjälp av modellen ska Scania förväntningar bättre kommuniceras, leverantören bli bättre införstådd i de olika momenten i PPAP och på sikt förbättra sin prestation gällande kvalitet. Målet är att använda kommunikation som ett verktyg för att ständigt förbättra kvaliteten på inköpta artiklar.

Figur 1 Analysmodell.

UTGÅNGSLÄGE

Utgångsläget avgörs av leverantörens placering i qMap, se Figur 2. Fokus ligger på proaktivt arbete gällande kvalitet och syftet blir därmed att se till leverantörer i de gröna och gula fälten inte hamnar i det röda. Därför är de gula och gröna fälten utgångslägen för diskussionen.

Framgångsläget avgörs av leverantörens placering i qMap, se Figur 2. Fokus ligger på proaktivt arbete gällande kvalitet och syftet blir därmed att se till leverantörer i de gröna och gula fälten inte hamnar i det röda. Därför är de gula och gröna fälten utgångslägen för diskussionen.

Tips: Fundera gärna på olika leverantörexemplet som du vill lyfta för att diskussionen ska kunna baseras på konkreta fall.

KOMMUNIKATION

För utvalda steg i kvalitetsåtskäringsprocessen, PPAP, med utgångsläget som beskrivs ovan, kommer vi att diskutera följande frågor:

- Hur ska man kommunicera?
  - Besök, telefon eller digitalt?
- Vad ska kommuniceras?
  - Vilka krav och förväntningar?
  - Vilka PPAP-dokument är relevant att diskutera?

Utöver detta kommer vi diskutera hur man som SQA kan säkerställa att rätt saker kommuniceras baserat på utgångsläget samt hur kommunikationen följs upp.

LEVERANTÖRENS PRESTATION

Under denna workshop kommer vi inte beröra leverantörens prestation i någon större omfattning. Däremot är det bra att ha inåtanke att det är detta som ska förbättras. Leverantörens prestation utvärderas med hjälp av bland annat qMap som i sin tur utgör utgångsläget. På så sätt fortsätter arbetet med att förbättra leverantörens prestation, gällande kvalitet, genom kommunikation.
APPENDIX J INTERVIEW QUESTIONS FOR FOCUS GROUP

STARTING POSITION

How are suppliers different from each other? How should the starting position be defined?

COMMUNICATION

WHERE IN THE PROCESS?

- After submission requirements are defined
- When PPAP is initiated
- When PPAP is checked
  - Explain to supplier reasons for decision
- When PPAP is not approved
  - How is the result communicated?
  - How does SQA assure better result next time?
- Are there any other examples when communication is important that should be discussed during this interview?

WHAT IS COMMUNICATION?

- What is communication?
- How is communication with supplier handled today?
  - What is communicated?
  - How is it communicated?
  - When is it communicated?
- Which problems are related to communication today?
- What works well?
- Good and bad examples

FILLER QUESTIONS

- How should communication be handled?
  - Telephone
  - Visits
  - Digital
  - When are the different methods used?
  - Is it possible to combine them?
- What should be communicated?
  - Requirements and expectations
    - Which are the requirements and expectations
  - Special PPAP documents
    - Should there be special reference documents that explain requirements?
    - Which requirements should be put extra emphasis on during this step?
  - Deadlines/time plan?
    - Should there be different deadlines for different documents?
  - Anything else?
- How can we assure that right things are communicated based on starting position?
  - Checklists
  - Educational material presented by Scania
  - Reference documents
  - Models, processes, or matrices?
  - What will these look like?
- When should we communicate?
  - Where in the process (above)?
  - During visits/audits?
FEEDBACK AND EVALUATION

• How do we verify that the supplier understands the communicated message?
• How is communication followed up?
  o Should there be a communication plan
  o Reminders to supplier?
  o Check lists?
• How do we evaluate communication?
  o How is communication improved for next time?
  o Evaluation together with the supplier?

FINAL DISCUSSION

• How should the model be designed to be useful in your daily work?
• Other suggestions for improvements
APPENDIX K INTERVJUFRÅGOR FÖR FOKUSGRUPP

UTGÅNGSLÄGE

Hur skiljer sig leverantörerna åt? Hur ska utgångsläget definieras?

KOMMUNIKATION

VAR I PROCESSEN?

- Efter submission requirements är bestämda
- När PPAP har initierats
- När PPAP är granskat
- Förklara för leverantören orsakerna till beslutet
- Om PPAP inte är godkänd
- Hur communiceras beslutet
- Hur ser SQA till att det blir bättre nästa gång
- Finns det andra tillfällen då kommunikation är viktigt och värt att diskutera?

VAD ÄR KOMMUNIKATION?

- Vad är kommunikation?
- Hur ser kommunikationen med leverantören ut idag?
- Vad communiceras?
- Hur communiceras det?
- När communiceras det?
- Vilka problem finns det med kommunikationen idag?
- Vad fungerar bra?
- Bra och dåliga exempel

UTFYLLNADSFRÅGOR

- Hur ska man communicera?
  - Telefon
  - Besök
  - Digitalt
  - När passar de olika alternativen?
  - Kan man kombinera?
- Vad ska communiceras? För varje aktuellt steg i processen:
  - Krav och förväntningar
    - Vad gäller kraven och förväntningarna?
  - Om speciella PPAP-dokument
    - Ska det finnas referensdokument som förtydligar kraven?
    - Vilka bör man lägga extra vikt vid i detta steg?
  - Deadlines/Tidplan?
    - Ska det vara olika deadlines för olika dokument?
  - Annat?
- Hur ska man säkerställa att rätt saker communiceras baserat på utgångsläget?
  - Checkelister
  - Utbildningsmaterial utvecklat av Scania
  - Referensdokument
  - Modeller, processer eller matriser?
Appendix K

- Hur ska dessa se ut?

- När ska kommunikationen ske?
  - Var i processen (se ovan)
  - I samband med audits?

**ÅTERKOPPLING OCH UTVÄRDERING**

- Hur säkerställer vi att leverantören förstår det som har kommunicerats?
  - Hur följs kommunikationen upp?
  - Bör man utforma en kommunikationsplan?
  - Päminnelser till leverantören?
  - Checklistor?

- Hur utvärderar vi kommunikationen?
  - Hur förbättras kommunikationen till nästa gång?

- Utvärdering tillsammans med leverantören?

**AVSLUTANDE DISKUSSION**

- Hur ska den här modellen utformas för att den ska bli så användbar i ert dagliga arbete som möjligt?
- Övriga förbättringsförslag
Appendix L

APPENDIX L PROCESS MAP PPAP

Figure 1 Process map PPAP. Source: (Scania CV AB g, 2013).
## Appendix M Observation at Supplier Visit

### Table 1 Participants at supplier visit.

<table>
<thead>
<tr>
<th>Date</th>
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<th>Aim</th>
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<td>April 14 2014</td>
<td>Observations at supplier visit</td>
<td>Gain a deeper understanding of how communication is characterized</td>
<td>Factory Manager</td>
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<td></td>
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<td>Quality Manager</td>
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<td></td>
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<td>Industrialization Project Manager</td>
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<td>Production Engineering Manager</td>
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<td>Lean Coordinator</td>
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<td>Production Leader</td>
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<td></td>
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<td>Sales Manager</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Production Engineer 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Production Engineer 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PQA Engineer</td>
</tr>
</tbody>
</table>
APPENDIX N INTERVIEW AFTER SUPPLIER VISIT

INTERVIEW QUESTIONS

1. Is this visit representative of other visits?
2. Are you satisfied with the visit?
3. Who determines the agenda?
4. What happens next?

INTERVJUFRÅGOR

1. Är det här besöket representativt för andra besöken också?
2. Är ni nöjda med besöket?
3. Vem sätter agendan?
4. Vad händer nu?
APPENDIX O VISIT TO VOLKSWAGEN

THE PURPOSE OF THE VISIT

The thesis concerns the quality assurance of purchased parts in the automotive industry. After analyses of the current situation at Scania CV AB, it has been found that communication is essential in order to improve supplier performance. Therefore, it is relevant and interesting to investigate and evaluate how Volkswagen works with communication with its suppliers to find suggestions for improvements concerning communication.

The questions will broadly concern:

- How does Volkswagen communicate with suppliers concerning quality assurance?
- When does Volkswagen communicate with suppliers?
- How does the communication differ depending on supplier etc.?
- What is communicated with the supplier?
- How does Volkswagen use communication to develop the supplier's performance?

WHO WE WANT TO MEET

Someone working with the quality assurance of purchased parts or suppliers. Preferably a quality engineer that operates in this area on a daily basis.

We wish to conduct a deeper interview with at least one person but preferably more. Not more than three in-depth interviews due to time delimitations.

WHEN WE WANT TO VISIT

To be able to follow our time plan we wish to visit Volkswagen between March 31 and April 16. The sooner the better.

PREPARATIONS

To be well prepared before the visit we wish to have this information in advance:

- A short description of the organization, both of purchasing and the quality organization
- If and how Volkswagen uses Production Process and Product Approval (PPA) by VDA
- How suppliers are evaluated in terms of quality
  - Which factors are considered?
- Process map and description on the quality assurance process
- How Volkswagen communicate with their suppliers
  - Is there a communication plan or process?

CONTACT

Agnes Zakrisson
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Lovisa Ulfsdotter
lovisa.ulfsdotter@scania.com
APPENDIX P QUESTIONS DURING VISIT AT VOLKSWAGEN NUTZFAHRZEUGE

VOLKSWAGEN NUTZFAHRZEUGE

• Get to know more about the organization of quality assurance
  o What is their connection to the purchasing department?
• Strategy
  o Is quality a priority?
  o How is this connected/communicated to suppliers and purchasing function?

PROCESSES

• Get to know more about the connection between VDA (PPA) and QPN.
• Follow-up of supplier’s requirements to second tier suppliers
  o What is done by Volkswagen Nutzfahrzeuge?
• Learn more about PPA

COMMUNICATION

• How does Volkswagen Nutzfahrzeuge communicate with suppliers concerning quality assurance?
• When does Volkswagen Nutzfahrzeuge communicate with suppliers?
  o When is the first time?
  o How is it managed?
  o How are results communicated?
• How does the communication differ depending on supplier etc.?
  o Is there a difference if the part is developed by Volkswagen Nutzfahrzeuge or the supplier?
    ▪ The part complexity
    ▪ German or international suppliers?
    ▪ Previous performance
• What is communicated with the supplier?
• How does Volkswagen Nutzfahrzeuge use communication to develop the supplier’s performance?
• How is the importance of quality/strategic issues communicated to the supplier?
• How is communication evaluated and improved?
• How are second tier suppliers assured?
• Who is responsible for communication?
• What are the limitations?
• Is the quality engineer present at design reviews?

NEW PARTS QUALIFICATION PROGRAM (QPN)

• Is it used for all new parts in new project?

LESSONS LEARNED

• How is the project evaluated?
• Who is participating?
• What happens with the results of Lessons Learned?
DETERMINING THE PRIORITY NUMBER FOR SPECIFIC PARTS

- Get to know more about priority number for specific part and how it affects communication and limitations of resources, time and quality.
- How does this priority check affect communication?

B2B GROUP BUSINESS PLATFORM

- Examples of what is included in the B2B platform
- What communication is transmitted through the platform?
- How does it affect supplier-customer collaboration?
- It is said that supplier needs to keep the platform updated with documents, how is this secured?
- Are second tier suppliers included in the platform?
- For how long have the software existed?
- Do you see differences from when the platform did not exist?
- Are suppliers satisfied with the system?

ROUND TABLE

- It is said to be included in parts where high maturity risks exist, how?
- Is it normally used for new parts?
- Describe how it is a factor for success?
  o How does it show off?
- Is it better to discuss measurement criteria in connection with Round table, does it get the same effect when discussing over telephone or software methods?